High-Efficiency Receivers for Supercritical CO_2 Cycles

Brayton Energy, LLC

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PROJECT OBJECTIVES

Goal:

- High performance supercritical carbon dioxide (s-CO_2) Brayton-cycle engines are currently under development and promise to significantly reduce LCOE via high cycle efficiency.
- The proposed receiver uses s-CO_2 as the heat transfer fluid, enabling these highly efficient engines to be used in concentrated solar power (CSP) applications.

Innovation:

- A solar receiver adapted to the s-CO_2 recompression cycle represents a major advancement in technology over the state-of-the-art in CSP systems, and will contribute directly to the SunShot goal of 6¢/kW-hr.

Quarterly Milestones (in progress):

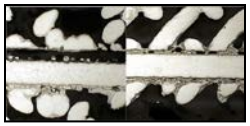
- Define an s-CO_2 Brayton Engine Cycle Model that can be used to specify receiver statepoints

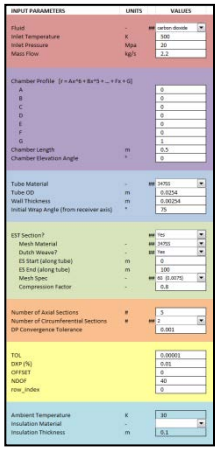
APPROACH

- Numerical Modeling is used to capture the highly nonlinear physical properties of s-CO_2 within the highly-effective enhanced heat transfer. region, where fluid temperature is changing rapidly
- Manufacturing Trials are used to demonstrate reliable methods for fabricating the enhanced heat transfer surfaces that will reside within the high-flux environment of the receiver
- Historical Data from a baseline installation location will be used to provide a year-long solar profile which feeds into the overall performance model to produce an annualized performance metric
- Subcomponents will undergo simulated operating conditions in test rigs to demonstrate their suitability and performance
- Ultimately a prototype receiver will be tested on sun in a power-tower application to demonstrate the full receiver system performance

KEY RESULTS AND OUTCOMES

- Significant progress in the development of the Extended Heat Transfer Absorber Surface Numerical Model. Input variables can be seen in the graphic to the right.
- Initial conversations and preliminary agreements made with s-CO_2 engine developers; developers to provide receiver inlet/outlet statepoints that will tie the receiver design to a real system.
- Preliminary extended heat transfer surface manufacturing techniques considered
- Initial extended-surface wire-mesh/plate bonding trials were conducted with promising results.





NEXT MILESTONES

- An s-CO2 Brayton Engine Cycle that will provide the baseline statepoints which will guide the design the receiver
  - Anticipated completion date: 15 December 2012
  - RISK: Receiver statepoints derived from an s-CO_2 Cycle Model should be forthcoming from an engine developer. Delays on the developer side are outside Brayton control
  - MITIGATION: In-house models and calculations may be used to produce representative statepoint values that may be updated when specific statepoints become available