CSP Tower Air Brayton Combustor

Southwest Research Institute, Solar Turbines, DLR

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PROJECT OBJECTIVES

Goal: The objective of the project is to increase the CSP tower air receiver and gas turbine temperature capabilities to 1,000°C by the development of a novel external gas turbine combustor. This will be achieved at a reduced scale with emphasis on effects of thermal cycling on hardware and while emitting extremely low emissions.

Innovation: The design will be the first external combustor for a full MW scale gas turbine integrated and optimized for CSP. This combustor will allow for a combustor inlet temperature that is 350°C higher for CSP Brayton cycles than the current state of-the-art, which is a critical step to achieve 50% cycle efficiency.

Milestones:

Subtask 1.1.1: Evaluate combustor concepts and layouts – *Completed*

Subtask 1.1.3: Down-select combustor concepts – *Completed*

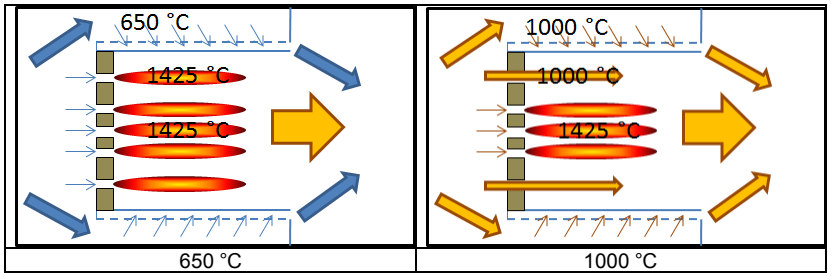
Milestone 1.1: Provide a rank-ordered list of the conceptual combustor designs with rationale for disqualification of other concepts – *Completed*

APPROACH

- During Phase I, the combustor and all its components (injector, liner, fuel management system) as well as the new combustion test facility will be fully designed and manufacturing/engineering drawings will be produced.
- CFD, FEA, heat transfer, and acoustic analysis of the major components will be conducted to verify and optimize the combustion performance and assure proper integration with the solar receiver.
- During Phase II all the test articles will be fabricated (combustor, liner, injector) and the test facility will be built and commissioned.
- Phase III will be dedicated to performance and endurance testing of the combustor.

KEY RESULTS AND OUTCOMES

- Several concepts for the combustor, injector, and liner were considered and a final selection for each was made.



- The selected design uses a micromixing injector, metallic double-walled liner with impingement cooling, single can combustor, and a regenerative-cooled casing.
- The conceptual design of the test facility was also finalized.

NEXT MILESTONES

- **Task 1.1.2**: Initiate the solar receiver to combustor integration work. Verify that concept is compatible with solar receivers – 1/31/2013
- **Task 1.2**: Complete definition of part load and transient operation requirements with Solar Turbines – 1/31/2013
- **Task 1.3.1**: Detailed CFD will be completed on the injector, combustion region, and liner cooling passages – 2/28/2013
- **Task 1.3.2**: Heat transfer analysis will be performed – 2/28/2013
- **Tasks 1.3.4 and 1.3.5:** Material and mechanical analysis will be performed to establish preliminary structural design of the injector and liner – 2/28/2013
- **Task 1.4:** Finalize facility functional requirements by completing all instrumentation and control system requirements. Begin the design phase by obtaining quotes and estimating lead time. Begin physical mapping of components, layout and construction schematic – 1/31/2013