Rulemaking No.: 13-12-010
Exhibit No.:
Witness: S. Liu

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.

Rulemaking 13-12-010

PHASE I.A. REPLY TESTIMONY OF DR. SHUCHENG LIU
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.	Rulemaking 13-12-010

PHASE I.A. REPLY TESTIMONY OF DR. SHUCHENG LIU ON BEHALF OF THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

I. BACKGROUND AND TESTIMONY SUMMARY

Q. What is your name and by whom are you employed?

A. My name is Shucheng Liu. I am employed by the California Independent System Operator (CAISO), 250 Outcropping Way, Folsom, California as Principal, Market Development.

Q. Have you previously submitted testimony in this proceeding?

A. Yes. On August 13, 2014, I submitted initial testimony describing the results of the CAISO's 2014 Long-Term Procurement Plan (LTPP) deterministic study.

Q. What is the purpose of this reply testimony?

A. The purpose of my testimony is to respond to technical questions raised regarding the CAISO's deterministic LTPP modeling and the alternative modeling sensitivities prepared by other parties. My testimony specifically addresses the following issues:

(1) The CAISO's reasons for modeling a 25% regional generation requirement in the San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE) service areas;

(2) The CAISO's reasons for modeling a zero net export limit from the CAISO;

(3) The conclusions to be drawn from the alternative gas flexibility sensitivities run by the Union of Concerned Scientists and the Sierra Club (UCS/Sierra Club); and

(4) Other concerns regarding the CAISO's deterministic modeling raised by the parties filing testimony on September 24, 2014.[1]

II. REGIONAL GENERATION REQUIREMENT

Q: Please summarize the concerns expressed regarding the CAISO's implementation of the 25% regional generation requirement in the deterministic modeling.

A. Several parties raised concerns or questions regarding the CAISO's modeling of a 25% regional generation requirement in the SDG&E and SCE regions. Parties requested that the CAISO explain why it modeled 25% regional generation requirement and how it determined the resources that meet the requirement.[2] Parties also suggested that alternative solutions to meeting regional generation requirements should be investigated in this proceeding.[3] The CAISO continues to believe that including the 25% regional generation requirement assumption in the studies is necessary to appropriately account for transmission constraints and contingencies that are not otherwise directly modeled in the deterministic study. Otherwise the study would produce unrealistic results that ignore well know local constraints. However, additional analysis is necessary to both better incorporate preferred

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[1] The following parties submitted testimony related to the CAISO's deterministic modeling in this proceeding: the Center for Energy Efficiency and Renewable Technologies (CEERT), the California Environmental Justice Alliance (CEJA), the California Storage Alliance (CESA), L. Jan Reid, EDF Renewable Energy, Inc. (EDF Renewable), the Green Power Institute (GPI), the Independent Energy Producers Association (IEP), the Large-Scale Solar Association (LSA), Pacific Gas & Electric Company (PG&E), the City of Redondo Beach (Redondo Beach), SDG&E, The Utility Reform Network (TURN) and UCS/Sierra Club.

[2] CEERT Testimony at II-10; CESA Testimony at 13; Redondo Beach Testimony at 3.

[3] UCS/Sierra Club Testimony at 21-22.

resources into the CAISO modeling and consider resources that can meet the regional generation requirement. In this testimony, I address the reason for implementing the 25% regional generation requirement and the challenges associated with properly modeling this constraint.

Q. What is the purpose of the regional generation requirement?

A: The regional generation requirement is necessary to comply with NERC reliability standards. Specifically, the regional generation requirement modeled by the CAISO is designed to ensure that there is (1) sufficient online controllable capacity to balance the system and control frequency in real time in order to meet NERC control performance standards (CPS);[4] and (2) sufficient dispatchable resources to respond to contingencies. NERC reliability standards for planning and operating the bulk power system are developed using a results-based approach that focuses on performance, risk management, and entity capabilities. The CAISO must plan and operate the system to meet these results-based standards.

Q. Do the NERC reliability standards apply to the CAISO balancing authority area as a whole or to specific regions within the CAISO?

A. The NERC CPS apply to the CAISO balancing area as a whole. In addition, there are planning and operating standards that we need to account for and model in the deterministic study to take into account underlying transmission and voltage constraints within the system. These constraints require responsive generation to be online to manage normal and contingency events within the CAISO system. If the CAISO were able to use a detailed full network model for simulations, perhaps the CAISO could explicitly enforce such constraints. However, the CAISO's LTPP study uses a zonal model that focuses on system resource and flexibility sufficiency. The CAISO chose to use a zonal model rather than a full network model due to the time constraints on developing the model and running simulations. A shortcoming

[4] *See* NERC Standard BAL-001-1 – Real Power Balancing Control Performance.

of using the zonal model is that it cannot enforce transmission constraints inside the zones or voltage stability constraints. As a result, it is appropriate and necessary to use a proxy for maintaining a minimum amount of controllable generation in regions where local constraints are expected to be an issue. As explained in more detail below, the transmission constraints affecting SCE and SDG&E necessitate the implementation of such a proxy.

Q: Why did the CAISO only apply the regional generation requirement to SCE and SDG&E within the CAISO?

A: The CAISO deterministic study applies the regional generation requirement to all balancing authority areas in California, including the CAISO, IID, LADWP, SMUD, and TIDC. In addition, the CAISO separately applied regional generation requirement to the SCE and SDG&E regions within the CAISO due to the transmission constraints inherent to that area. Southern California is served in part by two major transmission paths from the north, Path 26 (4,000 megawatts (MW)) and PDCI (3,200 MW). These paths are often highly loaded in order to transfer economic energy to southern California. If for example, a contingency occurs on either of these paths, sufficient responsive generation is needed in southern California to be able to simultaneously meet demand and unload the remaining transmission into southern California. Therefore, Path 26 is a major transmission constraint within the CAISO balancing authority area. In the CAISO deterministic study, if a contingency event related to Path 26 occurs, the supply that is committed south of Path 26 could be insufficient to respond to the event. The enforcement of the regional generation requirement ensures that the contingency can be addressed and there is sufficient local generation to meet load. This is a realistic assumption that cannot be ignored in evaluating system needs through the zonal modeling.

In addition, within southern California there are local pocket areas that do not have sufficient transmission capability to maintain system reliability without local generation. A certain amount of generation resources must be located in these areas for voltage support, real-time congestion management and other real-time

operational requirements to prevent post-contingency overloads.[5] Because the CAISO deterministic model does not explicitly enforce underlying transmission and voltage stability constraints, the regional generation requirement was implemented as a proxy to ensure these local resource requirements are met within the deterministic model. The transmission and voltage stability concerns are real concerns that cannot be ignored in any study that attempts to mimic the actual operating realities of the system. This is illustrated in the fact that even prior to October 2013, when the CAISO enforced the under-frequency import limit procedure that required 25% of SDG&E load to be met by responsive generation in the SDG&E area, this limit was rarely binding, partly because transmission and voltage stability constraints in the SDG&E area routinely require that local generation be in excess of 25%.

An additional reason for modeling the regional generation requirement is the need to meet ancillary service requirements across the entire CAISO balancing authority area. In order to geographically distribute contingency reserves, the CAISO ensures that 35% of the CAISO's total contingency service requirements are met by resources in the Expanded South of Path 26 A/S Region based on the considerations explained above.[6] However, the ancillary service regional requirements for southern California are not explicitly enforced in the LTPP model. The southern California ancillary service requirements are also included in the model through the regional generation requirement.

To illustrate the necessity of the regional generation requirement, consider the following example using actual data from SDG&E's territory. SDG&E has a minimum load around 2,500 MW. If SDG&E were to lose a main transmission path in a contingency, its import capability drops to approximately 2,000 MW. If there were insufficient dispatchable resources online to respond to the contingency,

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[5] *See* the CAISO's 2013-14 Transmission Plan: http://www.caiso.com/Documents/Transmission%20planning/Transmission%20plans%20and%20studies/2013-2014%20transmission%20planning%20process/2013-2014%20transmission%20planning%20process%20-%20board-approved%20plan%20and%20appendices at 95-96.

[6] Refer to section 3.1 of the Operating Procedure 1340 Ancillary Service Procurement.

SDG&E would need to reserve at least 700 MW quick-start flexible capacity within the SDG&E area. Because the CAISO's LTPP model does not enforce the ancillary service requirements for SDG&E, the minimum generation requirement operates as a proxy to maintain the available dispatchable capacity in SDG&E's service area.[7]

Table 1 below shows what the model would have dispatched within the SDG&E region with and without the 25% regional generation requirement on April 13, 2014. Without the regional generation requirement there are no dispatchable resources committed during hours with renewable curtailment. This would fall short of meeting the 700 MW amount of dispatchability needed in case of a contingency event discussed above.

Table 1 SDG&E Local Generation on April 13, 2024 (MW)
40% RPS Scenario

Hour	8	9	10	11	12	13	14	15	16
with 25% regional generation requirement									
CCGT & GT	454	504	550	588	593	589	560	558	553
CHP	46	46	46	46	46	46	46	46	46
BTMPV	161	297	357	445	480	478	448	383	278
Renewable	1,316	1,536	1,688	1,900	2,096	2,045	2,012	1,993	1,273
without 25% regional generation requirement									
CCGT & GT	24	11	0	0	0	0	0	14	24
CHP	46	46	46	46	46	46	46	46	46
BTMPV	161	297	357	445	480	478	448	383	278
Renewable	1,316	1,536	1,688	1,900	2,096	2,045	2,012	1,993	1,836

Unlike SDG&E and SCE, the PG&E system does not require the implementation of a regional generation requirement in the model based on the actual distribution and flexibility of the generation resources and load in the PG&E system.

[7] The CAISO may consider modeling local ancillary service requirements in the future studies.

Q: Why did the CAISO model the regional generation requirement at 25% of load?

A: The CAISO set the regional generation requirement at 25% of load based on its review of actual balancing authority area operating practices. For example, the California Energy Commission requested information from California balancing authority areas regarding their minimum local generation levels, and the responses indicated minimum local generation levels from 25% to 35% of load. The CAISO notes that some of the BAAs are members of reserve sharing groups and, as a result, do not need contingency reserves to cover their most severe single contingencies. That reduces their local generation requirement. As such, the 25% regional generation requirement the CAISO used is a conservative, but reasonable, representation of local generation necessary to meet real-time control performance and contingency standards.

Q: Can renewable, demand response and battery storage meet the regional generation requirements in this study?

A: Yes, if the operational characteristics of such resources were known, we could have included these. In order to meet the regional generation requirement, resources must meet the CAISO operational requirements. To meet operational requirements resources must be (1) controllable (to be *able to move up and down quickly and constantly*) in order to balance the system and control frequency, (2) dispatchable to respond to contingency, and (3) able to support voltage in the local area. The CAISO based its primary assumptions regarding demand response and energy storage on the May 14, 2014 Assigned Commissioner's Ruling (ACR) in this proceeding. With respect to energy storage, the ACR provides specific assumptions for 2024 installed values and technical characteristics.[8] The ACR also notes that the "default planning assumption for new storage capacity shall account for a

[8] *See* R.12-13-10, Assigned Commissioner's Ruling Technical Updates to Planning Assumptions and Scenarios for Use in the 2014 Long Term Procurement Plan and 2014-15 CAISO TPP (May 14, 2014) at Attachment 1, page 18-19.

conservative expected contribution to grid services and reliability from the storage procurement target in D.13-01-040."[9] Similarly, the ACR provides default planning assumptions for demand response. In providing these assumptions, the ACR specifically noted that the intention was to "model the grid conservatively to start with in order to reveal potential reliability needs."[10] In the study, renewable resources are not fully controllable and therefore cannot be relied upon to meet the regional generation requirement.

Q. Is the regional generation requirement level modeled by the CAISO consistent with observed regional generation levels?

A. Yes. Table 2 shows the percent of load served by local generation in the PG&E, SCE and SDG&E service areas. It is based on the CAISO operation data from October 1, 2013 to September 30, 2014. As shown in Table 1, SCE local generation, including renewable generation, served more than 36% of its load in 95% of hours. SDG&E had local generation 23.9% of its load or more for 95% of the hours. It is important to note that the actual local generation figures presented below do not include the ancillary services that must be procured in the SCE and SDG&E service areas. The observations support the CAISO 25% regional generation requirement for SCE and SDG&E in the model.

Table 2 Local Generation as Percent of Load (Oct 1, 2013 – Sep 30, 2014)

(%)	PG&E	SCE	SDG&E
Maximum	99.8	79.8	99.8
Minimum	54.7	22.9	7.7
Average	89.5	49.9	42.4
5th Percentile	72.2	36.1	23.9

As explained above, the 25% regional generation requirement is a proxy applied to the SDG&E and SCE regions to cover local constraints, contingencies

[9] *Id*. at Attachment 1, page 17.
[10] *Id*. at Attachment 1, page 22.

and ancillary service requirements. Table 1 illustrates that in practice, local generation in the SDG&E and SCE regions rarely falls below 25%. Ignoring these constraints and excluding the assumption from the modeling would give unrealistic results that do not reflect the true rigidities of the physical characteristics of the system.

III. ZERO NET EXPORT CONSTRAINT

Q. Several parties, including CEERT, CEJA, LSA, SDG&E and UCS/Sierra Club recommend that over-generation and curtailment issues could or should be addressed by increasing export capabilities from the CAISO.[11] Does the CAISO agree that increased export capabilities should be pursued?

A. Yes. The CAISO continues to pursue increased export capabilities through greater regional coordination of day-ahead and real-time scheduling and commitment decisions. As stated in my initial testimony filed on August 13, 2014, a regional jointly cleared market with both day-ahead and real-time scheduling processes would be ideal in optimizing export capabilities.[12] The CAISO has taken an important step in this direction by developing the Energy Imbalance Market (EIM) with PacifiCorp and NV Energy. It is crucial that the coordination be both in the day-ahead and real-time markets because many of the west-wide resource plans are set in the day-ahead time frame, making it difficult to rely only on real-time measures to deal with changes in conditions. The CAISO is committed to pursuing these important changes and is already engaged in a regional dialog to enhance understanding of the benefits of regional commitment coordination. The CAISO supports the vision put forth by the UCS/Sierra Club in its submitted testimony in this proceeding that demonstrates how allowing net export by the CAISO could eliminate renewable curtailment. However, achieving these improvements requires

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[11] CEERT Testimony at II-4; CEJA Testimony at 35; LSA Testimony at 8; SDG&E Testimony at 2; UCS/Sierra Club Testimony at 9.

[12] Phase 1.A. Direct Testimony of Dr. Shucheng Liu on Behalf of the California Independent System Operator at 15.

greater commitment by external balancing authority areas towards the same goal, which may not be immediately realized. Part of the challenge in achieving the regional coordination is balancing the degree of certainty needed to serve another balancing authority area's load by relying on the CAISO's variable over-supply. The over-supply may not be coincident with the other balancing authority area's need and may displace commitment of resources that it could have otherwise dispatched with more certainty. Improved regional coordination is not an impossibility to achieve and the CAISO has demonstrated its intention to continue to pursue these solutions, but there needs to be greater understanding regarding how and when such coordination can be achieved. Therefore, the net zero export limit is a realistic and reasonable assumption to account for the known current and near future limitations in regional coordination.

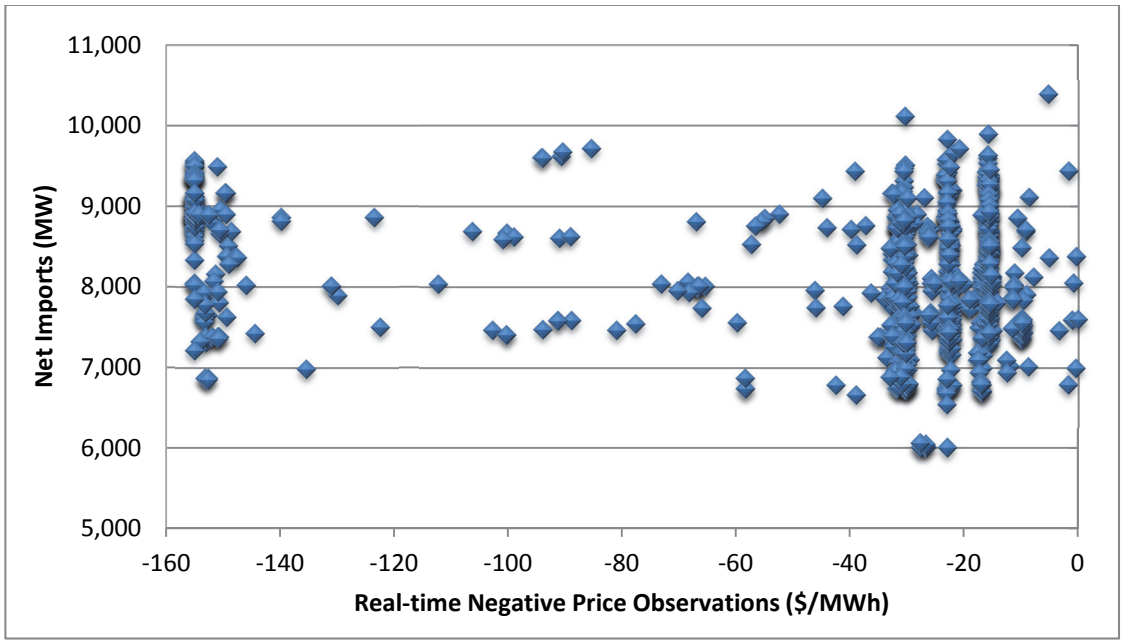
Q. Based on the existing CAISO and west-wide framework, is it reasonable to assume no net export limit from the CAISO in the 2014 LTPP study?

A. No. In this LTPP the Commission needs to consider realistic developments within the next 10 years and not just assume such export will be realized. This will provide a more accurate assessment of the over-generation situation and allow the Commission to explore solutions for mitigation.

Even reducing net imports to zero, which is permitted in the CAISO's deterministic model, will require significant changes from today's market. As it currently stands, since the May 1, 2014, implementation of a 15-minute real-time market in compliance with FERC Order No. 764, the CAISO continues to observe a significant amount of net imports even when real-time prices are negative. This demonstrates that net exports are not necessarily achievable in response to real-time negative prices alone, which confirms the need to for greater day-ahead coordination. Figure 1 below demonstrates that the CAISO real-time market typically experiences net imports in excess of 6,000 MW even when prices are negative.

Figure 1 Net Import vs Real-time Negative Prices

May 1 - September 9, 2014



Q. Please explain the extent of imports from out-of-state renewable resources and other resources.

A. In the daily operation, the CAISO must import from out-of-state RPS resources to meet the state RPS goal, resources jointly owned by California utilities and power purchase contracts. These imports are largely self-scheduled and may be limited by the RPS rules that require delivery to count toward meeting the RPS requirement. Table 3 summarizes the current imports into the CAISO under these requirements. While the specific capacity figures may change between now and 2024, these provide a good indication of the type of imports into the CAISO. By setting a zero net export constraint in the LTPP study, the model assumes the CAISO can export energy up to the amount of imports.

Table 3 Expected Pseudo Ties and Dynamic Schedules into the CAISO

Resources	Capacity (MW)	Type
Palo Verde	811	Jointly Owned Unit
Hoover	768	Jointly Owned Unit
Dynamic Schedules to MUNIs	627	
Pseudo Ties (Renewables)	40	Renewables
Other Dynamic Schedules (wind/solar)	676	Renewables
Dynamic Schedules from IID (Biomass & Geothermal)	518	Renewables
LSEs contractual agreement with BPA	200	Renewables
Total Expected Import	**3,639**	

Q. CEERT states at page II-3 and 11-4 of its testimony that CAISO should modify its tariff to reform import scheduling. Do you agree that reforming import scheduling should be the "first step" in addressing renewable curtailment?

A. As explained above, the CAISO has already taken significant actions towards greater regional coordination. The CAISO has already adopted new tariff provisions to allow changes of import schedules in the real-time market through its adoption of the 15-minute real-time market as part of its compliance with FERC Order No. 764. The new market structure allows market participants to modify their hourly import schedules in the 15-minute real-time market. The ISO anticipates that over time, as market participants observe the operational and economic benefits of utilizing the 15-minute market, there will be greater import intra-hour flexibility, which will contribute to addressing over-generation, However, there is no evidence that over-generation can be fully addressed simply by greater real-time import flexibility. It is important to recognize that import flexibility is also largely dependent on intra-hour flexibility provided by other balancing authority areas and as discussed above, much of the coordination must happen in the day-ahead.

Furthermore, CEERT's assertion is at least partially based on the understanding that the potential for over-generation is "virtually perfectly

predictable" in the day-ahead market.[13] This is not accurate because over-generation is caused collectively by load, renewable generation, resource and transmission outages and other factors. The accuracy of load and renewable generation forecasts has been improving, but it is not perfect. For 2014, the day-ahead aggregate wind and solar forecast error is 7.01% measured in Mean Absolute Error. However, more important than the forecast error are scheduling coordinator practices that generally reflect the scheduling of renewable resources below both forecast and actual levels. Results of this LTPP study show a somewhat "predictable" over-generation pattern, but the timing of over-generation changes from day-to-day and the volume varies from hour to hour. The study is based on the assumption of full information and perfect foresight of the next 24 hours, which is common in production cost simulation studies. That is not the case in the CAISO markets. The forecast changes from day-ahead to hour-ahead and again in real-time. The import and export schedules also affect the over-generation. Based on the variability of these factors, over-generation is certainly not "virtually perfectly predictable" in the day-ahead market.

IV. UCS/SIERRA CLUB GAS FLEXIBILITY SENSITIVITIES

Q. UCS/Sierra Club conducted three sensitivities by varying the operational characteristics of the current gas fleet in the 40% RPS scenario in order to determine the driving factors in renewable curtailment. The UCS/Sierra Club testimony concluded that "increasing the flexibility of CAISO's existing fleet in the 40% RPS in 2024 Scenario would not lead to substantial reductions in renewable energy curtailment." Do you agree with UCS/Sierra Club's conclusion?[14]

A. The gas flexibility sensitivities provide valuable insight into the operation of gas resources during over-generation hours. UCS/Sierra Club's conclusion is correct

[13] CEERT Testimony at II-4.
[14] UCS/Sierra Club Testimony at 28.

based the current assumptions, specifically unlimited renewable curtailment, implementation of the 25% minimum regional generation requirement and the zero net export constraint. Due to unlimited renewable curtailment, there is no steep morning and evening upward or downward ramping. The flexibility of the gas fleet therefore becomes less important. Also during the over-generation hours the few online gas resources are running just to meet the 25% minimum regional generation requirement and to provide ancillary services and load following. As a result, changing the operational characteristics of the gas resources to make them more flexible has little effect on the dispatch of the gas resources and on the curtailment of renewable generation.

However this does not mean the flexibility of gas fleet does not matter. In fact, flexibility could be critical if renewable curtailment is limited. In that case, the gas fleet will provide most of the ramping capability in the morning and evening. This reinforces the point made in Dr. Meeusen's testimony that renewable curtailment could be masking the need for flexible resources. The results of the Trajectory without Diablo Canyon sensitivity demonstrate the importance of gas fleet flexibility. In that sensitivity, after the Diablo Canyon nuclear plant is retired, the gas fleet fills in the 2,240 MW base load gap and is able to back down generation when there is over-generation. As a result, the total annual renewable curtailment is reduced from 153 GWh in the Trajectory scenario to 26 GWh in the Trajectory without Diablo Canyon sensitivity.

Q. Would you expect similar results if these sensitivities were run with the Trajectory, High Load or Expanded Preferred Resource Scenarios?

A. It is quite possible that other scenarios will produce similar results as the 40% RPS scenario because the unlimited ability to curtail renewable generation may mask the need for flexible capacity in each scenario. During over-generation hours only a small number of gas resources are running in the model to meet the 25% minimum regional generation requirement and to provide ancillary services and load

following, not necessarily to meet flexibility needs. This would likely be the same in other scenarios that allow for unlimited renewable curtailment.

V. OTHER CONCERNS

Q. Please respond to criticisms raised by CEERT, LSA and Redondo Breach regarding the CAISO's calculation of the net load forecast error.[15]

A. My initial testimony and the report referenced therein clearly set forth the methodologies for calculating net load forecast error. The testimony also provided the forecast errors used in the study. CEERT, CEJA and LSA assert that the net load forecast error was "overestimated," "conservative," and "outdated." They ignore the fact that the study used t-30 minute and t-5 minute forecast error. The t-30 is the forecast closest to the last unit commitment opportunity in the Real-Time Unit Commitment market. It is the most accurate forecast for unit commitment. The load forecast errors were calculated based on the CAISO's 2012 operational data. The data could be updated with 2013 operational data, but I expect the difference would be marginal. The forecast errors for solar and wind were based on the actual solar and wind generation profiles so they were consistent with the model assumptions.

Q. Several parties took issue with the CAISO's use of May 2014 TEPPC Common Case as opposed to a later version of the Common Case. Please explain why the CAISO used the May 2014 TEPPC Common Case in its modeling.[16]

A. The CAISO chose to use the May 12, 2014 release of the TEPPC 2024 Common Case due to time constraints and the tremendous amount of work that needed to be undertaken to incorporate the Common Case into the deterministic study. Specifically, the CAISO had to convert the TEPPC case to Plexos format, verify the data, incorporate the CAISO's own assumptions, especially inside California, test

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15 CEERT Testimony at II-6; LSA Testimony at 11-12; Redondo Beach at 4-5.

16 L. Jan Reid Testimony at 11; LSA Testimony at 10.

the model setups, run simulations of five scenarios, and finally produce results for discussion with the LTPP parties and for filing testimony. The CAISO communicated with TEPPC prior to May 12 regarding the release of the TEPPC Common Case and informed TEPPC that May 12, 2014 would be the last possible date for adopting the TEPPC case. TEPPC was very supportive and provided a release on May 12 as requested by the CAISO. The CAISO generally supports using the most up-to-date information possible in conducting its studies and in this case, the May 12, 2014 version of the TEPPC 2024 Common Case was the most current information available that could be incorporated in time to meet the filing requirements in this proceeding.[17] The CAISO also notes that LSA reviewed the solar profiles and could not point to any material differences that would alter the results.[18]

Q. Please respond to the City of Redondo Beach's comments that the CAISO's model should show the "main contributors" to the shortfalls identified.[19]

A. The shortfalls reported in my testimony were all due to insufficient supply capacity to meet the combination of load, ancillary service and load following requirements. My initial testimony characterized this as "upward capacity" shortfalls. In such cases, all loads, ancillary services, and load following contributed to the shortfall. Any available capacity may help reduce the capacity shortfalls.

The model could also identify flexibility shortfalls during the morning and evening ramping hours due to quick changes in renewable generation. However, CAISO's study assumed unlimited curtailment of renewable generation. As a result, the model cannot identify the flexibility shortfall because the curtailment flattens the net load curve and eliminates the need for ramping. Therefore additional sensitivities, especially sensitivities with more reasonable assumptions

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[17] The CAISO notes that the final version of the TEPPC 2024 Common Case was released on August 15, 2014, two days after the CAISO filed its initial testimony in this proceeding.

[18] LSA Testimony at 10:14.

[19] Redondo Beach Testimony at 6-8.

regarding the maximum allowable renewable curtailments, are needed to identify the main causes or contributors to the shortfalls.

Q. IEP and PG&E assert that the results of the stochastic analysis, to be filed on November 12, 2014, are necessary to determine need. Please discuss your understanding about how the results of the stochastic model should be used.[20]

A. The CAISO intends to use the stochastic results to support the results of the deterministic model. In order to do so, the stochastic model and the reporting of results will be consistent with the deterministic model. The stochastic simulation results will provide frequency distributions with a range of capacity shortfall and renewable generation curtailment around the results produced by the deterministic model. As with the deterministic results, the stochastic results will not be able to capture the system flexibility shortfalls because the stochastic model must assume unlimited renewable generation curtailment in order to be consistent with the deterministic model. Additional studies in Phase 1b based on a more reasonable and expected level of renewable curtailment are necessary in order to determine the realistic need for capacity and flexibility.

VI. NEXT STEPS

Q. What is the status of the CAISO's stochastic modeling?

A. The CAISO is continuing to prepare the stochastic study results for the Trajectory scenario to be submitted on November 13, 2014. The CAISO intends to present its stochastic model and results to the parties at a workshop on a date to be determined. Dr. Meeusen's testimony describes the CAISO's policy recommendations regarding the need for additional studies in this proceeding.

[20] IEP Testimony at 31-35; PG&E Testimony at 1-4.

Q. Does this conclude your testimony?

A. Yes, it does.