CSPA
Concentrating Solar Power Alliance

Informal Comments of the Concentrating Solar Power Alliance on the Energy Division Staff Draft Proposal on Qualifying Capacity and Effective Flexible Capacity Calculation for Energy Storage and Supply-Side Demand Response Resources and Effective Load Carrying Capacity Assessment of Wind and Solar Resources In Rulemaking 11-10-023

October 22, 2013

The Concentrating Solar Power Alliance ("CSPA") appreciates this opportunity to provide its comments on the Energy Division's Draft Proposal (the "Proposal") on the Qualifying Capacity ("QC") and Effective Flexible Capacity ("EFC") Calculation for Energy Storage ("ES") and Supply-Side Demand Response ("DR") Resources as well as the assessment of Effective Load Carrying Capacity ("ELCC") for wind and solar resources. These efforts are important for the concentrating solar power ("CSP") industry and the grid at large in order to appropriately value and induce deployment of wind, solar, ES and DR resources and to contribute to AB 32 goals in a cost-effective manner. In these comments, the CSPA will identify necessary modifications for ELCC analysis and to the Proposal related to treating and modeling CSP with thermal energy storage as well as offers to meet with CPUC staff to discuss these proposed modeling modifications in greater detail.

The CSPA consists of concentrating solar power developers and suppliers who advocate for CSP technology and thermal energy storage ("TES") and increased recognition of the value these technologies offer to the energy supply. CSP with TES ("CSP+TES") has certain unique attributes, notably the capability to integrate solar energy with low-cost thermal energy storage systems. CSP+TES offers higher economic benefits relative to other renewable resources, particularly in power systems with high penetrations of renewable energy.[1] The work of the Resource Adequacy ("RA") proceeding is critical to improving valuation of resource options to achieve California's energy and environmental policies with respect to wind, solar, ES and DR resources, including CSP+TES.

There are over 20 operating CSP+TES plants worldwide, with two coming online in the southwestern U.S. over the next 6 months and one scheduled for completion in 2016 with a CPUC-approved power purchase agreement with PG&E. CSP+TES projects are eligible for procurement to comply with the Renewable Portfolio Standard ("RPS") as well as the newly-approved CPUC Storage Procurement Targets. Accurate evaluation of CSP+TES Resource Adequacy credit, both generic and flexible, is essential to the future competitiveness of new projects in the procurement process.

As an analytical framework approach, the CSPA commends and supports the use of Effective Load Carrying Capacity ("ELCC") to assess the QC of wind, solar, ES and DR.

[1] See, e.g., Denholm, P., Wan, Y-H., Hummon, M., and M. Mehos, "An Analysis of Concentrating Solar Power with Thermal Energy Storage in a California 33% Renewable Scenario," National Renewable Energy Laboratory, Technical Report, NREL/TP-6A20-58186, March 2013; Mills, A., and R. Wiser, "Changes in the Economic Value of Variable Generation at High Penetration Levels: Pilot Case Study of California", June 2012b, Lawrence Berkeley National Laboratory, LBNL-5445E. See http://eetd.lbl.gov/ea/emp/reports/lbnl-5445e.pdf .

However, given the CSPA's familiarity with modeling ELCC and capacity credits for CSP+TES, the CSPA understands that the CPUC's proposed ELCC modeling for CSP+TES will require some additional steps to account for "solar fuel" limitations and bulk storage capacity, which in combination create a partially dispatchable resource. These characteristics have required additional modeling adaptations in the case of third-party modeling of CSP+TES capacity value, and CSPA is concerned that the SERVM model does not possess the necessary capabilities. In addition, these characteristics may necessitate adaptations for real-time assessment of capacity ratings by the investor-owned utilities ("IOUs") and CAISO, to account for economic trade-offs between energy production and ancillary service provision. In general, refining and vetting the conclusions of such modeling will be challenging in the proposed timeline. One such challenge is that there are multiple variations in CSP+TES plant configurations, such as parabolic trough or power tower, and ranging from less than one hour to more than ten hours of storage capacity. Different IOUs will desire varying design configurations given specific operational needs. The CPUC will need to provide IOUs with easily implementable general rules and procedures for ELCC modeling of new *and* existing[2] CSP+TES plants with various design configurations.

Regarding the Proposal's approach to ES, the CSPA requests clarification on whether solar resources co-located with storage will be assessed with the ELCC methodology regardless of the adoption of ELCC for QC assessment of ES. The CSPA is concerned that the Proposal suggests a default approach to co-located ES resources, in the absence of ELCC use for ES, that will fail to accurately assess the capacity values of renewable generation co-located ES and could create a disincentive for optimal operations.

General Comments on ELCC Assessment of CSP+TES

The ELCC methodology can provide accurate QC assessment of CSP+TES facilities, but it will require the noted modifications to account for CSP+TES plant operation and production specifications. CSP+TES is a unique category of generator:

1. It is an energy-limited on a daily basis based on the available solar irradiance,

2. Due to thermal energy storage, it is able to shift energy to the highest capacity value hours (e.g., highest Loss of Load Expectancy ("LOLE") hours as identified in the ELCC analysis) on particular days or over a series of days, and

3. Despite a certain level of standardization, each CSP+TES plant can have a tailored configuration to optimize energy production, storage capacity and delivery flexibility for the particular utility off-taker, resulting in unique operational capabilities and constraints in each case.

[2] Accurate modeling of CSP+TES plants is not only relevant for new resource evaluation, but also for accurate modeling of the WECC system, which includes *existing* CSP+TES plants, whether operating or included in base cases as planned generating units.

To date, researchers have used two types of models to calculate the capacity value of CSP+TES facilities. The first type of model uses a detailed plant-level model of the particular CSP+TES plant and optimizes its operations to maximize production during highest LOLE hours, as derived from an ELCC model that *does not include* the CSP+TES plant.[3] This approach can evaluate an individual plant as an incremental resource but not as a component of a portfolio of resources. The second uses a system-level model, such as a production simulation model (e.g., PLEXOS), and optimizes CSP+TES energy production against the hourly prices derived endogenously to the model. This allows for a more robust valuation of the plant under different scenarios. In this second approach, an input to the system model is the forecasted state of the storage charge, typically derived *ex ante* using a tool such as the NREL Solar Advisor Model ("SAM"). Using a modified hydroelectric storage approach,[4] the system-level model then assigns the exogenously derived hourly storage charge to power block operations to maximize value across energy production (or energy production and ancillary services provision).[5] This kind of model can also be run to estimate maximum capacity value, instead of highest value energy production, for example, by placing an adder on the highest LOLE hours since these may differ from the highest value hours for energy production (and ancillary services provision).

The CSPA and CSP companies are engaged as leaders and members of technical advisory committees for the national laboratories and other third-party consultants examining CSP+TES capacity valuation, in addition to having developed internal expertise on modeling CSP+TES. The CSPA is willing to facilitate any discussions necessary to advise the Energy Division in adapting ELCC methodologies to accommodate and accurate model CSP+TES.

With regards to relevant details for CSP+TES modeling, these plants are operated in an integrated fashion with respect to energy collection, storage and generation – sharing a steam turbine generator; therefore, it is not appropriate to model or assess the capacity value of the TES and balance of plant separately. Hence, the assessment of capacity rating for CSP+TES requires an integrated model that can account for specific CSP technologies and storage configurations. Other standard system modeling tools have already been adapted to model CSP+TES. For example, NREL has adapted PLEXOS, and the CAISO has adapted its modeling approach when incorporating Solar Reserve's Rice CSP+TES project in the 2012 LTPP simulations. In the case of NREL's research, custom generator types for different CSP+TES configurations were created using NREL's SAM to generate "fuel" availability based on solar Direct Normal Irradiance ("DNI") data and plant characteristics, such as solar field size, storage capacity size, minimum generation levels and facility ramp rates. Presumably, a similar process of adaptation would need to be undertaken by Energy Division staff in order to assess the capacity rating of CSP+TES using the SERVM model.

[3] E.g., Madaeni, S.H., R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants: A Case Study of the Southwestern United States," *IEEE Transactions on Power Systems*, Vol 27, No 2, pp 1116-1124, May, 2012.
[4] See discussion in Denholm et al., (2013), cited in footnote 1.
[5] See the references in footnote 1. There are several other sources as well.

In designing a capacity rating approach for real-time operations (and for *ex ante* modeling), it is important to avoid perverse results that can arise from prioritizing capacity availability over the optimal dispatch, which delivers the highest value to system-wide performance and costs, excluding resource adequacy cost considerations. For CSP+TES, which is renewable, energy-limited and dispatchable, the highest-value energy or ancillary services production may not necessarily correlate with the highest Loss of Load Expectancy ("LOLE") hours if the energy and ancillary service markets send different price signals. A capacity rating approach should reward, and not penalize, these plants by aligning capacity value with optimal dispatch rather than with the highest LOLE hours.

General Comment on the Proposal

The Proposal recognizes that the ELCC methodology may not be adopted for ES and DR. However, in compliance with SB 1(x)2, the CPUC will be implementing an ELCC methodology for wind and solar resources. Presumably, this would apply to solar resources where energy storage is entirely integrated within a facility, such as CSP+TES, but also may be true for other solar and storage technologies. At the October 15th workshop, though, Energy Division staff referenced that ES would serve to enhance the performance of a co-located generation facility under current QC assessment methods, such as the exceedance methodology for renewable facilities. Further clarification on the timing and application, if at all, of ELCC assessment for wind and solar resources would be appreciated.

With regards to co-located ES enhancing "performance data,"[6] methods for measuring capacity value need to properly account for the dispatchability of co-located ES systems; the current QC exceedance methodology fails to do. Adoption of a modified methodology would be required to accurately quantify the reliability value that co-located ES facilities provide in terms of both generation and availability to the grid. Further, as many studies have now shown, the existing Qualifying Capacity hours do not always align with highest whole energy and ancillary services prices and, thus, the lowest system cost and best use of generation in real time operations. If a QC exceedance methodology persists, without modification to better reflect the reliability benefits of energy storage, then storage will be deterred from deployment at wind and solar facilities, despite potential plant- and system-level efficiencies of doing so. This status quo approach creates a perverse incentive to maximize production during historic Resource Adequacy hours of the year (which would not encourage the use of storage), rather than to optimize facility configuration and operations for the provision of reliability services that will be needed as the grid evolves

[6] Proposal at 19.

Specific Comments to the Proposal

- Page 1, third paragraph

"It is noted that only ES and DR resources that bid into California Independent System Operator (CAISO) markets and are subject to a Must-Offer Obligation (MOO) are within the scope of this Proposal."

The Proposal addresses QC and EFC for ES facilities, including those co-located with generation. Certain ES facilities, when incorporated with generation, have ES use limitations due to shared equipment and interconnections, contractual obligations, and/or technical aspects, and thus cannot have fully independent Must-Offer Obligations ("MOOs"), which would be consistent with an aggregate QC, EFC and resource ID approach. The Proposal should be clarified that adoption of the ELCC / Effective Ramping Capability ("ERC") methodology for co-located ES and generation facilities is not intended to be limited to those facilities where the ES is, or could be, independently subject to a MOO. CSP+TES facilities are fully capable of bidding into the CAISO markets and would be subject to the applicable MOOs, if participating as RA or Flexible Capacity resources, even though the ES component of the facility would not have an independent MOO separate from the MOO applicable to the generation unit alone.

- Page 3, Item 1, second bullet (first full bullet on page)

"Co-located ES operating in conjunction with another, larger RA-eligible resource need only meet the MOO requirements separately; in all other respects, the RA qualification of the primary generating facility is sufficient."

Co-located ES may not be capable of meeting MOO requirements separately under all conditions. This is true for various technologies, but CSP+TES illustrates the problem.

CSP+TES facilities harness solar radiation to make steam that powers turbine generators. When combined with thermal energy storage, solar radiation heats a thermal storage medium (generally molten salt); the stored heat is used to create steam as needed for generation. These facilities may heat the storage medium directly or indirectly (such as with high temperature steam or a heat transfer fluid). In all instances, the CSP+TES facilities should be governed by the applicable MOO, such as the Flexible Variable Energy Resource MOO,[7] and not an ES-specific MOO.

[7] Refers to the ISO's Third Straw Proposal on Flexible Resource Adequacy Criteria and Must-Offer Obligations

At CSP+TES plants, the ES portion of the larger facility makes the *generating unit* partially dispatchable, subject to technical constraints of a facility and/or solar resource availability, but does not create a separate and distinct dispatchable storage resource at all times, as the energy storage operations share turbines, interconnection and other equipment with the generation facility. The ES portion therefore cannot be held to its own separate MOO. This may also be the case for other ES co-located facilities where the maximum output of a facility is limited by some shared equipment or construct, such as inverters, transformers, transmission lines or interconnection equipment or size allowance.

- Pg 3, item 2, first bullet

"The Energy Division would like party comment on the extent to which QC and EFC should be based on historical performance data. To the extent that historical performance data is not available or appropriate, program design and/or test data may be used."

CSPA proposes that QC and EFC testing and verification is initially based on historical performance data from existing plants of similar design and technology in operation elsewhere in the world. Allowance for adjustments from this historical performance would be required to account for relevant plant design differences and plant operations dictated by the local regulatory regimes. These adjustments could be supported by equipment supplier technical specifications and owner-provided project-specific modeling analysis, to be reviewed by relevant experts at the California Independent System Operator ("CAISO"), CPUC and/or independent engineers.

- Pg 4, item 3, fourth bullet

"In the event that ES is co-located with and operating as a supplement to a larger generating facility, the ES should modify the QC and EFC of the primary facility and not receive its own unique QC or EFC. Such an ES facility need not independently meet RA eligibility requirements; however, the ES facility remains subject to the RA MOO (to schedule or bid into CAISO markets) or the FRACMOO (for facilities wishing to qualify as Flexible RA), as previously described."

For CSP+TES facilities, which are co-located ES facilities, the ES should supplement the applicable QC and EFC of the primary facility, and there should be no independent RA requirements. However, as stated above, the shared equipment of the ES and the generating equipment means that the entire facility is integrated and must have a single MOO, rather than having the ES subject to its own MOO. The MOO for the entire facility would follow the requirements of the solar thermal generating facility; however, the MOO could be specific to recognize the presence of the storage capabilities.

- Pg 16, fourth paragraph

"The QC and EFC are assigned to a combined facility Resource ID; both the ES and the associated generating or DR resource also receive individual Resource IDs for modeling and reporting purposes."

> As it is not possible to fully separate the ES and the generating unit for certain technologies, including CSP+TES, as discussed above, it may not possible or logical CSP+TES facilities to have individual resource IDs for the ES and the solar thermal portions of the plant.

- Pg 17, first paragraph

"Minimum output occurs when the ES is charging from the grid (i.e., a negative Pmin) and the primary generator is not generating any power (or an DR resource has increased its consumption to also create a negative Pmin)."

> CSP+TES facilities may be designed to act as a load as well as a generator, with a design ability to charge ES with grid electricity. In these instances, for the purpose of calculating EFC, the facility's Pmin could be negative. This capability should be incorporated and recognized in the ERC analysis of applicable CSP+TES facilities, subject to the submission of technical support, testing and verification.

- Pg 18, footnotes 32 & 33

"The model includes all resource operating characteristics, including use limitations and forced outage rate (FOR). Characteristics to be determined based on historical data when possible, or based on manufacturer test data submitted to the CAISO (for initial operation). The ES is permitted to charge from the grid, as well as from the primary generating facility."

> For CSP+TES facilities, and likely other co-located ES facilities, the relevant performance characteristics are not purely a function of the manufacturers' specifications for individual pieces of equipment, but rather a function of the facility's overall design, configuration and operating environment. Characteristics should be determined based on historical data from similar facilities, adjusted for expected operating conditions and modeled data provided by the plant owner, consistent with test data submitted to the CAISO for initial operation.

- Pg 19, last paragraph

"If an ES is not capable of independently qualifying as an RA resource, then it would not receive a QC or EFC according under this alternative proposal. However, it would still

enhance the performance of the co-located facility, which would be reflected in the performance data used to calculate the QC (and EFC) of the co-located generator."

For CSP+TES facilities, and any facility where ES cannot independently qualify as an RA resource, the proposal for ES to serve as a "performance enhancer," if the ELCC / ERC methodology is not adopted, could lead to mischaracterization of capacity value, absent adequate modeling and modification of current assessment methodologies. CSP+TES, for example, may be available to generate, but may not be dispatched to do so during certain RA or MOO hours, particularly in those hours for which energy production performance is recorded for the current exceedance methodology for renewable facilities. In fact, if a CSP+TES facility were operated to maximize "historical" performance under the current RA assessment regime, the facility would have to be self-scheduled in a sub-optimal manner, and as a result would not be available to the CAISO for dispatch as most needed. In the absence of interim or permanent ELCC implementation, recognition of operating capabilities is necessary to provide accurate assessment of capacity value. Simply enhancing the "performance" of a facility could result in a failure to optimize grid operations, maintain reliability and minimize ratepayer costs.

A modified exceedance methodology is necessary in order to recognize and encourage the provision of ancillary services and to avoid sub-optimal generation in arbitrarily set RA hours. In real time operations, there will be benefits to reliability, grid operation (e.g., avoided overgeneration, renewables curtailment, negative price energy exports to buyers outside of the CASIO control area) and wholesale market clearing prices to deferring generation to more valuable hours. Co-located ES facilities could provide telemetry data regarding their ability, or availability, to generate for each upcoming 15 minute interval based on the current storage charge state and short-term natural resource forecast. Both generation and availability should be used in such a modified exceedance RA calculation, rather than solely generation.

Submitted respectfully by,

Frank (Tex) Wilkins
Executive Director, Concentrating Solar Power Alliance

520 SW Yamhill Street, Suite 600
Portland, Oregon 97204-1329
Tex.Wilkins@gmail.com
410-960-4126