On-Sun Testing of a Novel High-Temperature Bladed Supercritical CO_2 (sCO_2) Receiver Design (CSP-1)

A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

A solar thermal receiver capable of heating sCO_2 has been constructed and tested on-sun. Preliminary tests using air show that the novel bladed receiver design absorbs more sunlight than conventional flat-panel receivers.

Significance and Impact:

The development of a solar receiver able to deliver sCO_2 at high pressures (~20 MPa) and temperatures (~700°C) is required to enable a high-efficiency (~50%) sCO_2 Brayton cycle. This advance will make CSP technologies more cost-competitive.

Research Details:

- A novel bladed receiver configuration intended to trap more incident sunlight was designed and constructed per *ASME Boiler and Pressure Vessel Code* (Fig. 1)
- On-sun testing using air was performed at the National Solar Thermal Test Facility at Sandia National Laboratories (Fig. 2)
- Results show that the thermal efficiency of the bladed receiver was ~5 percentage points higher than a flat panel for an outlet air temperature of over 400°C.

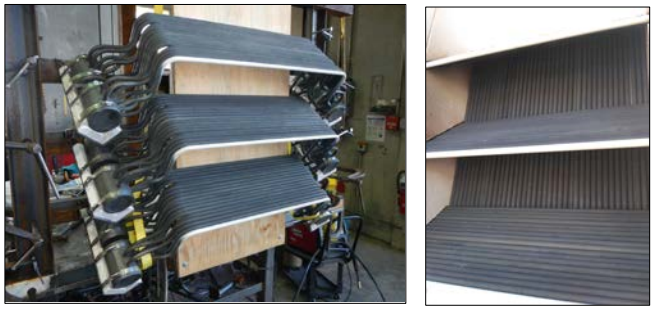

Fig. 1: Construction and testing of the novel bladed panel configuration.

Fig. 2: On-sun testing of the bladed receiver design at the National Solar Thermal Test Facility, Sandia National Laboratories, USA.

Publications:

- Ortega, J.D., J.M. Christian, and Ho, C.K., 2017, Design and testing of a novel bladed receiver, Proceedings of the ASME 2017 Power & Energy Conference & Exhibition, ES2017-3524, Charlotte, NC, June 26–30, 2017.
- Ortega, J., S. Khivsara, J. Christian, C. Ho, and P. Dutta, 2016, Coupled modeling of a directly heated tubular solar receiver for supercritical carbon dioxide Brayton cycle: Structural and creep-fatigue evaluation, *Applied Thermal Engineering* **109**, 970–978.

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