Powers Engineering

March 31, 2008

Mr. Ryan Pletka
Black & Veatch Corporation
2999 Oak Rd, Suite 490
Walnut Creek, CA 94597

Subject: Comments on RETI and the RETI Phase 1A Draft Report

Dear Ryan:

I have one comment on the composition of the Renewable Energy Transmission Initiative (RETI) stakeholders steering committee and a number of comments on the solar energy sections of the March 14, 2008 RETI Phase 1A Draft Report. These comments are provided in the following paragraphs.

General Comment on RETI Stakeholder Structure

The RETI stakeholders steering committee should be expanded to include one fixed-plate PV industry representative and one concentrating PV industry representative. This is especially true in light of SCE's announced 250 to 500 MW PV project for the Los Angeles area at an installed cost of $3,500/kW, and PG&E's announced decision to contract for power from a concentrating PV facility to be located in Tracy, California. Both fixed-plate PV and concentrating PV are in direct competition with other forms of concentrating solar electricity generation and need to be represented on the stakeholders steering committee. The lack of representation of these two aspects of the solar industry on the RETI stakeholders steering committee may open the RETI process to criticism by elected officials and the public that important segments of the solar energy industry are not officially represented in the RETI process.

Comments on B&V Draft RETI Phase 1A Draft Report Solar Energy Sections

Section 5.4.5 "Environmental Impacts" states: *Solar thermal projects are large installations that require significant amounts of land, anywhere from 7 to 10 acres per MW. Solar thermal systems do not have air emissions of criteria pollutants, such as carbon dioxide, sulfur dioxide, or particulates. Wet cooled plants will use significant amounts of water, but RETI has assumed that plants built in California will be dry cooled.*

It is unlikely that solar trough plants will be built using air-cooling. Solar trough plants produce relatively low pressure steam. Dramatic declines in power output are typical of low pressure steam systems with increasing steam turbine backpressure. Geothermal plants are also relatively low pressure systems. NREL cites a decline in the power output of air-cooled geothermal plants of more 50 percent on hot days.[1] State-of-the-art air-cooled condensers are designed with an "initial temperature difference – ITD" of approximately 35 ^{o}F. The large power loss that will occur with an air-cooled solar trough plant at an ambient temperature of 115 ^{o}F or 120 ^{o}F, representative of the Mojave on a hot summer day, assuming an air-cooled condenser designed with an ITD of 35 ^{o}F, would effectively negate the primary selling point of the solar trough plant – that it provides reliable peaking power on hot summer days. Designing the air-cooled condenser with an ITD of 35 ^{o}F could also add up to $100 million in 2008 dollars to the cost of a 200 MW solar trough plant.

In a September 2007 renewable energy assessment for the state of Arizona, B&V assumed all solar trough projects to be built in Arizona will be wet-cooled.[2] This is a reasonable assumption, given the degradation in performance that will occur with air-cooled plants at peak ambient temperatures of 115 ^{o}F or 120 ^{o}F in Arizona deserts. Southern California deserts experience the same climate profile on hot summer days. Wet-cooled solar trough plants consume water at a rate three times greater than wet-cooled combined cycle plants on a "water consumed per MWh" basis.[3]

B&V needs to include the following elements in the next iteration of the RETI report relative to air-cooled solar trough plants:

- Compare the performance of a wet-cooled and dry-cooled solar trough plant at an ambient temperature of 115 ^{o}F. Assume the air-cooled condenser has an ITD of 35 ^{o}F.
- Estimate the capital cost of a 35 ^{o}F ITD air-cooled condenser for a 200 MW solar trough plant and its impact on the overall $/kW cost of the plant.
- Estimate the parasitic power consumption of the air-cooled condenser fans at an ambient temperature of 115 ^{o}F.
- State whether the 250 MW solar trough plant announced by SCE on March 27, 2008 will be wet-cooled or dry cooled.[4]
- Describe the source of water that will be used if the SCE solar trough plant will be wet-cooled.

---

[1] C. Kutscher et al – NREL, *Hybrid Wet/Dry Cooling for Power Plants*, 2006 Parabolic Trough Technology Workshop, February 14, 2006, Incline Village, NV. Online at: http://www.nrel.gov/csp/troughnet/pdfs/40026.pdf
[2] Black & Veatch, *Arizona Renewable Energy Assessment*, September 21, 2007, Table 5-10, p. 5-25. Average water consumption assumed for solar trough plants is approximately 8,500 acre-ft per year per 1,000 MW (assuming average of 1,700 acre-ft per year for 200 MW per Table 5-10).
[3] U.S. DOE – Energy Efficiency and Renewable Energy, *Cooling for Parabolic Trough Power Plants - Overview*, 2006 Parabolic Trough Technology Workshop, February 14, 2006, Incline Village, NV. Online at: http://www.nrel.gov/csp/troughnet/pdfs/40025.pdf
[4] Los Angeles Times, *Two big projects will amp up solar power in the Southland* , March 28, 2008. FPL Energy's proposed 250-megawatt plant, dubbed the Beacon Solar Energy Project, will be situated on about 2,000 acres in eastern Kern County.

- Examine whether it is reasonably foreseeable that the water source that will be used for the SCE solar trough plant could be used for additional solar trough plants in the Mojave Desert.
- If not, examine what additional water resources might reasonably be available that can be allocated for 30-40 years to supply water to future solar trough plants in the Mojave Desert.

On p. 5-23, B&V states the capital cost of a solar trough plant is $3,600 to $4,200/kW. This is presumably the cost of an air-cooled solar trough plant. However, it is reasonable to assume that utilizing a state-of-the-art air-cooled condenser on a 200 MW solar trough plant could add as much as $100 million, in 2008 dollars, to the cost of the solar trough plant relative to the wet cooled basecase based on my experience with the cost of air-cooled condensers. That is an incremental cost increase of $500/kW. The cost of a wet-cooled solar trough plant estimated by B&V in the September 2007 Arizona renewable energy assessment is $4,200/kW.[5] Therefore the basecase cost of a wet-cooled solar trough plant should be $4,200/kW, not a range of $3,600 to $4,200/kW that leaves the impression that $4,200/kW is the upper boundary. The $4,200/kW capital cost also needs to be adjusted upward by approximately $500/kW to reflect that fact that B&V is assuming that all solar trough plants will be air-cooled. This increases the capital cost of the solar trough plant to $4,700/kW. The O&M cost of the solar trough plant also has to be adjusted to reflect the parasitic load of an air-cooled condenser.

SCE is estimating a capital cost of 250 MW of fixed-plate PV at $3,500/kW.[6] B&V estimates a minimum capacity factor for PV of 0.20.[7] B&V assigns a capacity factor of 0.26 to 0.29 for solar trough.[8] This appears to be the capacity factor for a wet-cooled solar trough plant. For the sake of argument I will assume that an air-cooled solar trough plant loses 10 percent of its net output on an annual basis relative to the wet-cooled basecase. Therefore the adjusted capacity factor of the air-cooled case is (1.0 - 0.10)(0.26) to (1.0 - 0.10)(0.29), or 0.23 to 0.26. This would result in the air-cooled solar trough plant achieving an annual capacity factor 15 to 30 percent greater than a similarly sized PV plant.

The capital cost of the air-cooled solar trough plant is approximately 35 percent greater than PV alternative, $4,700/kW versus $3,500/kW, yet the net output may be only 15 to 30 percent greater. Also, the net output from the solar trough plant and the PV plant may in fact be similar during the afternoon peak on a hot summer day, due primarily to the performance degradation of

---

[5] Black & Veatch, *Arizona Renewable Energy Assessment*, September 21, 2007, Table 5-11, p. 5-29.
[6] Southern California Edison, *Application of Southern California Edison Company (U 338-E) for Authority to Implement and Recover in Rates the Cost of Its Proposed Solar Photovoltaic (PV) Program*, March 27, 2008, p. 13.
[7] Black & Veatch, *Renewable Energy Transmission Initiative Phase 1A – Draft Report*, March 14, 2008, Figure 5-9, p. 5-28.
[8] Ibid, Table 5-5, p. 5-23.

the solar trough plant caused by relying on air cooling at 115 ^{o}F ambient air temperature. Bottom line – An air-cooled solar trough plant may not be able to compete economically against other low water use solar alternatives. Therefore the issue of where the water will come from for potentially 1,000s of MW of solar trough plants must be addressed squarely in the RETI report.

Please feel free to call me at (619) 295-2072 or e-mail at bpowers@powersengineering.com if you have any questions about the comments in this letter.

Regards,

Bill Powers, P.E.

Powers Engineering
4452 Park Blvd., Suite 209
San Diego, CA 92116

tel: (619) 295-2072
fax: (619) 295-2073

cc: RETI stakeholders steering committee members
RETI coordinating committee members