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Commissioner	:	Michael Picker
Admin. Law Judge	:	David Gamson
ORA Witnesses	:	Robert M. Fagan Patrick Luckow

OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

REPLY TESTIMONY OF ROBERT M. FAGAN AND PATRICK LUCKOW, SYNAPSE ENERGY ECONOMICS, ON BEHALF OF THE OFFICE OF RATEPAYER ADVOCATES

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans
Phase 1a

(R.13-12-010)

San Francisco, California
October 22, 2014

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Q1. What is the purpose of this testimony?

A.1. The primary purpose of this testimony is to reply to certain aspects of the Direct Testimonies submitted by Dr. Shucheng Liu and Dr. Karl Meeusen of the California Independent System Operation Corporation (CAISO) on August 13, 2014. This testimony also replies to the opening testimony submitted on September 24, 2014 by William A. Monsen for the Independent Energy Producers Association (IEP), and references selected aspects of the testimonies of Robert B. Anderson for San Diego Gas & Electric Company (SDG&E), Janice Y. Frazier and Antonio Alvarez for Pacific Gas and Electric Company (PG&E), Dr. Jimmy Nelson on behalf of the Union of Concerned Scientists (UCS) and Sierra Club, and Kathleen Treleven on behalf of the Large-Scale Solar Association (LSA).

Q2. Please summarize your testimony.

A.2. Phase 1b of the Long-term Procurement Planning (LTPP) proceeding should allow for modeling of additional deterministic scenarios that address renewable curtailment issues and include modifications to key planning assumptions associated with 1) the potential export of energy from the CAISO region during "over-generation" periods, 2) the protocols for curtailment of renewable energy, and 3) the assumptions for inclusion of a certain level of 2012 LTPP authorized Track 1 / Track 4 resources. These three planning assumptions should also be addressed in any stochastic modeling undertaken as part of Phase 1b.

Q3. What did Southern California Edison Company (SCE), SDG&E, PG&E, and UCS and Sierra Club indicate in their Phase 1a testimonies?

A.3. SDG&E found that "there is insufficient evidence to support Commission authorization of additional procurement at this time to meet system need".[1] SCE found that "[t]here is no need for the Commission to authorize additional procurement to meet

[1] Prepared Phase 1a Testimony of San Diego Gas & Electric Company (SDG&E Opening Testimony), September 24, 2014, 1:20-21.

system needs at this time."[2] ORA agrees with these statements. PG&E noted that the August 13, 2014 studies reveal "significant peak and upward flexibility shortfalls" but recommended that the Commission continue to investigate these findings.[3] PG&E further recommended that the Commission should consider stochastic analysis results to be filed in November 2014.[4] UCS and Sierra Club conducted a sensitivity analysis of the 40% RPS Scenario that indicates significant changes to renewable curtailment patterns under different input assumptions for "net export" allowances and changes to the "minimum generation" requirement utilized by CAISO in its deterministic modeling.[5] UCS's and Sierra Club's sensitivity analysis of the 40% RPS scenario underscores the importance of the net export and minimum generation assumptions in evaluating renewable curtailment, and supports the need for ongoing analysis in Phase 1b that addresses these assumptions as they relate to renewable curtailment.

Q4. What did CAISO witnesses indicate in their Phase 1a testimonies?

A.4. CAISO provided the results of its deterministic modeling of the five Commission-mandated scenarios. CAISO indicated that additional modeling work is required in Phase 1b to flesh out issues concerning the renewable curtailment seen in the modeling results, and the potential masking of flexibility needs.[6]

[2] Phase 1a Testimony of Southern California Edison Company on Resource Need (SCE Opening Testimony), August 13, 2014, 1:3-4.

[3] Pacific Gas and Electric Company Opening Testimony in Phase 1a of the 2014 Long-Term Procurement Plan (PG&E Opening Testimony), September 24, 2014, 1-3:30 through 1-4:3.

[4] PG&E Opening Testimony, pp. 1-3 and 1-4.

[5] Prepared Opening Testimony of Dr. Jimmy Nelson on Behalf of the Union of Concerned Scientists and Sierra Club Including Errata (UCS and Sierra Club Opening Testimony), September 24, 2014, 1:21 through 3:18.

[6] Phase 1a Direct Testimony of Dr. Karl Meeusen on Behalf of the California Independent System Operator Corporation (CAISO Opening Testimony/Meeusen), August 13, 2014, 16:1-4, 11-13, 19-21.

Q5. Please address CAISO's Dr. Meeusen's Phase 1a testimony conclusions and recommendations.

A.5. Dr. Meeusen testified that additional modeling studies are required to determine overall capacity needs[7] and that unlimited renewable energy curtailment in the modeling construct may be masking a need for flexible capacity.[8] His testimony proposes that CAISO conduct two additional studies to explore the curtailment issue. He also noted the effect that Track 1 and Track 4 resource authorizations may have on "capacity shortfalls" based on the results of the deterministic studies reported by Dr. Shucheng Liu in his testimony. Dr. Meeusen stated that:

> Based on the upward capacity shortfalls identified in the scenarios as studied thus far it seems likely that the authorized procurement would reduce and possibly eliminate the magnitude of the upward shortages.[9]

However, he also noted that additional studies would be required to test how Track 1 and Track 4 resources would affect the need for "system" or "flexible" capacity.[10]

Q6. In which months did CAISO's modeling results reveal capacity shortfall(s)?

A.6. Among all the scenarios CAISO studied, it found capacity shortfalls only during the summer months of July and August 2024.

Q7. Was there any renewable energy curtailment during July and August 2024 in the CAISO's studies?

A.7. Table 18 of Dr. Liu's testimony provides the curtailment data by month.[11] There was no renewable energy curtailment in July and August in the Trajectory, Trajectory without Diablo Canyon, and High Load Scenario. There was minimal renewable curtailment in July and August in the Expanded Preferred Resources Scenario: for July, 107 GWh (or 1.6% renewable curtailment); and for August 40 GWh (or 0.7% renewable

[7] CAISO Opening Testimony/Meeusen, 3:19-20.

[8] CAISO Opening Testimony/Meeusen, 5 24-26.

[9] CAISO Opening Testimony/Meeusen, 6:16-18.

[10] CAISO Opening Testimony/Meeusen, 6:10-22.

[11] CAISO Opening Testimony/Liu, 39:1-2.

curtailment). There was minimal renewable curtailment in July in the 40% RPS in 2024 Scenario, 47 GWh (or 0.6% renewable curtailment) and no renewable curtailment in August in that scenario.

Q8. What does this finding indicate concerning the effect of renewable energy curtailment on summer capacity shortfalls?

A.8. The capacity shortfalls identified by CAISO in the summer months are not due to renewable curtailment, since those shortfalls occurred during the later afternoon periods when all available renewable energy was being produced and none was being curtailed.

Q9. How significant is the overall magnitude, frequency, and duration of renewable energy curtailment?

A.9. The overall annual level of renewable curtailment in 2024 in the Trajectory Scenario is relatively low – just 0.2% of the potential total energy generated by renewable resources. The curtailment is concentrated in the spring months, especially in March and April; however, there are only 96 hours total over the course of the entire year where any curtailment is seen. The incidences, duration, and periods of curtailment are similar or lower than this for the Trajectory without Diablo Canyon Scenario, and for the High Load Scenario. Overall incidence and duration of curtailment in the other two scenarios (Expanded Preferred Resources and 40% RPS) is greater, and maximum hourly curtailment is higher in those scenarios (14,599 MW in April for the Expanded Preferred Resources Scenario and 13,402 MW for March under the 40% RPS Scenario) compared to the Trajectory Scenario (5,927 MW in March).

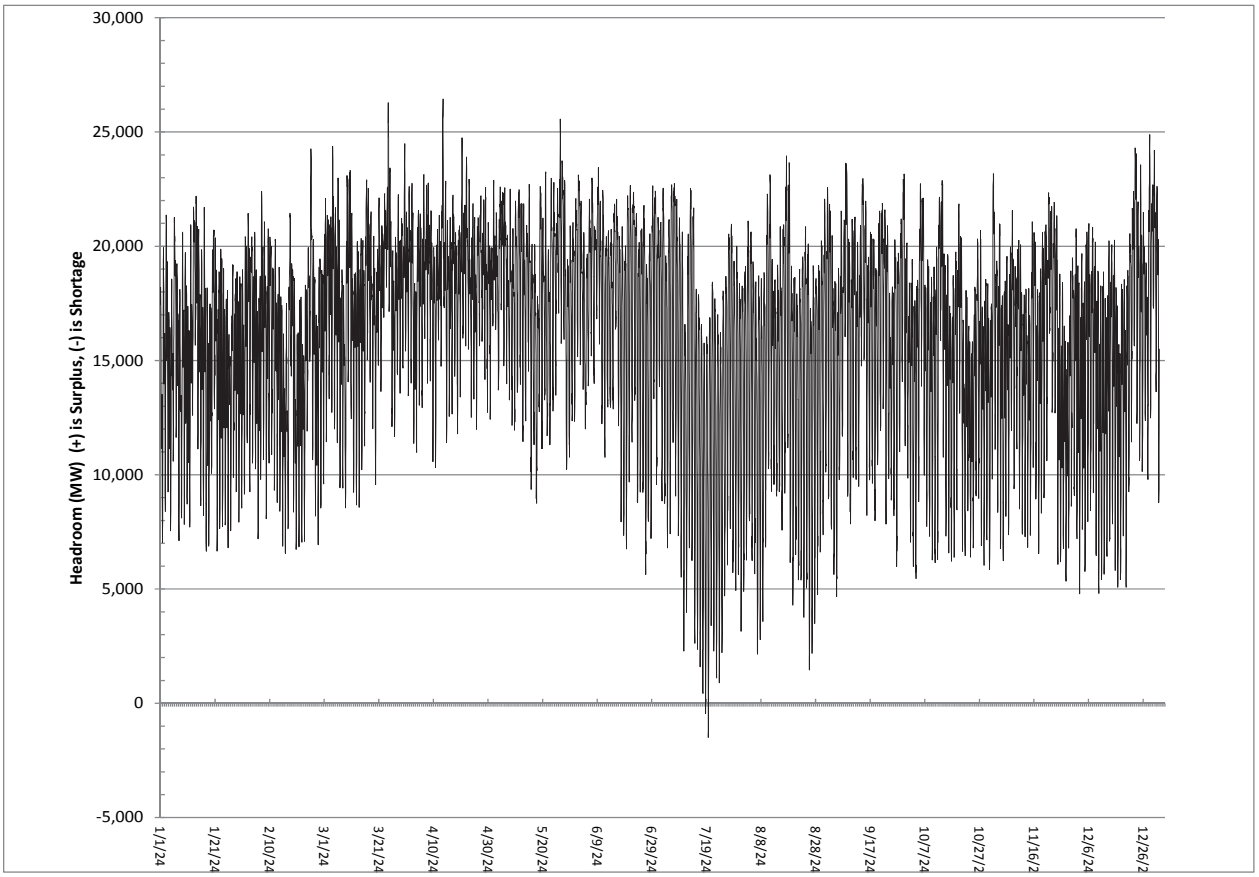
Q10. When is renewable energy being curtailed?

A.10. CAISO's modeling indicates that renewable energy curtailments are at their maximum during the spring months. In the Trajectory Scenario, significant levels of curtailment (e.g., >0.1%) are seen in March, April, and May only. The other scenarios exhibit maximum curtailment levels during these months, with additional curtailment occurring in winter and fall months.

Q11. If the curtailment of renewable energy in the spring months is masking a flexible capacity need, does that imply that additional procurement is likely to be required?

A.11. No, not necessarily, because even though the model curtailed renewable resources during those spring intervals, significant amounts of capacity remain available during those periods to serve as potential "additional" flexible supply if required under scenarios where renewable energy was curtailed at lower levels than seen in the Phase 1a results. For example, as seen in Figure 1 of ORA's August 13, 2014 opening testimony and reproduced below, considerable capacity headroom exists in the Trajectory Scenario during the spring months. Generally, upwards of 5,000 MW of headroom exists over all spring months and more than 10,000 MW of headroom exists during April.

Figure 1. Capacity Headroom – Trajectory Scenario



Source: Fagan/Luckow Direct Testimony, Figure 1, August 13, 2014.

Q12. Is there a way to determine more definitively if the masking effect of curtailment might lead to a capacity shortfall in the spring months in the Trajectory, or other planning scenarios?

A.12. Yes. Modifying the curtailment provisions, and/or the "net export" assumptions in CAISO's model would reveal the extent to which any additional flexibility needs could be met with existing resources or if additional resources are required. ORA recommends such additional modeling for Phase 1b, which is described later in this testimony.

Q13. Is changing the renewable curtailment parameters in the model the only way to address concerns one might have about the level of curtailment seen in springtime in the modeling?

A.13. No. The modeling assumption did not allow for net exports from the CAISO region. As noted by Dr. Meeusen, CAISO believes "existing practices" would need to change to allow for such net exports.[12] Dr. Liu noted that CAISO imposed this modeling condition because of the historic pattern of net imports into CAISO,[13] and that CAISO has never been a net exporter of energy even during times of over-generation. He also noted that lack of a west-wide jointly cleared day-ahead market may contribute to the observation that neighboring balancing authorities have limited ability to back[down] or decommit resources.[14] While Dr. Meeusen noted that the forthcoming Energy Imbalance Market (EIM) will help this situation, he caveats this by stating that EIM may have limited ability to address over-generation because it does not address decommitment of resources in neighboring areas, which may be needed to allow for CAISO net exports.[15]

Q14. Is it reasonable to assume zero net export capacity from the CAISO region for the purpose of determining procurement needs in 2024?

A.14. No, the zero net export assumption is not a reasonable assumption for 2024 when considering procurement needs. It may serve as a bookend to modeling scenarios, but it is an extreme assumption. Just because CAISO has historically been a net importer does

[12] CAISO Opening Testimony/Meeusen, 15:26-28.

[13] CAISO Opening Testimony/Liu, 14:20-23.

[14] CAISO Opening Testimony/Liu, 15:6-24.

[15] CAISO Opening Testimony/Liu, 15:15-20.

not mean that near-future or 2024 market constructs will not be able to address the export issue. At least some level of net exports from the CAISO region should be assumed when considering procurement needs for 2024, for the following reasons: 1) Energy market structures in the Western Electricity Coordinating Council (WECC) do not currently prohibit net exports--the extent to which net exports will occur is a function primarily of wholesale market economics; 2) Efforts in the WECC to improve market conditions for intra-regional energy balancing (including exports from CAISO during times of high renewable output and low load) will likely continue;[16] 3) Predictable patterns of springtime low load and concurrent high renewable energy output allow for efficient market response, thus leading to net export if the economic conditions warrant such transfers.

Q15. IEP testifies that ORA appears to recommend that Phase 1b of this proceeding should be cancelled.[17] What is ORA's response to IEP's claim?

A.15. IEP is mistaken. ORA is not recommending that the CPUC cancel Phase 1b of the 2014 LTPP proceeding. ORA's opening testimony recommends that the Commission not authorize additional procurement, based on the results of its Phase 1a modeling. ORA further notes that testing the effects of combinations of changes to the modeling assumptions used in Phase 1a would be useful to understand how renewable curtailment patterns, especially those seen in the spring months, would change. The renewable curtailment incidences in the model are notable, as is the lack of scenarios inclusive of Track 1 and Track 4 resources. In order to properly gauge what different results may be seen in future years, ORA recommends a set of scenarios to consider for Phase 1b to further examine CAISO and other parties' concerns.

[16] For example, the forthcoming CAISO-run Energy Imbalance Market, and ongoing balancing area protocol changes pursuant to FERC Order 764 (Integration of Variable Energy Resources, 6/22/2012, available at: http://www.ferc.gov/whats-new/comm-meet/2012/062112/E-3.pdf) will allow for more exchange of energy between WECC regions.

[17] Opening Testimony of William A. Monsen on Behalf of the Independent Energy Producers Association Regarding Phase 1a of the 2014 Long-Term Procurement Planning Proceeding (IEP Opening Testimony), September 24, 2014, 12:2-3.

Q16. IEP recommends including Additional Achievable Energy Efficiency (AAEE) as a variable in the stochastic modeling in this proceeding.[18] Please respond.

A.16. AAEE should not be used as a separate, stochastic variable in this proceeding. While it is not unreasonable to test for different levels of AAEE – such as the five levels presented as a range in the IEPR forecast[19] (low, low-mid, mid, high-mid, and high) – a reasonable modeling approach is to use different scenarios that modify the annual energy and peak load, and possibly even the overall profile of load, but not to treat AAEE in the same stochastic manner as is considered for weather and other effects on load, and solar and wind output variation. It is reasonable to allow those variables (wind, solar, hourly load) to be represented as a distribution of many possible values for any given hour, since data exists to help define those patterns.[20] No such data exists for AAEE effects; the scenario analysis approach is sufficient to capture the range of effect from different levels of AAEE.

Q17. IEP states "the cost implications of a shortage are much greater than it is of having excess procurement" (sic) and recommends that the Commission "should use only median and higher shortfall results from the stochastic modeling to determine the range of shortfall to be filled in Phase 1b."[21] Please respond.

A.17. IEP has not considered the time periods involved when making its statement about "cost implications" noted in the question above. Different types of resources come with different procurement timeframes. Projection of a shortage for 2024 based on modeling performed in 2014 does not imply that procurement to "fill" any potential shortage must happen now. Nor does it mean that the costs of procuring would be lower if procured in 2015; or that choosing to not procure in 2015 would threaten reliability in 2024.

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[18] IEP Opening Testimony, 22:11-13.

[19] See, e.g., California Energy Commission, Draft Staff Report, "Estimates of Additional Achievable Energy Savings," Supplement to the California Energy Demand 2014-2014 Revised Forecast, September 2013.

[20] See, e.g., CAISO's Dr. Liu's description of Step 0 and Step 1 processes in his Direct Testimony at p. 7-10.

[21] IEP Opening Testimony, 34:18-19 and 38:15-16.

IEP's recommendations to adopt a range of shortfall "to be filled in Phase 1b"[22] that eliminates reserve violations (based on stochastic modeling) 90% of time is arbitrary since it makes no accommodation for the timing and resource type considered to meet any needs that may be revealed in this process. IEP's recommendation is not supported by any statistical analysis that affirms the example given in Table 6 of IEP's testimony.

Q18. IEP states "[i]nstead of curtailing renewable resources, it is more reasonable to procure additional flexible capacity resources that enable greater levels of renewable development"[23] Please respond.

A.18. As noted in ORA's recommendations above, incorporating a number of changes to the modeling assumptions in Phase 1b to address net export, Track 1 and Track 4 procurement authorizations, and renewable energy curtailment protocols is a better first step than simply procuring additional flexible capacity. Moreover, renewable curtailment as seen in CAISO's deterministic modeling occurs at times when considerable excess capacity remains across the CAISO system. Thus, the modeling results do not support procuring more flexible capacity resources as a first step.

Q19. What does ORA suggest for the Phase 1b deterministic modeling scenarios?

A.19. ORA recommends modeling a range of scenarios that will evaluate the renewable energy curtailment issues noted in CAISO's August 13, 2014 testimonies, and modeling that will incorporate procurement authorizations from the Track 1 and Track 4 2012 LTPP decisions. There are many potential scenarios that could be constructed to address these two issues. While ORA recommends the Commission consider parties' written comments (and if necessary, convene a technical workshop) to develop a full set of scenarios to be modeled, the following matrix offers combinations of critical input assumptions that should be considered.

[22] IEP Opening Testimony, 38:16.

[23] IEP Opening Testimony, 29:15-17.

Table 1: Suggested Matrix of Deterministic Modeling Scenarios for Phase 1b

	Change to Original Parameters		
Scenario	**Net Export Constraint**	**Renewable resource curtailment protocol**	**Track 1 / Track 4 resource additions**
Trajectory	Remove/Fully Relax	No curtailment – must take	50%-100% of authorized
Trajectory	Remove/Fully Relax	Limited curtailment	50%-100% of authorized
Trajectory	50% of maximum import	No curtailment – must take	50%-100% of authorized
Trajectory	50% of maximum import	Limited curtailment	50%-100% of authorized
Expanded Preferred	Remove/Fully Relax	No curtailment – must take	50%-100% of authorized
Expanded Preferred	Remove/Fully Relax	Limited curtailment	50%-100% of authorized
Expanded Preferred	50% of maximum import	No curtailment – must take	50%-100% of authorized
Expanded Preferred	50% of maximum import	Limited curtailment	50%-100% of authorized
RPS 40%	Remove/Fully Relax	No curtailment – must take	50%-100% of authorized
RPS 40%	Remove/Fully Relax	Limited curtailment	50%-100% of authorized
RPS 40%	50% of maximum import	No curtailment – must take	50%-100% of authorized
RPS 40%	50% of maximum import	Limited curtailment	50%-100% of authorized
High Load	Remove/Fully Relax	No curtailment – must take	100% of authorized

Q20. Please explain the suggested Phase 1b modeling scenarios in Table 1.

A.20. The suggestions in Table 1 are offered as a starting point to inform discussions on modeling needs in Phase 1b of this proceeding. Table 1 lists three key input assumptions that would affect the level of capacity need (or surplus) that is seen in the deterministic modeling results. Those are:

1. **Inclusion of Track 1 / Track 4 resources.** As seen in ORA's August 13, 2014 Direct Testimony, the inclusion of even a portion of the authorized resources from the Track 1 / Track 4 2012 LTPP decisions significantly changes the level of "shortfall" observed in the modeling results. For the High Load Scenario, which shows a summer capacity shortage level, it may be appropriate to assume the full level of Track 1 / Track 4 resources. For the other scenarios, the maximum shortage levels seen suggest adding resources at a level lower than the full Track 1 / Track 4 amounts.

Notably, since the issuance of planning assumptions for this proceeding and since the issuance of the Track 1 / Track 4 procurement authorizations, CAISO has approved additional transmission resources that will serve to lower the local reliability area

resource requirement in the San Diego / LA Basin areas and will increase import capacity into the Southern California region.[24] These developments should be considered when constructing scenarios in Phase 1b that include requirements based on the Track 1 / Track 4 procurement authorizations.

2. **Modifying the net export constraint**. As seen in UCS's and Sierra Club's opening testimony,[25] the net export constraint can have a significant effect on the level of renewable energy curtailment otherwise seen in the modeling results. The reasoning provided by CAISO for constraining the model to zero net exports is not sufficient for assessing outcomes in 2024. At a minimum, the Commission should be aware of the impacts the relaxation of the modeling constraint may have on both the need and amount of renewable curtailment.

3. **Changing the protocols for renewable curtailment in the model inputs**. Currently, the model allows unlimited curtailment of renewable resources in order to solve for energy and ancillary service requirements in each hour. Allowing for some, but not unlimited renewable curtailment (represented in the table as "limited curtailment"); and assuming no curtailment at all, will complement the CAISO's modeling results currently based on the assumption of full curtailment capability. There are a number of ways to model a "limited curtailment" regime and ORA welcomes suggestions on different modeling constructs that reflect real-world practicalities of renewable resource contracting issues.

Additional modeling assumption changes could be considered in Phase 1b of this proceeding. As noted by the LSA, it may be reasonable to consider solar shape changes.[26] As noted by UCS and Sierra Club[27] the imposition of the 25% minimum local

[24] CAISO 2013/14 Transmission Plan, July 16, 2014. Group 1 facilities as noted on pgs. 105-108.

[25] See e.g., UCS and Sierra Club Opening Testimony, p. 3, Table 1, "curtailment results" for the "Allow Net Exports" sensitivity.

[26] Prepared Direct Testimony of Kathleen T. Treleven on Behalf of the Large Scale Solar Association, September 24, 2014, 2:1-2.

[27] UCS and Sierra Club Opening Testimony, 14:3-1.

generation requirement may need refinement, in particular given the effects of new transmission facilities likely to be online by 2024.[28]

Q21. What does ORA suggest for Phase 1b stochastic modeling scenarios?

A.21. ORA makes no recommendations at this time except to note that the modeling representation of the three key input assumptions listed above is also important for stochastic modeling approaches.

Q22. What are ORA's recommendations?

A.22. ORA recommends that the Commission consider other parties' comments to flesh out a reasonable set of changes to modeling assumptions to account for key variables (and if necessary, convene a "Phase 1b" technical workshop).

Q23. Does this complete your testimony?

A.23. Yes.

[28] See for example Table 2.6-5: Summary of Proposed Transmission Solutions, Cost Estimates and Local Resource Reduction Benefits" in CAISO 2013-2014 Transmission Plan, p. 108.