PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

INTERNAL COOLING IN LEADING AND TRAILING EDGE PASSAGES WITH ROTATION AND BUOYANCY

PRIMARY PARTNER

Louisiana State University

TOTAL ESTIMATED COST

$ 228,873

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems Research (AGTSR) program, Louisiana State University is investigating rotation effects on cooling of turbine blades. An experiment task first modifies an existing test facility. A rotating ribbed channel facility is modified to incorporate a two-pass test section with four alternate aspect ratios for the rectangular channels. A color camera and pressure transducers are mounted on the test section to acquire data. Liquid crystal heat transfer measurements and pressure measurements are then obtained for a range of Reynolds numbers, rotation numbers, and buoyancy parameters for all channel aspect ratios and channel orientations ranging from 0 to 180 degrees relative to the rotation axis. Figure 1 shows the instrumented test section. The computation task conducts DNS/LES and RANS computer simulations for model validation with published experimental data. Computer predicted flow fields for the test channels and measured heat transfer are then used to obtain a complete picture of the physical processes for the experimental cooling passages. Finally, RANS computer simulations are used to extend the parameter range of understanding for cooled rotating passages by investigating other aspect ratios of interest to gas turbine companies, triangular cross section passages, and an extended range of Reynolds numbers, rotation numbers, and buoyancy parameters pertinent to gas turbines.

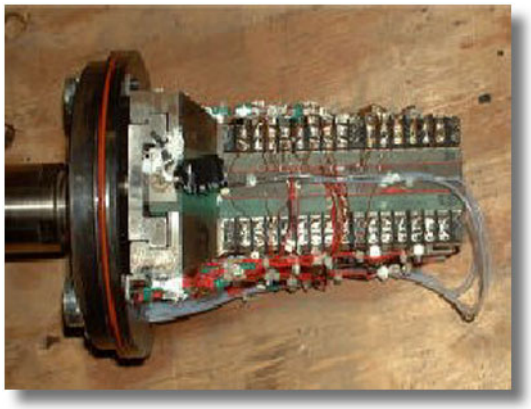

Figure 1. Instrumented test section

Internal Cooling in Leading and Trailing Edge Passages with Rotation and Buoyancy

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Duration

24 months

Goals

This project provides data and understanding of flow and heat transfer mechanisms in a rotating cooling channel for parameter ranges pertinent to gas turbine rotating blades.

Benefits

Data and evaluations from this project will increase the understanding of turbine engineers for design of rotor blade airfoil cooling.