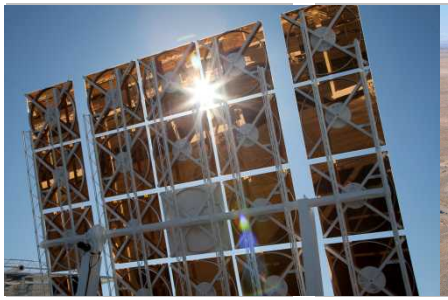
SERIIUS CSP-1: High-Temperature, Pressurized CO2 Receiver

Clifford K. Ho
Sandia National Laboratories
Concentrating Solar Technologies Dept.
Albuquerque, New Mexico
ckho@sandia.gov, (505) 844-2384

SAND2013-6904P

Exceptional service in the national interest

Sandia National Laboratories



U.S. DEPARTMENT OF ENERGY

NNSA

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Objectives

- Design, optimize, fabricate, and test suitable cavity receivers that can be used to provide heat to a high-temperature air/CO2 Brayton cycle
- Both direct and indirect methods of heating the air or CO2 will be considered

Two Tasks in CSP-1

- Task 1: Receiver Modeling, Engineering Design and Prototyping
  - P. Dutta, IISc-Bangalore
  - S. Kedare, A. Paranjape, Clique
  - C. Ho, Sandia National Labs
  - S. Bandopadhyay, S. Singh, IIT-Bombay
- Task 2: Supercritical CO_2 Test Loop Testing, Validation, and Optimization
  - P. Dutta, IISc-Bangalore
  - S. Kedare, A. Paranjape, Clique
  - T. Conboy, Sandia National Labs
  - S. Bandopadhyay, S. Singh, IIT-Bombay

Milestones

- Project Milestones:
  - C1: Receiver concept development and exploration of preliminary designs (6 months)
  - C2: CFD modeling and optimized design (18 months)
  - C3: High pressure CO2 test loop (24 months)
  - C4: Detailed design and prototyping (36 months)
  - C5: Testing and design refinement (60 months)

Schedule

			Year 1				Year 2				Year 3				Year 4				Year 5			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1 : Exploation and Conceptual protype design		Particpants																				
Subtasks	1.1 Initial Planning/Specification meeting	IISc, Clique, IITB, SNL																				
	1.2 Exploarion of Receiver designs, and Conceptualization	IISc																				
	1.3 CFD Modeling and simulation of concept designs	SNL, IISc, IITB																				
	1.4 Desgin Review based on CFD modeling	SNL, IITB, IISc																				
	1.5 Evaluation, Feasibilty for Prototyping and Manufacturability	Clique, IITB																				
	1.6 Detailed Modeling and Development of receiver testing tools and procedures	IITB, SNL, IISc																				
	1.7 CAD modeling and tooling design for 1st gen protype receiver	Clique																				
	1.8 Manufacturing and preliminary lab testing of the prototype 1st gen receiver	Clique, IITB, IISc																				
	1.9 Desgin review and modification based on preliminary field trials	Clique, IITB, SNL, IISc																				
	2.0 Publication of field testing and CFD modeling data	Clique, IITB, SNL, IISc																				
Task 2 : Development of CO2 Test Loop																						
Subtasks	2.1 Capacity evaluation and sizing for the CO2 test loop, Support to IISc for developing the test loop	IISc, SNL																				
	2.2 Component and CAD piping layout of the CO2 test loop	IISc																				
	2.2 Component sizing, piping layout evaluation using modeling tools	IISc, SNL																				
	2.3 Desgin of high temperature, high pressure heat source system, component procurement such as heat excangers, throttle valves, valves, instrumentation, safety equipment and fabrication of structural frame to house the test loop,	IISc																				
	2.4 Development of control system, safety, testing and operating procedures	IISc, SNL																				
	2.4 Preliminary trials, evaluation of test loop, control system, safety, training and handling	IISc																				
	2.5 Testing of copmponents developed for CO2 Bryaton cycle by other participating consortium members such as CO2 receivers, expanders, heat exchangers etc.	IISc SNL, Clique, IITB																				
	2.6 Documentation and publication of test results	IISc SNL, Clique, IITB																				

Summary

- Have held monthly teleconferences for CSP-1
- Task 1 and Task 2 milestones and activities are on schedule
  - Receiver designs have been developed and analyzed using FEA and CFD models
  - T. Conboy has provided consultation and advice regarding CO2 test loop