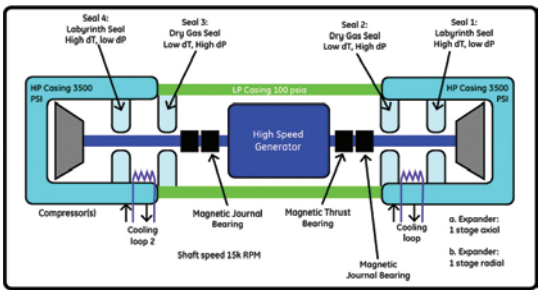
Supercritical Carbon Dioxide Turbo-Expander and Heat Exchangers

SOUTHWEST RESEARCH INSTITUTE	
PROGRAM:	SunShot CSP R&D 2012
TOPIC:	Advanced Power Cycles
LOCATION:	San Antonio, Texas
AWARD AMOUNT:	Up to $6.8 million
PROJECT TERM:	2012–2015



Conceptual layout of an integrated, high-efficiency supercritical CO_2 hot gas turbo-expander that is optimized for the highly transient solar power plant duty cycle profile. *Illustration from Southwest Research Institute*

MOTIVATION

Use of supercritical carbon dioxide (s-CO_2) in a closed-loop recompression Brayton cycle offers higher cycle efficiency when compared with supercritical or superheated steam cycles at temperatures relevant for concentrating solar power (CSP) applications. Supercritical carbon dioxide is particularly well-suited as a working fluid for use in power towers. A single-phase process using s-CO_2 as both heat transfer and thermal cycle fluid would simplify the power-block machinery and is compatible with sensible-heat thermal energy storage.

PROJECT DESCRIPTION

The research team is working to develop a megawatt-scale s-CO_2 hot-gas turbo-expander optimized for the highly transient solar power plant profile. The proposed CSP power cycle uses s-CO_2 as both the heat transfer fluid in the solar receiver and the working fluid in the power cycle. The team is also working to optimize novel printed circuit heat exchangers for s-CO_2 applications to drastically reduce their manufacturing costs.

IMPACT

The lower thermal mass and increased power density of the s-CO_2 power cycle enables the development of compact, high-efficiency power blocks that are compatible with sensible-heat thermal energy storage. Because they can also respond quickly to transient environmental changes and frequent start-up/shut-down operations, these smaller, integrated power blocks provide an ideal solution for modular tower-mounted CSP plants in the 5–10 MW range.

CONTACTS

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Partnering Organizations:
- General Electric Global Research Center
- Thar Energy
- Bechtel Marine

For more information, visit the project page at: www.solar.energy.gov/sunshot/csp_sunshotrnd_swri_exchangers.html.

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