



U.S. Department of Energy
**Energy Efficiency
and Renewable Energy**

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APS 1-MWe Parabolic Trough Thermocline Storage Design and Modeling

Doug Brosseau, Sandia National Laboratories

**Trough Workshop
February 13-14, 2006**





- **New 1-MWe parabolic trough plant; organic Rankine cycle**
- **Arizona Public Service (owner) and Solargenix partnership**
- **SunLab collaboration**
- **Near Red Rock, AZ**
- **Small but mighty!!**





Primary Objective

- **Produce power to satisfy AZ Environmental Portfolio Standard**

Additional Objectives

- **Evaluate cost and performance against other APS solar technologies**
- **Develop an understanding of trough operations and maintenance**
- **Understand latest technological advances in solar troughs**
- **Gain familiarity with ORC power systems for other renewable projects**



Overall Project Status

- **All construction items complete!!**
- **Startup activities underway.**

Solar field by Solargenix

OEC power block by Ormat





- **Design Reviews in FY04 (Price, Brosseau, others)**
- **Preliminary thermal storage design and cost estimates in FY04 and FY05 (Kelly, SunLab reviewers)**
- **Plant modeling (TRNSYS) without, with, storage (Kolb)**
- **O&M database development (Moore, Kolb, Brosseau)**
- **Alignment tools and support (Diver, Moss, Wendelin)**
- **Future startup, operational performance monitoring support and evaluation**
- **Ultimate: install thermal storage system, expanded solar!!**



- **Assess cost and performance of small-scale trough plant**
- **Evaluate first commercial deployment of Solargenix concentrator system**
- **Evaluate the integration of modern ORC technology**
- **Demonstrate unattended operation of this commercial plant**
- **Eventually, demonstrate cost, performance, and operating characteristics of a thermocline-based direct thermal energy storage system**



- **NREL contract with Bruce Kelly, Nexant, FY04**
- **Project Plan (phased approach for implementation)**
- **Preliminary design iterations Summer 2004**
- **“Final” preliminary design early FY05**
- **Cost estimates (Nexant, Brosseau)**
- **Full APS/SunLab review November 2004**
- **No significant DOE funding, or APS cost-share, to pursue TES development in FY05, or as yet, in FY06.**
- **But, there is increasing interest...**



- **Design, install and test thermocline-based thermal storage.**
- **Commercial demonstration of the thermocline concept.**
- **Gain experience with performance, cost, operability, and maintenance issues.**
- **TRNSYS modeling of plant without, and with, TES. Use performance data to validate models.**



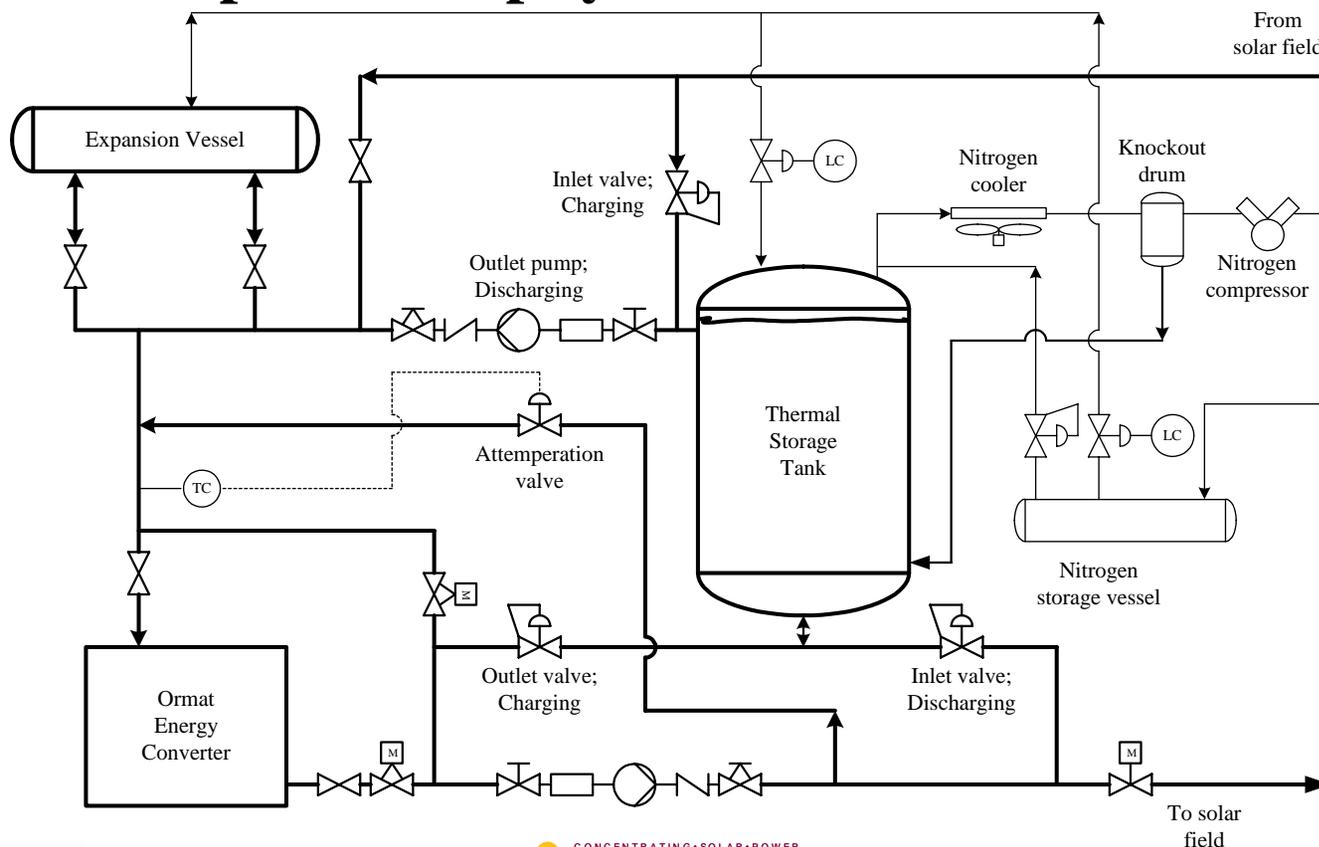
- **Develop design, including costs and specifications**
- **Integrate with existing plant design and operations**
- **Optimize storage utilization within allowable temperatures**
- **Design to test interactions between thermal storage system, solar field, and organic Rankine cycle power block.**



Take lessons learned to next phases of modeling and deployment!!



- **Done**: design, cost estimates, supporting TRNSYS models.
- **Cost share partnerships yet to be determined.**





- **Re-visit, revise, Project Plan and schedule for FY06, FY07.**
- **Secure partnerships and cost-shared funding.**
- **Finalize design, estimates, and equipment specifications.**
- **Obtain plant performance data, validate models.**
- **Develop detailed implementation plan for FY07 for procurement, construction, startup, and test & evaluation.**
- **Make it happen!!**

