

**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 10-05-006
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**COMMENTS OF THE LARGE-SCALE SOLAR ASSOCIATION ON OCTOBER 22,
2010 WORKSHOP: CAISO AND PG&E RENEWABLE INTEGRATION MODEL
METHODOLOGIES**

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I. INTRODUCTION

In accordance with the November 10, 2010 email from the Administrative Law Judge (ALJ) Setting a Schedule for Comments Regarding the October 22, 2010 Workshop on Renewable Integration Models and the attached post-workshop Questions for Party Comment provided therein, the Large-Scale Solar Association (“LSA”)¹ submits these comments on the October 22, 2010 presentations by Pacific Gas and Electric Company (“PG&E”) and the California Independent System Operator Corporation (“CAISO”) and the additional Step-1 Related Information provided by the CAISO since the August 24-25 Workshop.

LSA appreciates the efforts of the CAISO and PG&E in contributing to the evolving understanding of renewable integration. However, LSA is concerned about how this renewable integration modeling will fit into the overall 2010 Long Term Procurement Planning (LTPP) process and the timelines for the proceeding.

¹ LSA represents twelve of the nation’s largest developers and providers of utility-scale solar generating resources. Collectively, LSA’s members have contracted to provide over 5 gigawatts (“GW”) of clean, sustainable solar power under contract to California’s load-serving entities. Its members develop, own and operate various types of utility-scale solar technologies, including photovoltaic and solar thermal system designs. For more information, see <http://www.largescalesolar.org>

Without a robust understanding of future renewable generation profiles, which include appropriate assumptions for variability and forecast error, consideration of the system needs at different times during the 10 year planning period of the LTPP, and the development of duration curves to better describe the frequency and magnitude of the integration needs, we believe that the Public Utilities Commission (“Commission”) simply does not have sufficient information to translate the models’ computed integration flexibility needs to an appropriately timed and sized procurement authorization for new integration resources. Accordingly, LSA reiterates its call for the Commission to undertake a “least regrets” approach in this proceeding.

II. LSA COMMENTS ON PG&E RENEWABLE INTEGRATION MODEL

The PG&E model was designed to perform as a tool to quickly and simply approximate renewable integration needs and costs. The primary strengths of the model are its accessibility and the processing speed – users can manipulate the inputs and quickly obtain results for different cases. However, the accessibility and speed of the model come at a cost – the model makes a number of simplifying assumptions that inhibit the model’s ability to fully describe the system’s integration needs and provide the data needed to determine how best to meet those needs. Some of these simplifying assumptions are discussed in detail below. In addition, the model is unable to consider more than four intermittent renewable profiles or to evaluate the full range of resources potentially available to provide the operational flexibility needed to integrate renewables – including operational changes, demand response, and energy storage. These limitations indicate that while the model may allow users to quickly obtain rough estimates of relative integration resource needs for different scenarios, it is not suited to provide accurate estimates of the actual resource needs for a single scenario. Finally, LSA has more serious concerns about the limitations of the model’s assessment of costs, as the costs are based on meeting all flexibility needs with conventional gas-fired generation without any assessment of other flexibility resources or changes to the system that could provide additional

flexibility.² This approach to cost further compounds the effect of the simplifying assumptions and could lead to serious inaccuracies in the resulting cost data for individual scenarios. Moreover, the failure to account for appropriate design of integration to meet each scenario's computed integration needs also undermines the ability of the model to provide a sense of relative integration costs between scenarios.

a. Calculation of Renewable Integration Needs

LSA is concerned by the PG&E model's focus on incremental flexibility. According to LSA's understanding of the PG&E model, the model assumes that the system has no untapped flexibility in the baseline year. LSA is not aware of any evidence or data supporting this assumption. To the contrary, CAISO's 20% Renewable Integration Study³ suggests that the current system has the flexibility needed to integrate 20% renewables without the addition of significant new resources, suggesting that the system has untapped flexibility to meet integration needs. Failing to quantify or account for current untapped flexibility will have a material impact on the results – both for the integration needs and the costs of integration resources. Although the magnitude of this impact is uncertain, the model overestimates the need for flexibility resources in assuming all future flexibility needs must be met by new resources.

To address this overestimation of needed integration resources, Slide 21 of PG&E's October 22nd presentation assumes that the CAISO system with a 15 to 17% planning reserve margin can integrate 20% RPS in 2020, and then subtracts the model's computed integration requirements for 20% RPS in 2020 from the computed

² See Western Wind and Solar Integration Study; prepared by GE Energy for the National Renewable Energy Laboratory (May 2010), p.309-316, *available at*

http://www.nrel.gov/wind/systemsintegration/pdfs/2010/wwsis_final_report.pdf.

³ CAISO & GE Energy Consulting, Integration of Renewable Resource: Operational Requirements and Generation Fleet Capability at 20% RPS (August 31, 2010), Executive Summary, p. xv, *available at* <http://www.caiso.com/2804/2804d036401f0.pdf>.

integration requirements for 33% RPS.⁴ Based on this calculation, the model's disregard of the untapped integration potential of the CAISO system's existing resources appears to overestimate resource needs for the 33% RPS by approximately 30%. However, the calculation is based on the unsupported assumption that the flexibility existing in a system with a 15 to 17% planning reserve margin is sufficient to integrate exactly 20% renewables. Further, this calculation does not resolve the larger question of how much untapped system flexibility is available in the base year – and what level of renewable penetration could be supported by this flexibility (i.e., 20%, 25%, 30%, etc.). Thus, the model's overestimation of resource needs, based on the failure to account for existing flexibility, could be greater than 30%. LSA urges the Commission to address the question of untapped system flexibility to ensure the computed integration requirements are in addition to the needs that can be met by existing untapped system flexibility.

Similarly, LSA is concerned that the PG&E model could overestimate resource needs by assuming that all operating flexibility needs are additive, rather than overlapping. In other words, the model assumes that different resources are needed to meet each of the three flexibility requirements: regulation, load following, and day-ahead commitment. However, a single integration resource could have the capability to meet multiple flexibility needs. The PG&E model disregards any such capability. Further, the PG&E model provides only seasonal maximum results, as opposed to hourly results. This data is not sufficient to determine the magnitude and duration of the flexibility needs over time. To determine the most appropriate integration resources and system changes to address integration flexibility needs, it is critical to understand how these integration needs change over time. For instance, if the integration needs have high peaks for very short duration, the resources and/or system changes to address integration needs should be designed differently than if the integration needs remain at high levels for extended periods of time.

⁴ PG&E, Renewable Integration Model: Results and Model Demonstration Presentation (CPUC October 22, 2010 Workshop), *available at* <http://www.cpuc.ca.gov/NR/rdonlyres/7462FECF-81A3-490A-AAE7-56AB0A7D8EFE/0/PGCEPUCWorkshopOct22v8Final.ppt>.

PG&E's model assumes that study year imports and exports have the same impact on operating flexibility requirements and the system's ability to meet those requirements. LSA believes that this assumption fails to account for flexibility that will likely result from improved coordination between balancing area authorities and subhourly scheduling. These system changes could provide some of the flexibility needed to manage renewable integration.⁵ In a Notice of Proposed Rulemaking issued on Nov. 18, 2010, the Federal Energy Regulatory Commission (FERC) proposed mandatory intra-hourly transmission scheduling to improve integration of variable renewable energy resources.⁶ In addition, the CAISO has been conducting a stakeholder process to potentially expand CAISO dynamic transfer scheduling policy. The expansion of dynamic transfer services could affect operating flexibility requirements from imports and exports.

For the integration of imported renewables, the PG&E model's assumption that 100% of generation from the RPS portfolio must be integrated within California is conservative. Depending on the final rules regarding the use of firmed and shaped products and tradable renewable energy credits for RPS compliance, this assumption could lead to an overestimation of CAISO system integration.

In summary, LSA is concerned that the combined effect of these simplifying and conservative assumptions used in the PG&E model could result in calculated flexibility needs that are much higher than the actual incremental flexibility needed to integrate 33% renewables.

b. Calculation of Renewable Integration Costs

Basing the calculation of integration costs exclusively on new simple and combined cycle gas turbine capacity could exaggerate integration costs. By using simple and combined cycle turbines costs as a proxy for all integration resource costs, the model fails to account for innovative and, potentially, more cost-effective

⁵ Western Wind and Solar Integration Study; prepared by GE Energy for the National Renewable Energy Laboratory (May 2010), p.19, *available at* http://www.nrel.gov/wind/systemsintegration/pdfs/2010/wwsis_final_report.pdf.

⁶ See 133 FERC ¶ 61, 149.

ways of addressing integration needs through increased balancing area cooperation, sub-hourly scheduling, increased utilization of transmission, improved renewable forecasting, new demand response programs, energy storage, and changes to operating practices or market rules. The PG&E model's use of simple and combined cycle gas turbines⁷ to compute integration costs is understandable, as the costs of many of these innovative ways to address integration needs are unknown and difficult to determine. However, these other integration solutions could provide the needed flexibility services at a lower cost and be better tailored to address integration requirements. For instance, improvements to forecasting or changes in market rules could help meet integration needs with less up-front investment and could help reduce overall system costs. Similarly, according to recent presentations in the California Energy Commission's Integrated Energy Policy Report proceeding, other integration resources have the potential to meet certain integration needs more efficiently or at a lower cost than the integration resource cost used in the PG&E model.⁸ Regardless, the model cannot provide an accurate estimate of the true costs of integration, as it fails to consider the appropriate design of integration solutions to meet the actual integration requirements.

III. LSA COMMENTS ON CAISO STEP-1 RELATED INFORMATION

In the October 22nd workshop, CAISO discussed a handful of modeling issues that it is working to resolve. One of those issues is the forecast error assumptions used in the model. According to the presentation, the CAISO uses "improved error"

⁷ The net capacity costs in PG&E's model for integration resources are \$157-160 kW-year. Notice of Availability of Pacific Gas and Electric Company's (U 39 E) Renewable Integration Model and Results, Appendix A, p. 17 (August 16, 2010).

⁸ See, e.g., LBNL Demand Response Research Center, Automated Demand Response: a Grid Resource for Integration of Renewables, Presentation at CEC IEPR Staff Workshop (November 16, 2010), available at http://www.energy.ca.gov/2011_energypolicy/documents/2010-11-16_workshop/presentations/12_Piette_Automated_Demand_Response.pdf (Slide 4, AutoDR ranged from \$75-300/kW); see also KEMA, Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid, Presentation at CEC IEPR Staff Workshop (November 16, 2010), available at http://www.energy.ca.gov/2011_energypolicy/documents/2010-11-16_workshop/presentations/03_Hawkins_Technologies_to_Support_Renewable_Integration.pdf (Slide 19, "Storage equivalent to 110 MW Combustion Turbine appears to range between 30 – 50 MW of storage").

assumptions for load, wind, and solar in the 33% RPS study.⁹ While LSA supports the improvement of these forecast error statistics from the 20% RPS study, LSA believes additional improvements are warranted. In particular, LSA is concerned about the high hour ahead forecast errors for solar in the summer and fall.¹⁰ Currently, significant research effort is being devoted to solar forecasting.¹¹ Over the coming years, LSA expects that solar forecasting will rapidly improve as additional solar generation is deployed. Rather than the constructed forecast error used for solar, LSA suggests assigning solar the same forecast error as wind. As the penetration of solar generation increases and additional resources are devoted to studying solar forecast error, LSA expects improvements to solar forecasting on a similar trajectory to wind.

Regarding solar variability, LSA understands the CAISO's model lumps together predictable variation from changes in the sun position (deterministic changes) with less predictable variation resulting from cloud movement (stochastic changes).¹² The research of Andrew Mills and Ryan Wiser indicates that, with sufficient geographic diversity, stochastic changes are almost negligible relative to the deterministic variability from sun movement through the sky.¹³ LSA requests that the CAISO perform sensitivities to determine whether its model results are consistent with this finding. In addition, LSA requests that the Commission to consider what integration resources and market and operational changes are best suited to integrate intermittent resources whose variability is driven by deterministic, as opposed to stochastic, changes.

⁹ CAISO, ISO Study of Operational Requirements and Market Impacts at 33% RPS: Continued Discussion and Refinement of Step 1 and Step 2 Simulation Methodology, Presentation at Commission October 22, 2010 Workshop, Slide 18.

¹⁰ CAISO, Integration of Renewable Resources: Technical Appendices for California ISO Renewable Integration Studies Version 1 (First Draft for External Review, October 11, 2010), p. 42, available at <http://www.caiso.com/282d/282d85c9391b0.pdf>.

¹¹ See, e.g., UCSD Website, Assistant Professor Jan Kleissl, <http://maeresearch.ucsd.edu/kleissl/>, last visited November 19, 2010.

¹² See Andrew Mills & Ryan Wiser (Lawrence Berkeley National Laboratory), *Implications of Wide-Area Geographic Diversity for Short-Term Variability of Solar Power*, (September 2010), p. 7, available at: <http://eetd.lbl.gov/ea/ems/reports/lbnl-3884e.pdf>

¹³ *Id.* at 11.

Since the last set of Commission workshops in this proceeding, the CAISO released a variety of documents related to its renewable integration studies, including the technical appendices for its renewable integration studies.¹⁴ LSA's comments on the CAISO's Step-1 related information focus on these technical appendices. While LSA appreciates the details about the CAISO's methodology provided in these technical appendices and believes that the overall approach outlined in the technical appendices is sound, LSA believes that additional information is needed to fully describe the modeling process and has some concerns about the data included in these appendices, as described below.

LSA understands that the CAISO's one minute solar variability data was based solely on the one minute irradiance data collected by the Sacramento Municipal Utility District (SMUD) from one pyranometer located at a site in SMUD's service area (Anatolia).¹⁵ LSA does not believe that irradiance variability data from a single location can form the basis for an accurate projection of irradiance variability at multiple, distant locations. LSA is also concerned that reliance on data from just one location to construct a library of assumed variability data for all solar resources could inadvertently introduce correlation in the variability between geographically separated sites, contrary to the findings of the Mills and Wisser study discussed above.

Regarding the plant areas presented in Table 3¹⁶ of the technical appendix, the heading of the table should be corrected, as the table provides area numbers in square miles, as opposed to kilometers. Different solar thermal technologies have different plant area requirements. LSA would like some clarification on how the single figure for all solar thermal plants was computed and the assumptions underlying this calculation.

LSA wishes to obtain clarification regarding the CAISO's use of Figure 11 data, showing the response over time of different solar thermal technologies to a

¹⁴ CAISO, Integration of Renewable Resources: Technical Appendices for California ISO Renewable Integration Studies Version 1 (First Draft for External Review, October 11, 2010), *available at* <http://www.aiso.com/282d/282d85c9391b0.pdf>

¹⁵ *See id.* at p. 28 (Figure 12).

¹⁶ *See id.* at p. 27.

step change in irradiance. This graph attempts to characterize the very complicated dynamics occurring at solar thermal generation facilities. Within the different technologies represented on the graph, response times can vary based on the specific type of technology, the size of the plant, and the irradiance history leading up to the step change. Assuming that Figure 11 data is correct for 100 MW facilities, the response time cannot simply be normalized to match these curves for larger or smaller facilities because the response time depends on the size of the facility. In addition, Figure 11 focuses on the time it takes for a plant to go from 0 to 100% of its operating capacity, but is not suited to address the less dramatic changes in operation over short timescales (i.e., short shifts in generation due to cloud movement). Finally, Figure 11 provides response times to step increases in irradiance, but does not address step decreases in irradiance. LSA requests clarification on whether the inertia of plant responses to decreases in irradiance was taken into account and, if so, how this inertia was incorporated into the modeling.

Figure 16 does not contain any data.¹⁷ LSA reserves the right to comment on this figure when the data is provided.

LSA encourages the CAISO to expand their approach to forecast error to account for differences in solar technologies. As currently described in the technical appendix, the forecast error is based on photovoltaic technology and is not representative of solar thermal performance.¹⁸ For solar thermal, forecasts should be prepared by outside forecasters to account for plant performance and characteristics. Adding a lag time to PV is not a good first-order approximation of solar thermal performance.

LSA requests that the CAISO review its assumptions regarding the variability of out-of-state resources¹⁹ in light of the recently announced FERC Notice of Proposed Rulemaking, proposing mandatory intra-hourly transmission scheduling.²⁰

¹⁷ *Id.* at p. 31.

¹⁸ *Id.* at p. 37-41.

¹⁹ *Id.* at p. 44.

²⁰ See 133 FERC ¶ 61, 149.

LSA also seeks clarification on the two documents released by the CAISO summarizing the location and size of profiles used in the 1-minute analysis and those used in the hourly analysis.²¹ While these two documents appear to include the same locations and total megawatts of generation within each area, the 1-minute document breaks down the megawatts within each CREZ based on the number and size of the generating facilities, while the hourly document only includes total MWs for each CREZ. For instance, page 3 of both documents contains the listing of solar thermal locations. For the Carrizo North/Fairmont CREZ 33% case, the 1-minute analysis document breaks down the MW for that CREZ into four sites: 1x101 and 3x100, while the hourly analysis document just provides the total of 401 MW for the CREZ. From these documents, it is not clear whether the 1-minute and hourly data analysis treated the generation facilities differently (i.e., whether the hourly analysis treated all of the MW from the CREZ as a single generation facility), nor is it clear how this different treatment might affect the profiles. In particular, this document raises questions about whether the hourly production simulation data properly accounts for geographic diversity of the sites within the CREZ. LSA requests additional explanation of how the hourly generation data were developed.²²

IV. ADDITIONAL COMMENTS

LSA encourages the Commission to compare the CAISO photovoltaic modeling assumptions to the findings of recent studies analyzing irradiance variability, including the research of Thomas Hoff and Richard Perez conducted under a California Solar Initiative grant agreement. We look forward to seeing the results of this validation effort and to providing comments on the outcome of the validation and next steps, if appropriate.

²¹ CAISO, Mapping of location and profiles used in 1-minute analysis, *available at* <http://www.caiso.com/2845/2845ef0a62b40.pdf>; CAISO, Mapping of location and profiles used in hourly analysis, *available at* <http://www.caiso.com/2845/2845f08c5d0.pdf>.

²² Specifically, Appendix B indicates “the statistical simulation uses 1-minute synthesized production data for each solar technology type and location while the production simulation uses hourly production data for these same sites.” However, the Appendix focuses only the synthesis of the 1-minute solar data and variability.

V. CONCLUSION

LSA appreciates the opportunity to comment on the October 22nd workshop and the renewable integration modeling efforts to date. While we believe that the renewable integration modeling and stakeholder discussions have helped to advance the understanding on this subject, LSA remains concerned with the role of the renewable integration modeling in this LTPP. At this point, we believe that additional work needs to be done before procurement decisions are based on the results of these modeling efforts.

Respectfully submitted,

By: /s/ Shannon Eddy
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November 22, 2010

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing *Comments of the Large-Scale Solar Association on October 22, 2010 Workshop: CAISO and PG&E Renewable Integration Model Methodologies* on all parties of record in R.10-05-006 by transmitting an email message with the document attached to their email addresses of record and, for those parties without an email address of record, by mailing a properly addressed copy by first-class mail with postage prepaid to each party on the Commission's official service list for this proceeding.

This Certificate of Service is executed on November 22, 2010, at San Rafael, California.

/s/ Kristin Burford
Kristin Burford