U.S. House of Representatives

COMMITTIE ON SCIENCE AND TECHNOLOGY

Subcommittee on Energy and Environment

"Technology Research and Development Efforts Related to the Energy and Water Linkage"

Testimony of Terry Murphy, President and Founder of SolarReserve: July 9th, 2009

Good Morning Chairman Baird and members of the Committee.

Thank you for this opportunity to appear before you this morning to discuss the linkage between Energy and Water. My name is Terry Murphy and I'm the President and Founder of SolarReserve.

I co-founded SolarReserve, after a twenty-seven year career at Rocketdyne, where I was the Director of Advanced Programs. My executive responsibilities at Rocketdyne covered a wide range of advanced power systems for both space and terrestrial applications. My business unit generated over 40 patents which leveraged aerospace technologies into clean and renewable terrestrial energy projects, so I appreciate the opportunity to offer my perspective on water usage in the generation of electricity.

Power-plant cooling systems currently account for roughly one-third of our freshwater withdraws. This is a particular problem in the Southwest, where there is already a scarcity of water resources and where solar thermal power plants are expected to flourish. Solar based electricity will be a key enabler in achieving our renewable energy goals, but water is also a key ingredient for electrical power generation and must be allocated in a total systems management approach.

Concentrated Solar Power (CSP) plants capture the sun's thermal energy by focusing mirrors onto thermal receivers and then transforming that energy into steam, which in turn drives conventional steam turbines. Photovoltaic (PV) solar is more easily deployed and uses minimal water, but intermittent cloud cover can cause PV to drop off in milliseconds; and what's worse, turn right back on. This rapid and unpredictable intermittent generation profile isn't an overwhelming issue in distributed systems, but this intermittency will introduce problems with grid stability and reliability if over-deployed at utility scale. CSP, on the other hand, has the inherent thermal inertia to ride through these instantaneous transients and the steam turbine commonality with existing rolling stock makes it ideally suited for large scale utility deployment.

The SolarReserve molten salt technology takes CSP to the next level and allows electricity to be generated on demand and controlled like a combined-cycle power generator. The molten salt power towers can be operated like a load-following power plant; they are highly predictable, have zero price volatility, zero fuel costs, and can provide reasonably-priced renewable electricity for generations to come.

The molten salt power tower technology was thoroughly validated by the Department of Energy at the Solar Two pilot plant in Barstow, California and the critical components are designed, built and guaranteed by Pratt & Whitney, a United Technologies Company.

All conventional steam turbine power plants can be “dry” cooled, but “wet” cooling offers significant advantages over dry cooling in both cost and performance. Dry cooling can reduce water consumption by 90%, but generally means added capital cost, increased auxiliary power and reduced steam turbine performance. Air cooled system performance is inversely proportional to need. They exhibit the biggest performance penalty on the hottest days, when solar energy production could be at its best and demand is highest. These parasitic losses begin to show at temperatures over 85°F and 30% performance degradation is expected when ambient temperatures exceed 110°F, not an uncommon occurrence in the hot deserts of the American Southwest. Air cooled systems have reduced output when customer demand is at its highest and when CSP plants could have produced their maximum output if they had been wet cooled; so we need to be very cautious on our approach to water allocation on CSP plants.

Hybrid cooling; a combination of “wet” and “dry” may be the best alternative for reducing power plant water consumption, but these systems are also the most complex and expensive. Hybrid systems operate without water when the outside ambient air temperature remains below a specified level and they only use water when the outside temperature begins to impact energy production. This dual operational capability would significantly reduce overall power plant water consumption, while maintaining the maximum power output during the hot summer afternoons. The SolarReserve molten salt system brings another interesting twist to this issue, because the system has decoupled the power generation from the heat collection process. Molten salt power towers can store the sun’s thermal energy until the ambient temperature falls below the minimum threshold and then make power very effectively on just a dry cooled system, but that scenario does not address the energy demand, so the paradox remains. This committee should consider and institute appropriate public policy, combined with proper economic incentives, to realize the water savings opportunities associated with hybrid cooling technologies while simultaneously ensuring the successful launch of the promising CSP renewable energy projects into the competitive marketplace

From a technology roadmap perspective, the key to continued water reduction in power plants is to increase turbine inlet temperatures. Closed-Loop Brayton systems have received sporadic DOE funding over the years and although originally contemplated for the nuclear power industry, they share a very promising CSP application. This technology, coupled with increasing the operating temperatures of the molten salt systems and working on the incorporation of advanced cooling mechanisms would replace the conventional steam turbine, increase plant efficiency, potentially lower recurring costs and because of the higher temperatures, be more resilient to the ambient air exit conditions.

Perhaps we should consider replicating the “FutureGen” Coal power plant concept for Concentrated Solar Power. We have the technology in-hand to build the “Ideal Power Plant”. A full scale national test bed could produce 100% renewable energy while simultaneously commercially demonstrating these advanced technologies in cooling and turbine operations.

Concentrate Solar Power can’t solve all of our energy problems, but they do represent the best utility scale renewable energy system for the American Southwest. Molten salt CSP systems can run large steam turbines and can operate on demand. They are perfectly suited to replace the aging coal-fired power plants that are currently operating in the Southwest and they could be designed to use considerably less water than these existing systems. A typical CSP system would provide 500,000,000 kW-hr per year of clean, emission free, renewable energy and would abate over 500,000 tons of CO_2 annually when compared to a coal fired power plant. Many facilities are ready to begin construction in 2010 and would typically employ nearly 500 people during the two year construction period, followed by an operational staff of 50 permanent positions.

I look forward to answering your questions this morning and hope that our brief exchange of ideas, along with my written testimony will provide you with a more comprehensive analysis and awareness of water usage in power plants and the true potential of these water saving technologies.