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# DOE Solar Energy Technologies Program Peer Review

**Technical Track: CSP**

**Project Name: Power Cycle and Balance-of-Plant**

**Principal Investigator: Chuck Kutscher**

**Denver, Colorado**

**March 9-10, 2009**

This presentation does not contain any proprietary or confidential information.



- Address barriers associated with deployment and operation of the solar power plant

FY08 Funding: \$174K



- Jennifer Crawford – M.S. graduate student, mechanical engineer
- Allison Gray – UNLV Solar Research Center
- Dr. Chuck Kutscher – heat transfer, solar collectors (ASES 2006 Abbot Award, 2007 NREL Chairman's Award, 2008 Governor's Renewable Energy Individual Award)
- Dr. Craig Turchi – chemical engineer
- Mike Wagner – new Wisconsin M.S. grad, modeling

## Consultants/Subcontractors

- Bruce Kelly – power plant design expert, formerly with Nexant
- Dr. Dave Kearney – industry expert, acceptance testing
- Mark Lausten, Sentech – cooling analysis
- WorleyParsons – cooling analysis



## **FY08**

- Plant optimization and costing
- Advanced heat rejection systems

## **FY09 (Enhanced Funding)**

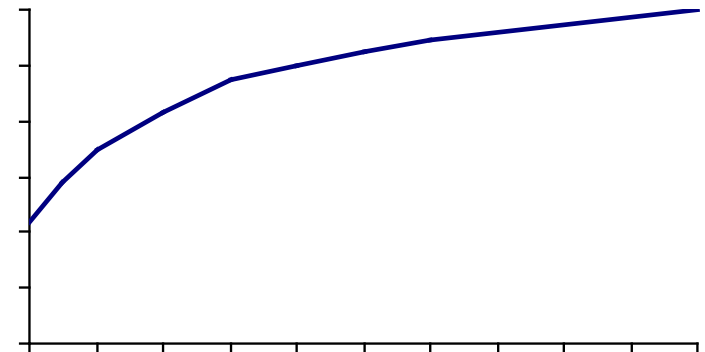
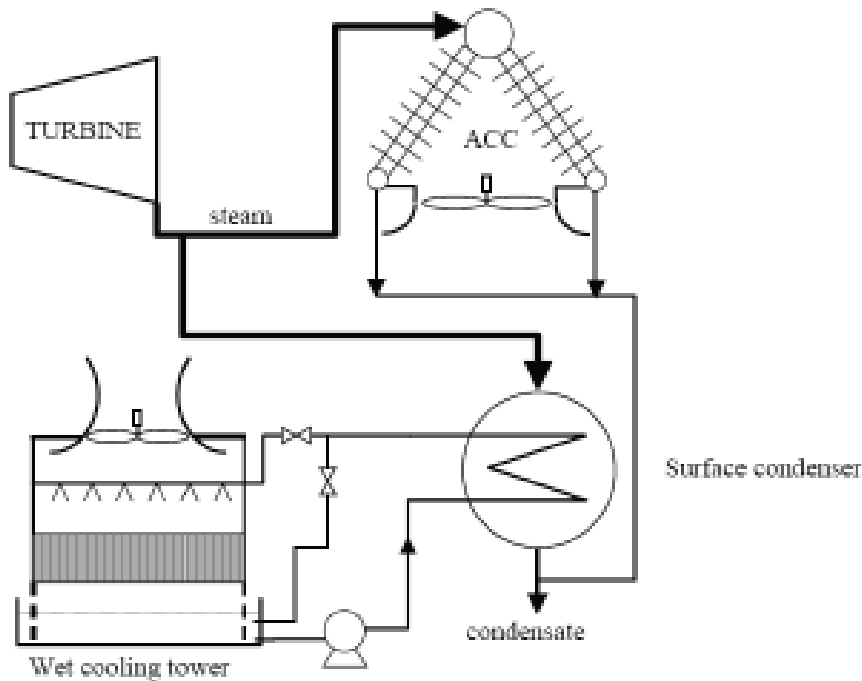
- O&M costs
- Detailed plant modeling
- Solar acceptance test standard



- Nexant used GateCycle to validate the steam cycle correlations used in Solar Advisor Model (SAM)
- Developed heat exchanger sizing and cost models for SAM
- Developed spreadsheet of power cycle component costs developed for use in SAM



- Hybrid air/water cooling systems can reduce water use 80% with modest performance and cost penalties





## Results:

- Study for Congress delivered ahead of schedule
- Presentation made at EPRI Advanced Cooling Workshop
- Developed task ordering agreement with WorleyParsons and SOW for cooling analysis; will leverage prior studies

**Concentrating Solar Power Commercial  
Application Study:  
Reducing Water Consumption of  
Concentrating Solar Power Electricity Generation**

**Report to Congress**

**U.S. Department of Energy**

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# FY09 Activities



## Objective:

- Determine the most economic means to significantly reduce cooling water

## Approach:

- Develop model to compare economics of air-cooled, water-cooled & hybrid-cooled trough power plants as functions of:
  - Location (Nevada Test Site, southwest New Mexico, San Luis Valley)
  - Water cost
  - Sizes of air-cooled and water-cooled units





## Objective:

- Collect O&M costs of existing parabolic trough plants and identify opportunities for cost reduction

## Approach:

- Work with industry to identify means for reducing costs
- Develop applied R&D tasks to address needs if appropriate



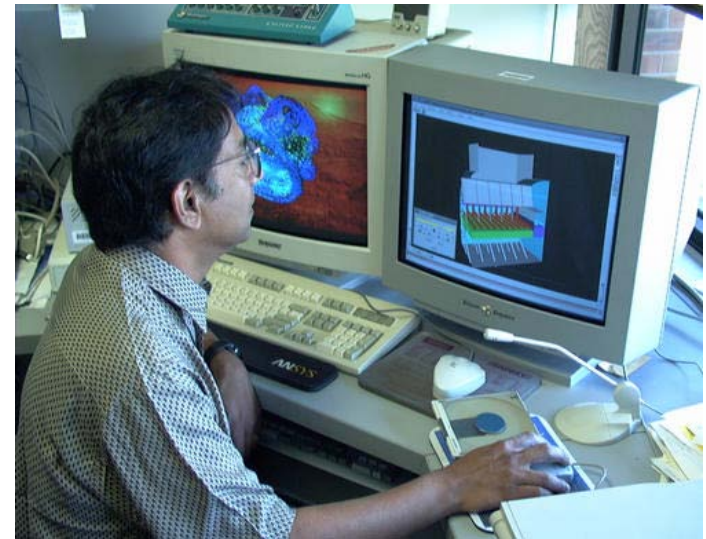


## Objective:

- Develop a detailed computer model containing both the collector field and the power cycle

## Approach:

- Compare different models: GateCycle, Aspen, IPSEpro, Prosim, TRNSYS, EES
- Develop combined model
- Utilize model to improve SAM





## Objective:

- Develop an acceptance test procedure for the collector field that will be acceptable to financial institutions

## Approach:

- Team of Kearney & Associates and WorleyParsons:
  - Conduct background/literature search
  - Participate in meeting with DLR
  - Identify recommended procedure
  - Obtain international and industry review



- Used recent engineering studies to quickly respond to Congressional request for study on CSP cooling water reduction
- Employed highly experienced consultants (Nexant in FY08, WorleyParsons in FY09)
- 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



- Strong team of industry and modeling experts
- Milestones for funded cooling study met ahead of schedule; developed subcontract that will leverage previous studies



- “Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar Power Electricity Generation,” Report to Congress, U.S. Department of Energy (M. Lausten and C. Kutscher)
- “Validation of Power Cycle Models in Solar Advisor,” Nexant, Inc., April 2008
- “Parabolic Trough Power Plant and Heat Exchanger Sizing and Cost Models for Solar Advisor Model,” Nexant, Inc., April 2008
- “Solar Advisor Model Review and Recommendations,” Nexant, Inc., April 2008



- 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

