High-Temperature Thermal Array for Next Generation Solar Thermal Power Production

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PROJECT OBJECTIVES

Goal: Development of the key technical challenges to enable the fabrication of long (>300 ft) heat pipes to act as a dual purpose receiver/heat transfer system.

- *The High-Temperature Thermal Array maximize the thermodynamic efficiency of solar energy capture and transport to the power converter. This enhanced efficiency results in lower Levelized Cost of Electricity.*

Innovation: The key innovation is the ability of construct an extended heat pipe array no longer constrained by the orientation of the heat pipe system.

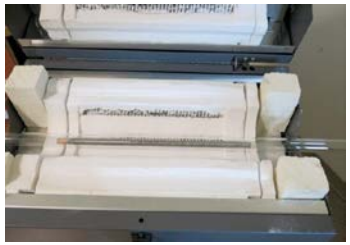
- *Traditional heat pipe systems are limited by the wicking height of the working fluid, the methodology utilized by LANL in this program enable the fabrication of vertical towers with extreme heights.*

APPROACH

- Technical approach is focused on advancing the thermal array from TRL 2 to 4 by overcoming a host of outstanding technical challenges focused on applicability to heat pipes to Concentrated Solar Power production. These include
  - Counter gravity physics
  - Counter gravity operation
  - Vertical start-up
  - Diurnal thermal cycling
- Technical effort also focus on cost metrics through development of new materials and compositions for new wick compositions. Development of high-porosity, high-permeability and low-pore-volume wicks directly impacts system capital costs.

KEY RESULTS AND OUTCOMES

- Parametric scaling models were developed validating the ability to fabricate 10-MW tower with a 30°C temperature drop.
- A mathematical counter gravity physics heat pipe model to simulate the hydrodynamic and thermal performance of heat pipes operating in any orientation with respect to gravity.
- Fabricate of a scaling heat pipe with header and artery system for validating countergravity and cold start has been initiated.



NEXT MILESTONES

Technical efforts will focus on

- Parametric scaling studies to validate the design of 100-MW tower.
- The counter-gravity physics model will be used to predict the performance of heat pipes with header and artery system.
- Experimental measurements validating counter-gravity physics model are performed.
- Scaling heat pipe and wicking test substrates will be fabricated.
- Composite wick substrates will be diffusion bonded and refractory metal deposited and sacrificial substrate will be removed.