PROJECT facts

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

High Efficiency Engines and Turbines

12/2002

TURBINE TIP CLEARANCE REGION DE-SENSITIZATION

PRIMARY PARTNER

Pennsylvania State University

TOTAL ESTIMATED COST

$ 427,247

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems (AGTSR) program, Penn State University (PSU) is evaluating methods to reduce aerodynamic inefficiencies associated with leakage flow through the gap between the tips of rotating turbine blades and adjacent stationary surfaces. The initial task identifies concepts and approaches with potential to minimize rotor tip leakage effects (desensitization approaches). A second task performs numerical analyses of candidate desensitization approaches. Another task obtains aerodynamic data and evaluates performance in an axial flow turbine rig for promising desensitization approaches.

Designs using side extensions at the tips of both the concave and convex side of rotor blades have been evaluated to date in the project. The experiments have shown that convex side extensions are not effective but concave side tip extensions weaken the tip vortex and reduce tip pressure losses. The measurements showed that local efficiency gains from pressure side tip extensions (Illustrated in Figure 1) can be as high as 5 %. This results in a significant improvement in the overall performance of a turbine stage.

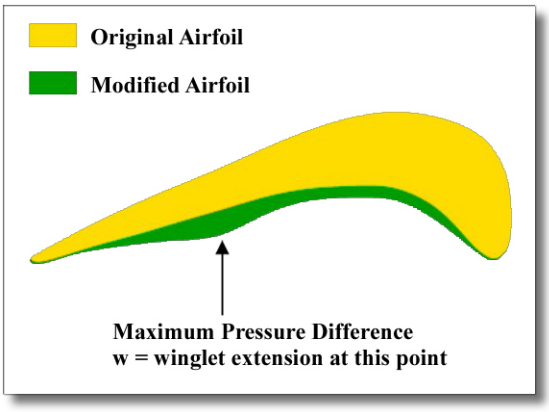

Figure 1. Pressure side tip extension

Turbine Tip Clearance Region De-Sensitization

CONTACT POINTS

Tom George
National Energy Technology Laboratory
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880
304-285-4825
tgeorg@netl.doe.gov

Richard Dennis
Product Manager,
High Efficiency Engines and Turbines
National Energy Technology Laboratory
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880
304-285-4515
richard.dennis@netl.doe.gov

Richard Wenglarz
South Carolina Institute for Energy Studies
386-2 College Ave.
Clemson, SC 29634
864-656-2267
rwnglrz@clemson.edu

Professor Cengiz Camci
Center for Gas Turbines and Power
Pennsylvania State University
223 Hammond Building
University Park, PA 16802
814-865-9871
C-Camci@psu.edu

Duration

24 months

Goals

Leakage of flows through the gaps between rotor tips and casings with associated tip vortices cause pressure losses and the aerodynamic inefficiencies in turbines. This project evaluates control of rotor tip leakage effects and resulting pressure losses.

Benefits

This project should identify promising turbine design methods to improve rotor aerodynamic efficiencies.