Power Cycle and Balance of Plant

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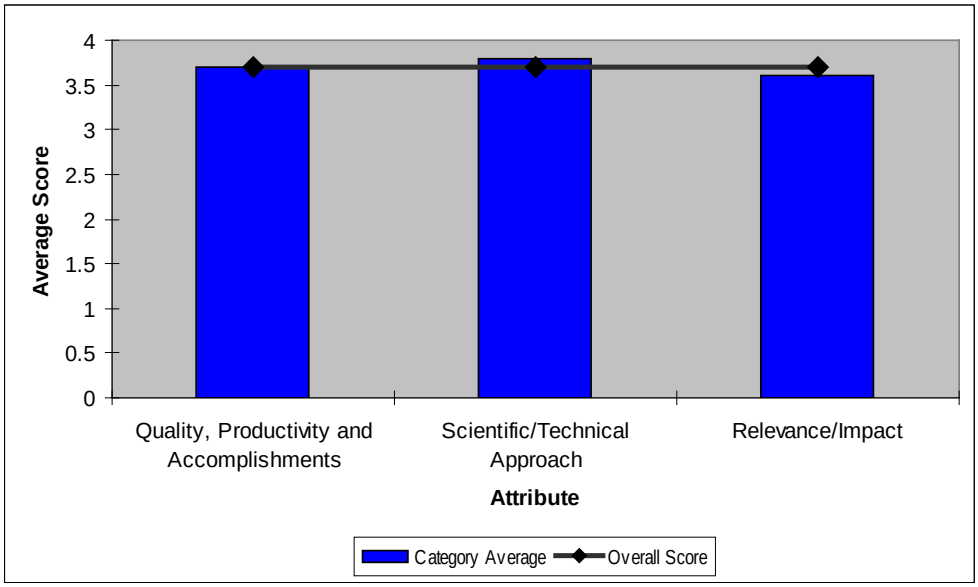

Review discusses NREL's work to address the barriers associated with deploying and operating solar power plants. Research addresses issues including optimization of plant design and costing, advanced heat rejection systems, detailed plant modeling and mitigation of O&M costs.

Quality, Productivity and Accomplishments (Average Rating 3.7)

Rating	Comments
4.0	The project achievements seem to be balanced with the allocated resources. The results obtained are of high interest to industry. The information provided indicates an effective management of the project.
4.0	Strong project team including NREL and expert consultants like Bruce Kelly (Nexant), and Dave Kearney. Major accomplishment in plant optimization and costing includes validation of the steam cycle correlations, development of heat exchanger sizing and cost models, and spreadsheet of power cycle component costs for use in the Solar Advisor Model (SAM). Report to Congress on cooling water requirement for CSP delivered ahead of schedule. The quick response to the Congressional request was a major accomplishment. Other accomplishments: • Presentation made at EPRI Advanced Cooling Workshop • Developed task ordering agreement with WorleyParsons and SOW for cooling analysis; will leverage prior studies • Laid groundwork for 3 tasks to be supported by enhanced funding Without a list of tasks that were planned to be accomplished during the reporting period, it is difficult to assess the extent to which the reported accomplishments met the expected results for the reporting period. It seems a lot of work still remains to be done in 2009.
3.0	An appropriate number of people, with well recognized technical credentials have been engaged in this project. The members of the team and collaborators clearly demonstrate their ability to contribute to the project. The work under way is producing an appropriate level of accomplishment relative to the costs incurred. The project team appears to be on schedule, but the project is clearly still in progress and not yet complete. Carry over funds – how much

carryover is available? Not a very clear response on the amount of carryover funds available, but assuming that this is significant? Unclear response as to why the amount of carry over, and how this has or has not impacted scope. Not sure if there is simply not enough staffing to handle number of projects or some other issue.

3.8 Project staff has relevant background, such as heat transfer, solar collector and cooling analysis. The major focus of the Power Cycle and Balance of plant is to improve and optimize overall plant performance. EES model used to validate cycle. Issued report for congress Cooling system performance drops on hot days – On hot days, take some steam through water cooled condenser. 2% power penalty for 80% water reduction

Scientific/Technical Approach (Average Rating 3.6)

Rating	Comments
4.0	The technical approaches used in the execution of the different tasks are appropriate. They also seem well executed. The subcontractors used in the project seem very capable of carrying out their assigned tasks.
3.5	Noteworthy accomplishments: • Used recent engineering studies to quickly respond to Congressional request for study on CSP cooling water reduction • Employed highly experienced consultants • Focused work on improving SAM model to provide immediate benefit to CSP industry • Laid groundwork for 3 tasks to be supported by enhanced funding • Activities will be closely coordinated with CSP and financial industries and international experts
3.0	The project team applied an appropriate technical approach in pursuit of project objectives. The design and execution of the approach are good.
4.0	FY09 -Comparison of air cooled and water cooled condensers -Evaporative precooling of air -What is cost of cleaning mirrors? -Acceptance TEST PROCEDURES -Meets critical reduction of cooling water consumption in desert environment. -4800 planned MW

Relevance/Impact (Average Rating 3.8)

Rating	Comments
4.0	The goals and activities defined within this project are targeted to provide solutions to short and mid-term needs of the CSP industry. The development of accurate plant performance models is an urgent need, as it is the identification of ways to reduce water consumption in the plants.
4.0	Cooling water requirement in the desert regions of California, Arizona, and Nevada is a critical factor for CSP development. This study will have significant benefit for the CSP industry. • Economically reducing cooling water consumption is a critical need especially in desert environments • Power cycle and component cost modeling have improved SAM • O&M costs represent a cost reduction opportunity that is not currently being addressed and that will increase in importance as collector field costs decrease • Development of a detailed plant model will increase speed and accuracy of SAM • Acceptance test procedure identified as an important industry need to satisfy investor

requirements

3.0 Acceptance test procedure acceptable to financial institutions could be of significant value. Ability to demonstrate tradeoffs in performance vs. water consumption for hybrid cooling systems is of significant value, particularly as the number of CSP plants going into the desert southwest increases.

4.0 Hybrid air/water cooling can reduce water consumption by 80%, without adding major performance or cost penalties. The project will also help in providing component cost data for the SAM model. O&M Cost data compilation for the parabolic trough plants will help industry in identifying opportunities to reduce cost. Providing support to industry in resolving RD&D issues is justified in use of available resources.

Overall (Average Rating 3.7)

Rating Comments

4.0 The project addresses important short term needs of the CSP industry: It uses sound and effective technical approaches. The technical personnel and the rest of the resources allocated to the project execution are appropriate. The results obtained are of high interest to the CSP industry.

3.9 The results are very impressive and the findings of this project would be very useful for the CSP industry. It would be nice if some general recommendations are published for the industry. It was mentioned that different models such as GATE Cycle, Aspen, Transys were used. However, reference was made only to GATE Cycle. It would be helpful to show how the results of the different models compare. Looking far ahead in the future, we may expect tens of GWs of CSP in the desert areas of CA and AZ. When that happens, even hybrid cooling may not be possible due to lack of water and dry cooling may be the only option. Keeping that in mind, more focus should be given to dry cooling.

3.0 $174k

750degree F input temp coming out of parabolic trough
Worley Parsons subcontractor
Plant optimization and costing
Advanced heat rejection system
Solar Advisor Model – SAM
GateCycle code to validate steam cycle correlations used in SAM EES
EES extensive use , needed to validate
80% reduction in water user
8% penalty for dry cool plant relative to cost of electricity
Hybrid air/water cooling systems
Claim 80% reduction in water use, with 2% power penalty

Focusing a fair amount of development on the SAM model – how is the SAM model being disseminated for use by industry and research collaborators? In particular, are the other DOE researchers and labs using SAM internally to provide an apples to apples comparison of cost benefit? If water consumption is reduced by 80% with only a 2% power penalty, is that an approach that you recommend for all future installations?

FY09 plan forward.
What does it look like on the hottest day of the year?
Models include Gatecycle, aspen, ipsepro, prosim, trnsys, ees

4.0 The work performed will increase system efficiency, and reduce system cost The dry cooling analysis is of very high value.