Advanced Low-Cost Receivers for Parabolic Troughs

Norwich Technologies Inc.

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SunShot U.S. Department of Energy

NORWICH TECHNOLOGIES

PROJECT OBJECTIVES

Goal: This project is directed at developing a **novel receiver for parabolic-trough concentrating solar power** (CSP) systems that will dramatically improve performance at higher temperatures while substantially reducing acquisition and operation & maintenance costs.

Innovation: State-of-the-art vacuum receivers are limited by high capital cost, vacuum related failures of 1–5% of tubes per year[1-3], and declining performance at high temperatures (*T*). Our advanced receiver will address all of these major challenges and has the potential to **(1) dramatically reduce radiation losses at high *T*, (2) significantly increase reliability by eliminating vacuum loses, (3) decrease acquisition costs due to simpler structure and manufacture, and (4) operate at higher *T*.**

Milestones: 1.7: Finalized Prototype Design & Procurement, 2.1: Company and Marketing Development, Task 2.2: Build prototype; commence build of test apparatus

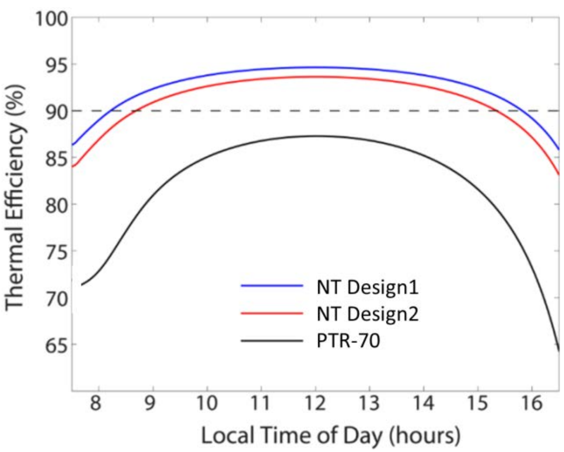
1. Burkholder F, Kutscher C. Heat Loss Testing of Schott's 2008 PTR70 Parabolic Trough Receiver (NREL/TP-550-45633): NREL, 2009.
2. Kutscher C, et al. Line-Focus Solar Power Plant Cost Reduction Plan: NREL Milestone Report, 2010.
3. Mahoney R. Trough Technology—Heat Collector Element (HCE) Solar Selective Absorbers (Trough Workshop, ASES 2000): Sandia National Laboratories, 2000.

APPROACH

•**Prototype Build** During the first two quarters of the project, we completed the rigorous overall design and analysis of our prototype receiver. During this third quarter we developed detailed fabrication level drawings for the receiver and the thermal and optical test facilities, fully specified the bill of materials, procured the relevant components, and are completing assembly. The build and assembly is being completed by Creare utilizing their state-of-the-art facility in combination with outside services for simpler technical components to reduce cost and increase speed.

•**Test Facilities Development** The development of the thermal and optical test facilities included specifying the test procedures. The thermal test procedures closely track the well documented NREL procedures. Given the inherent imprecision in the NREL optical procedures, our optical test procedures refine the NREL approach with a more robust approach. In the final quarter we will perform optical and thermal tests with the prototypes to refine and validate the thermal and optical models and to provide materials and performance operational feedback.

KEY RESULTS AND OUTCOMES



- **Thermal efficiency** for 2 candidate designs >90% at 650C (FOA Target)
- **Optical efficiency** for 3 candidate designs near or exceed SOA
- **Thermal cost**: \$75 to \$90kW_{th} << \$150/kW_{th} (FOA target)
- **Acquisition Cost:** Estimated materials and manufacturing more than 20% lower than SOA

NEXT MILESTONES

Task 3.1: Test Prototype

Testing of the prototype receiver will characterize performance in the three key areas of (1) optical efficiency, (2) thermal efficiency, and (3) material performance. In all instances, results will be compared with expected results from modeling. In cases where the results deviate substantially (>5%) from the model behavior, analysis will be performed to either improve the modeling or remedy the discrepancy. In this manner, we expect to produce not only a tested prototype, but validated modeling tools for the prototype receiver design. This will allow for optimization not only in the prototype design but in the predictive accuracy of the modeling tools.

Task 3.2: Project Management and Reporting:

Final report, including commercial prototype geometric and material design.