Stakeholder Comments Template
Subject: Integration of Renewables Report

Submitted by (Name and phone number)	Company or Entity	Date Submitted
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CAISO seeks written stakeholder comments on its Draft Integration of Renewable Resources Report, which was posted on September 20, 2007 at http://www.caiso.com/1c51/1c51c7946a480.html.

Stakeholders should use this Template to submit written comments and or suggestions. In order to be considered, written comments must be submitted no later than Close of Business on Friday, October 5, 2007 to: vjetmalani@caiso.com.

Apart from the 5 areas on which the CAISO seeks comment, the CPUC Staff's most important, overarching concern is that the study's implications could be better appreciated if its approach and scope were more explicitly placed within the broader context of overall renewable integration issues and studies. This concern is elaborated below.

The CAISO's Integration of Renewable Resources Report focuses on two major concerns, adequacy of the Tehachapi transmission plan to accommodate 4164 MW of total wind generation, and statistical assessment of increased demands on system operating flexibility due to the temporal patterns and forecasting uncertainty for 6688 MW of wind generation system-wide. These high priority issues have been addressed in a relatively short period of time using considerable detail and realism regarding electrical flows, system operations and wind generation patterns. As a result, the CAISO's Draft Report provides valuable insights as well as some reassurance that we can realistically and physically accomplish the system integration that our renewable energy goals will necessitate.

In pursuing such a detailed assessment of selected high priority issues in a short time, the Draft Report necessarily focuses on certain matters but not others. Assessing the wider range of renewable resource integration issues would necessarily take more time and resources. However, in order to facilitate a broad understanding of the context and significance of the study process that is reflected in the Report, and to help anticipate what is required going forward, it would be very helpful if the final Report more clearly identifies the *broader range* of renewable resources integration challenges and analyses, beyond those that are addressed in the Draft Report. This perspective would be enhanced by a summary of wind integration studies conducted elsewhere.

- For example, regarding the study of transmission plan adequacy (Chapter 3), it would be helpful for the Report to describe what the WECC power flow cases represent and how they were used (as noted in comments under subject area 1). Furthermore, it would be useful to describe the possibility that actual future conditions regarding generation, transmission and operations might differ, and how such differences could affect the

Report's conclusions and the identification of future challenges to the integration of wind resources.

- Also, the final Report should prominently state that the static, statistical-plus-qualitative assessment of system operating response requirements due to wind and load fluctuations and unpredictability on which the Draft Report's operations-related conclusions are based does not include dynamic modeling of system operations and composition, and does not address the roles of individual generators and transmission facilities. The implications of the Report's reliance on the statistical/static methodology should be discussed. For example, certain operational and wind generation details may actually be best explored by NOT modeling the system. On the other hand, some insights and identification of key constraints might require explicit modeling of system operations, including utilization, additions and retirements of assets. Further, it is important to recognize that analysis of the economic costs of integration requires an explicit consideration of system assets and operations as they may exist in the future.

The subject areas upon which CAISO seeks stakeholder input are:

1. Transmission Planning Issues associated with the integration of Renewables

It would be helpful to have a fuller description of what the WECC 2010 Heavy Summer peak load and 2012 Light Spring load cases represent in terms of generation and transmission changes from today. It would also be helpful to address the following questions:

- In what ways (and with what likelihood) could actual conditions during these periods differ from what the WECC cases imply, in a manner that would significantly affect the conclusions?
- Do we know what levels of California and west-wide intermittent wind generation these cases reflect, and what are the implications of higher levels of wind generation coming on line?
- When large amounts of new wind generation were modeled in the Tehachapi area to test the adequacy of the proposed transmission plan of service, what other generation/power flow was backed down from the WECC case levels, and (how) would this power flow back-down impact the conclusions in the Draft Report?
- Where was the 3540 MW of new wind generation assumed to be located within the Tehachapi area, and (how) would a different plausible distribution affect the conclusions in the Draft Report?
- Finally, can the CAISO identify other geographic areas where the transmission system is likely to be stressed by new renewable generation in the next five years that may deserve similar attention in subsequent studies, or that might impact the conclusions in the Draft Report applicable to the Tehachapi area?

2. Grid Operations Issues

In Chapter 5, it would be helpful to have a more clearly structured verbal presentation (apart from and complementing the equations), in outline form (e.g., 5.1, 5.1.2, etc.) organized around the different kinds of system response, such as DA, multi-hour ramp, load following, regulation and minimum load conditions.

In this structured verbal presentation there should be a clear explanation of how

- each quantitative or qualitative finding of operational impacts, such as those applicable to DA scheduling/RUC, multi-hour ramps, supplemental energy, regulation, or required curtailability

arises specifically from

- a particular aspect of wind intermittency, such as very short-term (i.e., not forecasted) variation vs. HA uncertainty vs. DA uncertainty vs. sustained (deterministic?) ramping

combined with the

- specific system response(s) from generation (or, potentially, load) able to address that aspect of intermittency,

and also indicating

- what market products (regulation, other ancillary services, etc.) and physical types of generators can provide that response.

This analysis could be performed using textual explanation supported by summary tables. The tables would clarify the above relationships and complement the report's existing tables that summarize operational requirements in terms of MW and MW/minute. The textual explanation and supporting tables should be comprehensible if standing alone, while underlying equations should be clearly linked to the textual explanation and be (for the most part) included in appendices.

While the desired information is generally already incorporated in the Draft Report, additional structuring (as discussed above) plus some reduction in redundancy would help make the report more accessible. For example, a complex issue should be fully described at a single point in the Report rather than being dealt with in a dispersed fashion throughout the Report.

This Report and/or future work should address the interdependence and substitutability of different kinds of system response to intermittency. As examples: up to a point, regulation and load following are interchangeable; wind curtailment could in certain cases substitute for downward load following or residual unit de-commitment; and day-ahead or hour-ahead commitment changes could affect the ease and cost of meeting intra-hour requirements.

In addition, the Report should incorporate a preliminary discussion of the localization of system flexibility requirements (*e.g.*, the potential mandatory use of specific, identified geographic locations for unit commitment, load following, etc.) as a means to address transmission constraints or reactive power consumption, and this concept should be explicitly targeted for future study. One important question that such future study should address is how such

localization could be affected by changing hydro conditions, or reliance on larger quantities of imported vs. in-state wind.

3. Forecasting Issues

There appears to be considerable overlap among Chapter 4, Chapter 5 and Appendices C-E, all of which contain some information regarding forecasting and associated error. Chapter 4 nominally addresses forecasting, but is incomplete. A more complete, self-contained description of forecasting in one chapter would be preferable. Verbal descriptions of forecasting and operational matters should be more structured and self-explanatory (*i.e.*, comprehensible without the equations) and more fully segregated into forecasting versus operations chapters, although the operations chapter will necessarily refer to forecasts.

For forecasting, as for operations, equations implementing logical steps should be more clearly linked to complete verbal descriptions of those steps, and could, by and large, be incorporated into Appendices. In several instances, equations and their notation could be more clearly explained.

The role that day-ahead wind forecasting and forecasting error plays in this study should be clarified. How the "7-9 percent" hour-ahead (two hour ahead?) wind forecasting error was applied, in combination with shorter term wind fluctuations (which, apparently, are assumed to be incapable of being usefully forecasted) to determine regulation versus load following requirements should be better explained verbally. The extent to which the analysis assumes application of wind forecasts beyond the current use or availability of such forecasts for grid operations should be clarified.

The derivation and application of temporal and spatial correlation of wind fluctuations and wind forecast error is discussed in the Draft Report, but needs to be explained more fully and clearly, and in one place. This includes correlations between and within individual wind areas, such as the three new "wind parks" assumed for Tehachapi. Going further, the robustness of the conclusions set forth in the Report would be improved by at least semi-quantitative consideration of how wind generation patterns, correlations (time and space) and forecasting error could differ from what was used as a basis for the Report's conclusions. Moreover, the Report should at least comment on how, qualitatively, significant wind development outside of Tehachapi and Solano (*e.g.*, in the San Bernardino corridor) might impact the Report's conclusions.

Finally, the recommendations in Chapter 10 discuss need for day-ahead and 5-hour wind forecasting tools, yet the operations analysis appears to assume hour-ahead or 2-hour forecasts. The Report needs to explain the linkage between 5-hour and 1- or 2-hour wind forecasts.

4. Implementation Issues

Tasks and associated discussion in Conclusions and Recommendations, Chapter 10, have an unclear relationship to topics and conclusions in the other chapters, and some "recommendations" in other chapters don't appear in Chapter 10. If Chapter 10 is intended to be a preliminary action plan or a set of "next steps," it should be more clearly identified and

presented as such. In contrast, perhaps "conclusions" should be set forth in the other chapters and the Executive Summary.

There should also be some discussion of significant transmission planning issues for supporting renewable resource integration beyond the Tehachapi area, possibly for a 20% RPS and certainly for a higher RPS. In this regard, certain transmission facilities, constraints or proposed transmission additions should be identified as critical to wind integration. Moreover, the Report should explain, in a summary fashion at least, how the different issues surrounding wind integration and transmission planning will be addressed in a coordinated manner.

Task 8 in Chapter 10 very briefly addresses resource adequacy, referring to the need to develop "new models and scenarios." This same chapter contains a fuller description of needs or priorities regarding changes in system operations, which in some instances might require tariff changes. Both of these kinds of implementation issues, operations/market design and especially RA/procurement, should be more fully discussed as action needs going forward. Both would be clarified and supported by specific modeling and projection of the retirements, additions and operations of supply assets and transmission, by detailed assessment of existing generating assets and their likelihood of retirement, by assessing likely operating characteristics of new generation, and by analyzing the use of and changes to various market/operational "tools" (such as scheduling, ancillary services and residual unit commitment) in a more detailed fashion. While these kinds of analyses are outside of the targeted scope of the present study, their role going forward might be discussed in Chapter 10, and their relationship to the present study might also be discussed, perhaps in the Executive Summary, Background (Chapter 1) and/or Chapter 10.

More explicit modeling and analysis of the types summarized in the preceding paragraph would provide a basis for assessing the *economic costs* of integrating renewable resources. It would be helpful if the Report were to discuss and anticipate such economic assessments and what they require, if for no other reason than that such considerations are becoming relevant to procurement of both renewable and responsive/flexible generation.

We note that storage technology is identified as a promising tool for addressing renewable resource integration, and the Report devotes an entire chapter to storage. Yet, storage is very difficult to value as a commercial investment. Perhaps, the "new models and scenarios to determine the 'best fit' generation portfolio for integration of large amounts of renewables" called for under Task 8 in Chapter 10 could include serious consideration of an operational and economic assessment of storage integrated with large amounts of renewable generation.

Finally, it would be useful for this Report, or a subsequent white paper to be issued in the near future, for the CAISO to begin to consider the role of stakeholders in addressing the complex and broad challenges posed by renewable resource integration.

5. Other Issues

In some instances, the Draft Report does not clearly distinguish specific analytic results of the present study versus generalizations, results, or information from other sources. This distinction should be made more explicit.

Near the front of the Draft Report, it was indicated that the approach for assessing the 33% RPS target would be addressed in Chapter 10. It is unclear if this approach will be included in the final Report.

Finally, for the sake of clarity, Appendices A, B, *etc*., should be internally structured as A.1, B.1, *etc*. The use of 1.1, 2.1, etc. in the appendices tends to confuse appendix contents with main body contents.