ASCENT Project 068

Combustor Wall Cooling with Dirt Mitigation

The Pennsylvania State University

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Objective:

Dirt accumulation on the surfaces of gas turbine components severely diminish the performance of various cooling technologies. The objective of this study is to investigate new cooling designs that are insensitive to dirt accumulation effects.

Project Benefits:

The expected benefits from this study are:

- A double-wall cooling design for combustors that is insensitive to dirt accumulation
- Key geometric and flow parameters that scale the dirt accumulation
- Measured heat transfer coefficients on double-walls with and without dirt accumulation.

Research Approach:

The research approach for developing new cooling designs for the combustor liner is:

- Testing of double-wall cooling concepts at engine scale using a multi-phase flow that contains small dirt particles
- Downselecting the most promising double-wall concept that has the least dirt capture;
- Measure detailed heat transfer coefficients of the most promising design with and without dirt accumulation; and
- Scale the most promising design for integration into an annular configuration upstream of a test turbine.

Major Accomplishments (to date):

- Evaluated over 20 different designs using both slug as well as continuous dirt feeds
- Identified promising concepts including a pin arrangement that reduces the dirt capture efficiency by a 35% improvement
- Evaluated scaling parameters for the dirt capture that showed the importance of flow parameter

Future Work / Schedule:

- Continue testing more double-wall concepts to reduce the dirt capture
- Develop a new test facility to directly measure the heat transfer coefficients with and without dirt on the two walls of the double wall.

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