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STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of:	**DOCKET NO. 09-AFC-07C**
Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DECLARATION OF CHARLES TURLINSKI**

I, Charles Turlinski, declare as follows:

1. I am presently employed by BrightSource Energy, Inc. as Director of Project Development.

2. A copy of my professional qualifications and experience was included with my Opening Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached supplemental rebuttal testimony relating to Project Description for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on July 17 2014.

Charles Turlinski

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of:	**DOCKET NO. 09-AFC-07C**
Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DECLARATION OF MATTHEW STUCKY**

I, Matthew Stucky, declare as follows:

1. I am presently employed by Abengoa Solar LLC as Manager of Business Development.

2. A copy of my professional qualifications and experience was included with my Opening Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached supplemental rebuttal testimony relating to Project Description for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on July 17 2014.

Matthew Stucky

PALEN SOLAR ELECTRIC GENERATING SYSTEM
PROJECT DESCRIPTION
SUPPLEMENTAL REBUTTAL TESTIMONY

I. Name:

Charles Turlinski and Matthew Stucky

II. Purpose:

Our testimony provides responses to questions raised by Staff in its Project Description Opening testimony for the Palen Solar Electric Generating System (PSEGS) (09-AFC-7C).

III. Our qualifications have been summarized with resumes included in our previous written testimony in this proceeding.

To the best of our knowledge all referenced documents and all of the facts contained in this testimony are true and correct. To the extent this testimony contains opinions, such opinions are our own. We make these statements and provide these opinions freely and under oath for the purpose of constituting sworn testimony in this proceeding.

IV. Opinion and Conclusions:

Schedule

Staff requested a more detailed discussion of the PSEGS construction schedule since the permitting and the original desired construction start date have been significantly delayed. While Palen Solar Holdings, LLC (PSH) has worked to find ways that would allow both units of the PSEGS to be constructed simultaneously in time to meet the Commercial Operation Dates (COD) of both of its Power Purchase Agreements (PPAs), it is now clear that the cumulative effect of all of the permitting delays have rendered it improbable to meet the COD for PPA Number 6. However, PSH is committed to developing two units at the PSEGS site, one unit now and one unit in the future. Therefore, PSH is submitting a revision to its original phasing plan. The original phasing plan identified areas within the power blocks of both units, the common area, and the linear facilities as Phase I. The remainder of the PSEGS facilities was identified as Phase II. PSH's new phasing plan includes all of Unit 1 (the westernmost solar field and power block), the common area and construction laydown area, the project switchyard, the access road, the natural gas pipeline, and the generation tie-line as Phase I. Phase II is now identified as the easternmost solar field and power block and addition of the second evaporation pond within the common area. See Exhibit 1167 which depicts the Revised Phasing Plan.

Phasing the PSEGS in this way should not prevent the Commission from approving the Project by October 2014 in order to provide PSH with the best possibility of achieving the Project Objectives. It is imperative that the Commission grant a license by October 2014, which would authorize Phase I. This would allow for equipment ordering, financing activities, compliance activities and early construction activities to take place prior to the Spring 2015 desert tortoise clearance window (when full mobilization would occur). Any further significant delay will result in PSH's inability to meet the COD of PPA Number 7.

PSH is providing Exhibit 1168 which identifies the new projected construction schedule and personnel for Phase I. Since all of the impacts associated with the construction schedule and workforce have been analyzed for both units and the impacts will be less for construction of the first Phase, the Commission can approve the revised phasing approach with no new analysis and only minor changes to conditions.

Exhibit 1169 is our proposed revision to Condition of Certification **SOIL&WATER-3** to apply the water use restrictions by phase. The revisions to the construction water projections were based on proportioning the total amount of groundwater using the ratio of disturbance of each phase to the total disturbance. Water for operations was divided in half per phase. No additional water beyond that which was already analyzed by Staff is being proposed.

Exhibit 1170 includes our proposed revision to the phasing tables of Condition of Certification **BIO-29.** The revisions are based on the same GIS maps of habitat that were provided to the Staff previously using the boundaries shown on Exhibit 1167, the Revised Phasing Plan. No new disturbance is proposed as a result of the Revised Phasing Plan beyond that which was already analyzed by Staff.

In addition, we have evaluated whether the Revised Phasing Plan would require substantial changes to the grading and drainage design of the project. It does not. Unlike the Approved Project, the drainage design for the PSEGS allows most of the storm water to run through the site rather than the use of large diversion structures to divert storm water around the site. In general the grading plan for the entire site relies on utilizing the existing drainage pattern and minimizing disturbance to native grades. The drainage concept for Phase II is basically to cut/fill the area needed for the power block and to add a diversion berm/swale on the upgradient side of the site in order to convey storm water drainage around the power block and then release the storm water back to existing grades once past the development. Therefore, if Phase II will be constructed subsequent to Phase I, rather than concurrent with Phase I, that area encompassing

Phase II can be left undisturbed until needed, including each entry point for the access roads inside of the nearest circular dirt road.

The existing conditions of certification require a Final Drainage Erosion and Sediment Control Plan and grading plans to be approved by the CPM prior to construction. That review will allow any minor modifications to the preliminary plans to be reviewed to ensure compliance with the clear performance standards outlined in the conditions.

To further California's renewable energy goals and consistent with PSH's Supplemental Opening Testimony that it wishes to pursue incorporation of Thermal Energy Storage (TES) in the future, PSH proposes that construction of Phase II (the easternmost unit) be conditioned upon the filing and Commission approval of a future amendment that would present modifications to the currently designed Phase II to incorporate TES. Exhibits 1125 and 1129 as well as Staff's Opening Testimony on TES (Exhibit 2017) demonstrate the feasibility of adding TES to the design of Phase II.

PSH believes that authorization of Phase I will allow a significant share of the benefits outlined in our Opening Testimony of the PSEGS to be realized in the near term (job creation, avoided CO_2 emissions, reduced environmental impacts, positive socioeconomic impacts, contributions to grid stability, reliability and transmission utilization, etc.), while requiring an amendment, which incorporates TES, before Phase II can be constructed.

To memorialize PSH's commitment, we suggest the following new condition of certification be incorporated into the Final Decision.

> **PD-1** The project owner shall not construct Phase II of the project as shown on Exhibit 1167 until it has filed, and the Commission approves, a Petition For Amendment that incorporates thermal energy storage into the design of Phase II. This condition does not prevent the project owner from proposing other design changes in the Phase II Petition For Amendment, but the Petition must include, at a minimum, thermal energy storage.
>
> **Verification:** The project owner shall file a Petition For Amendment to incorporate thermal energy storage into Phase II of the project at least 6 months prior to commencing construction of Phase II.

NATURAL GAS CONSUMPTION

As Stated in Exhibit 1152,

> Based on the preliminary design of the PSEGS, PSEGS will not require additional natural gas beyond that which is analyzed in the Final Determination of Compliance (FDOC) and Final Staff Assessment (FSA).

Staff presented several technical questions relating to natural gas consumption in its Supplemental Opening Testimony. The answers to these questions are presented below:

Staff stated in its Opening Testimony:

> The 525 mmscf annual fuel use for each 125 MW unit at ISEGS would be used in an auxiliary boiler with a capacity rated at 249 million British Thermal Units per hour (mmBTU/hr) and in a nighttime preservation boiler rated at 6.7 mmBTU/hr. In its amendment request to convert the facility technology from solar trough to solar power tower, PSEGS proposes to use 355 mmscf of natural gas per year for each power plant unit rated at a nominal 250 MW. This fuel would be used in an auxiliary boiler with a capacity rated at 249 mmBTU/hr and in a nighttime preservation boiler rated at 10.5 mmBTU/hr. As apparent here, even though the thermal capacities of the two projects' auxiliary boilers are comparable, PSEGS proposes substantially less natural gas per MW than ISEGS needs (355 mmscf/250 MW= 1.4 mmscf/MW for PSEGS versus 525 mmscf/125 MW = 4.2 mmscf/MW for ISEGS).[1]

PSH would like to clarify that in its Petition For Amendment filed on December 2012, the annual natural gas usage for the PSEGS is 371,000 MMBtu/hr or 371,000/1045 = 364 MMSCFfor each unit.

Staff also stated in its Opening Testimony:

> In order to determine whether or not PSEGS would have sufficient quantities of natural gas to ensure optimal and stable operations during periods where solar insolation is less than optimal, while consuming substantially less natural gas than ISEGS, staff needs to better understand how much annual natural gas would be necessary for PSEGS to use

[1] Exhibit 2017, Page 74

under actual field conditions. Thus, staff needs more details on the PSEGS' site conditions, designs, and annual operating profiles. Specifically, staff needs to know the following:

1. What level of analysis has been completed, including field studies, to ensure that the amount of gas expected to be used for PSEGS is actually sufficient under actual field conditions; those conditions described above based on actual operations of ISEGS? (Those conditions can include the need to operate the auxiliary boilers longer than anticipated to ensure steam flow is sufficient to carry excess heat from the heat recovery steam generator in the towers; to ensure plant equipment and systems are ready to operate as designed; and to prevent the steam turbine from tripping off line in the morning, during dense and/or long periods of cloud cover, and at the end of the day.)[2]

PSH Response: The gas consumption was estimated based on the following inputs:

- The site weather data analysis by BrightSource Engineering performance modeling team
- PSEGS startup/shutdown assumptions – Alstom (the SRSG turbine supplier) together with BrightSource Engineering have conducted analysis and optimization of the different modes of operation and provided the detailed requirements to the gas boiler operation to support the plant startup and shutdown. The optimized startup/shutdown curves of the SRSG and turbine have been considered in the BOP design (piping and equipment sizing) and in the gas consumption calculations
- Turbine operation during assumed periods of cloud cover have been analyzed
- Information provided by the potential gas boiler suppliers

Staff requested further information outlined below:

2. What are the specifics of the PSEGS' generating technology, such as the steam cycle (including steam quality requirements), steam turbine generator, solar receiver steam generator, and heliostat field, which could explain the lack of need for PSEGS to increase its natural gas consumption?

[2] Ibid, Pages 74-75

PSH Response: The PSEGS has the following gas usage advantages when compared to Ivanpah:

- ISEGS possesses a reheat cycle but PSEGS does not. Reheat requires additional panels in the receiver and a significant amount of large piping running to and from the top of the tower to the turbine at the base of the tower (the Cold reheat and Hot reheat lines – at ISEGS are 24" each). The absence of reheat panels and associated piping at PSEGS reduces the start-up and shut-down gas load on a per MW basis when compared to ISEGS.

- Although each PSEGS unit is twice as large as any single ISEGS unit, the auxiliary boilers are the same size (249MMBtu/hr) at each unit. Its sizing was defined based on the plant startup/shutdown requirements (primary usage) and not by MWe production - boosting mode (secondary usage). On a per MW basis, PSEGS therefore consumes less gas for auxiliary boiler startup, for keeping the gas boiler on hot standby, and for night preservation since these uses are not connected to the plant size in MW. Although each PSEGS unit has twice the output capacity compared to ISEGS, the preheating of the superheater panels during start-up uses a similar amount of gas. In other words, PSEGS has a defacto economy of scale advantage related to the gas usage in terms of the plant's MW capacity.

Staff request additional information about PSEGS operating profile:

> 3. What would be the PSEGS' annual operating profile, including its annual capacity factor, and its annual equivalent electricity production rate from operating on natural gas only, that could explain the lack of need for PSEGS to increase its natural gas consumption?

PSH Response: PSEGS' design and emissions profile is based on the assumption that natural gas usage is only used as a supplemental resource to maximize the efficiency of the plant's start-up and shutdown procedures as well as aide the plant with a supplemental 'smoothing' resource that enables the plant to maximize the efficiency of the available solar resource by maintaining boiler availability through short duration solar resource volatility. This function is anticipated and is referred to as 'boosting' mode, whereas, the gas boiler has not been intended to enable the plant to produce electricity without a primary solar resource available.

For the reasons stated above, the annual operating profile and capacity factor of PSEGs running on natural gas only would be zero MWh. Therefore, the capacity factor of the natural gas boilers would be zero in this operating mode.

Staff requested the following:

> 4. Are there any other supporting documents that would support PSEGS' statement that its expected quantities of natural gas are sufficient?

PSH Response: PSEGS does not have any additional supporting documents other than those emission spreadsheets already provided to the Commission.

SOLAR FLUX AND TEMPERATURE

Exhibit 3107[3], submitted by Intervener Center for Biological Diversity (CBD), includes some erroneous statements relative to solar flux and temperature. At Page 13/29 the report states:

> Ivanpah is the only facility in this study that produces solar flux, which is intense radiant energy focused by the mirror array on the power-generating tower. Objects that pass through this flux, including insects and birds, encounter extreme heat, although the extent of heating depends on many variables, including the duration of exposure and the precise location in the flux beam.

And at Page 20/29 the report states:

> Loss of relatively few flight feathers can, therefore, render a bird unable or poorly-able to fly. Birds encountering the flux field at Ivanpah may fall as far as 400 feet after feather singeing. Signs of impact trauma were often observed in birds with feather burns and are supportive of sudden loss of function
>
> Birds appear to be able to survive flux burns in the short term, as evidenced by the collection of several live birds with singed feathers.
>
> There was evidence of acute skin burns on the heads of some of the Grade 3 birds that were found dead. But interestingly, tissue burn effects could not be demonstrated in birds known to have survived short periods after being burned. Hyperthermia causing instantaneous death manifests as rapid burning of tissue, but when death occurs a day or later there will be signs of tissue loss, inflammation,

[3] National Fish and Wildlife Service Forensic Report entitled; Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis; Kagan et. al.

> proteinic exudate and/or cellular death leading to multisystemic organ failure. The beginnings of an inflammatory response to injury can be microscopically observed within one to a few hours after the insult and would have been expected in any of the four birds found alive. Signs of heat stroke or inhalation of hot air should have been observable a day or more after the incident. Rather, in these cases extensive feather burns on the body largely appeared to be limited to the tips of the feathers with the overlapping portions insulating the body as designed. This, in conjunction with what is likely only a few seconds or less spent in the flux, suggests that skin or internal organ damage from exposure to high temperatures in solar flux may not be a major cause of the observed mortality.
>
> Ocular damage following light exposure was also considered but could not be demonstrated in the submitted birds. In the four birds that initially survived, there were no signs of retinal damage, inflammation or other ocular trauma. Given the small sample size, this does not preclude sight impairment as a possible sequela but clinical monitoring of survivors would be needed to draw more definitive conclusions.

PSH Response: The absence of signs of heatstroke or inhalation of hot air is explained by the fact that solar flux does not have an appreciable effect on air temperature.Heat energy is created when radiant energy (light) passes through an object and is converted to thermal energy. Air over the solar field is not dense enough to be heated by reflected sunlight. At Page 23, the report states:

> Temperatures measured by the authors at the edge of the solar complex on the surface of a heliostat were approximately 200° Fahrenheit (~93° Celsius). Therefore, there is a gradient of temperature from the edge of the solar field to the tower that ranges from 200° to 900° Fahrenheit.

PSH Response: This assertion is erroneous as there is no temperature gradient. As reflected sunlight from solar field mirrors converge towards the SRSG at the top of the tower, solar flux concentration increases. This is consistent with the distribution of avian mortality near the tower associated with exposure to highly concentrated flux as reported by ISEGS in the monthly compliance reports. In order for a temperature gradient to exist there would need to be a mass to convert the radiant energy to thermal energy. As mentioned above, air is not dense enough to be heated by the reflected sunlight.