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Subject: Pending Solar Telemetry Requirements for PIRP EIRs

We are pleased to have had the opportunity to participate in the recent California Independent System Operator (CAISO) conference call regarding the Participating Intermittent Resource (PIRP) Solar Telemetry Requirements. Setting standards is needed and we support this effort. We also recognize it is very challenging and requires input from a variety of stakeholders. In this spirit, Cool Earth Solar would like to share its unique perspective as a company that is both developing an innovative solar resource measurement technology and planning to build small, utility-scale solar power plants (1-20 MW) based on our new concentrating photovoltaic (CPV) technology. Our appreciation goes to Jim Blatchford and the CAISO for their willingness to speak with us and hear our perspective.

The comments that follow are in response to Version 1.2 of the CAISO PIRP Solar Telemetry Requirements.

First, we would like to begin with some brief background on how solar telemetry systems relate to forecasting, their cost as a component of a solar power plant, the current state of affairs and what is on the horizon.

As of 2007 there were only 40 ground-based stations that measured solar irradiance scattered around the United States.[1] Based on the data from these stations, satellite images, and other weather data, models have been developed that can forecast and estimate the solar resource to within +/- 25% at any given time or +/- 16% when averaged out over a year.[2] This level of accuracy varies greatly from season to season and with the intensity of the sun (some solar telemetry devices become less accurate when less solar irradiance is present). To get more accurate data, more ground-based meteorological stations (met stations) are needed.

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[1] Stoffel, Tom and Ray George, National Renewable Energy Laboratory, *Solar Resource Data: NREL Parabolic Trough Technology Workshop*, March 8-9, 2007, page 17.

[2] Stoffel et al.

The primary barrier to setting up more ground-based met stations is cost. These stations can sell for anywhere from $13,000-$74,000 and generally require maintenance every one to three days, depending on the type of technology selected.[3] For an average 1 MW solar power plant built in the Central Valley and selling electricity for $0.12/kWh, one of these stations represents 5-30% of the plant's annual revenues. The annual maintenance costs represent an additional 3% of annual revenues. Since the CAISO is recommending that two of these stations be built within a 10-mile radius of the power plant, in cases where there are no other stations in the area, these costs will be doubled. This represents a major financial burden on the Eligible Intermittent Resource (EIR).

Is there a way the CAISO can get the highly accurate solar forecasts that it desires without saddling the EIR with the huge financial burden of building and maintaining these expensive met stations? We argue that this system can be made more efficient by 1) designing a standard that allows for the use of different types of solar forecasting devices, and 2) requiring only measurement equipment and data that is relevant to accurately forecasting solar output.

Table 2 sets the standard for what types of measurements are required. It specifies the data to report (e.g. GHI), the type of device to be used to measure it (e.g. Thermopile Pyranometer), and the level of precision required (e.g. +/- 3%). We recommend that:

1. Reword the "Precision" label as "Accuracy."
2. The new "Accuracy" requirements should be determined after consulting with numerous telemetry experts to make sure multiple types of equipment can meet the criteria.
3. The new "Accuracy" requirements should be more specific, giving ranges of accuracy for different levels of solar irradiance and basing these on the real measurement capabilities of existing telemetry equipment. As an example, Thermopile Pyranometers are known to be less accurate at lower levels of solar irradiance. Therefore a better accuracy requirement might be something like: +/- 25 W/m^2 at >800 W/m^2 and +/- 20 W/m^2 at <800 W/m^2.
4. The "Device Needed" column should be eliminated. There may be multiple devices existing or being conceived that could meet the new "Accuracy" requirements. Specifying a single device has the effect of both creating a virtual monopoly for the few companies that produce the devices specified, and stifling future innovation. By focusing on Accuracy of data rather than on devices, the market is allowed to develop the most cost efficient and highest performing solutions. If CAISO mandates particular device types then it runs the danger of “picking winners” to the exclusion of future solutions that would not be allowed to be used for the PIRP because they do not match the "device type" specified in Table 2.
5. The measurements specified in the "Element" column should be re-considered based on input from solar forecasting experts. Measurements such as "wind direction" have been demonstrated as an unnecessary factor in solar resource forecasting and should be removed from the list. Items such as "Back panel temperature" should be eliminated or modified to account for CPV systems, which do not use a panel system. The Global

[3] Wilcox, Steve and Tom Stoffel, National Renewable Energy Laboratory, *Solar Resource and Metereological Assessment Project (SOLRMAP) Solar and Meteorological Station Options: Configurations and Specifications,* July 1, 2009, page 3, 6, and 7.

Diffused measurement (GDIFF) should be able to be calculated from the other items measured so a separate device is not needed to measure it.

Another area of concern is the requirement that a project must have two met stations within a 10-mile radius no matter where in the state the project is located. First, the reality is that California's climate is not broken into discrete 10 mile-radius circles, but instead is broken into micro-climates whose size and shape is driven by the physical landscape. Some areas, such as the Central Valley, experience essentially the same solar resource over many more miles. A more accurate requirement for metering should make met station density dependent on a microclimatic map of California with an overlay of existing solar met stations.

Finally, we are concerned that requiring the same level of metering equipment of small (1 MW), medium (20 MW+) and large (100 MW) producers, will give an unfair cost advantage to the large producers who are able to spread met station costs out over a larger capital investment. An example: At $4/watt installed cost, a 1 MW plant would cost $4 million to install, whereas a 500 MW plant would cost $2 billion to install. Both plants could fit within a circle with a 10-mile radius, assuming 8 acres per MW (conservative). The cost of the two met stations as a percentage of total installed cost ranges from 0.6% to 3.7% for the 1 MW plant and 0.001% to 0.007% for the 500 MW plant. The met station cost as a ratio of the total project cost is a 500x greater burden for the 1 MW project than for the 500 MW project. This could mean the difference between going forward with and cancelling a project. These requirements, as currently conceived, have the effect of acting like a regressive tax, demanding more from those least capable of paying.

Economics aside, the impact to the grid of a 1 MW plant is much smaller than that of a 500 MW plant. The accuracy of forecasts and forecasting equipment should also be determined by the size of the plant.

In closing, we are asking for a system of requirements that is flexible enough to allow for new technologies to enter, appropriate for the size of the plant being built, and that the requirements of it are matched to the key parameters most forecast service providers need. Thank you for your time and consideration.

Sincerely,

Tony Chen
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