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INFORMATION

GAS TURBINE RESEARCH

Performance Analysis

The Gas Turbine Laboratory (GTL) of the NRC Institute for Aerospace Research (NRC Aerospace) offers integrated performance evaluation and R&D for aero and land-based propulsion systems. Highly qualified and experienced staff use comprehensive analysis and diagnostic tools to study and evaluate the aerothermodynamic performance, operability and condition of propulsion systems components. The objectives are:

- to develop and validate methods for predicting and measuring component performance, condition and operability, particularly contributing to diagnostics and prognostics systems
- to develop methods for improving the performance and reducing the weight of turbomachinery components.

The GTL management system has been registered to ISO 9001:2000

Both transient and steady-state performance applications are investigated for isolated components, engines in test cell installations and, more recently, while installed in aircraft. State-of the-art conventional and non-intrusive measurement techniques, complemented by computational fluid dynamics, are applied to research involving steady-state or time-dependent internal flows in turbomachinery components. Non-intrusive techniques such as thermal imaging are used to assess the operational environments of rotating and stationary aerothermodynamic and mechanical components.

Project areas

Within the Laboratory's performance analysis program, work is grouped in four domains covering research, development, and test and evaluation, with the following objectives:

Diagnostics, prognostics and health management

- To develop and validate analysis methods for assessing the health and remaining life of propulsion systems including cost-effectiveness models.

Performance testing

- To provide technology demonstration opportunities for R&D partners through specialized rigs, engines and propulsion systems.
- To develop and validate non-intrusive means to assess the condition of propulsion system components for maintenance and safety decisions.

Unsteady analysis

- To develop modeling methods for detecting and suppressing unsteady events in propulsion system components, such as compressor stall and surge.

Flow control

- To numerically investigate and experimentally validate techniques for improving the internal flow in components for performance enhancement and weight reduction.
- To develop high-bandwidth instrumentation for understanding the unsteady features of internal turbomachinery flows.

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In-flight performance estimation
- To develop models and test techniques for determining engine performance in-flight with minimal instrumentation.

Proven capabilities
NRC Aerospace expertise has attracted clients ranging from engine manufacturers and overhaul contractors to small and medium-size enterprises, universities, and Canadian government departments. Substantial savings in time and money also have resulted from novel approaches to engine operability, diagnostics, test cell calibration/ correlation, flow measuring techniques and cycle analysis.

Recent work includes:
- analysis, test and procedures for improved engine testing through quantitative stabilization criteria
- improvements in engine power assurance modeling and procedures
- statistical methods for fault detection in near real-time
- successful design of a test system for simulation of M0.44 operation of an engine-nacelle for icing tests
- prototype system for infrared image analysis in a test cell to detect fuel nozzle faults
- uncertainty analysis methods for correlating engine performance tests
- integrated analysis of aircraft-engine-propeller performance.

Facilities
The program and test and evaluation work for clients are integrated with extensive facilities and supported by comprehensive design, fabrication and operational capabilities. Projects and facilities are operated and developed following formal project management and quality management processes under ISO 9001:2000.

Details of these capabilities are provided in associated fact sheets, but an overview comprises:
- a calibrated gas turbine test cell referenced to internationally accepted standards
- three turboshaft test stands with low-speed dynamometers and a high-speed gearbox
- a large cross-section test cell for small and medium size turbofan engines
- a low-speed compressor/turbine cascade rig and probe calibration tunnel (in development)
- an engine flow simulator for inlet studies
- high-speed data system with integrated analysis support
- infrared cameras and digital image analysis system
- online spectroscopy system (in commissioning)
- traceable volumetric liquid flow calibrator
- access to compressor, exhauster and high pressure steam.

These core capabilities and facilities in aeropropulsion are supported and complemented by associated expertise and facilities in structural design and analysis, and in materials selection and evaluation. Specialists from across NRC Aerospace can be assembled to meet design or development challenges in combustion, internal flows, materials, structures, and calibration. NRC Aerospace also offers a turnkey R&D and test and evaluation capability with proven capabilities for on-site hardware modification and fabrication.

CONTACT:
Mr. Jeff Bird, Gas Turbine Laboratory
Tel: (613) 990-0652 Fax: (613) 957-3281
E mail: jeff.bird@nrc.gc.ca

Mr. Martin Trerice, Gas Turbine Laboratory
Tel: (613) 993-0142 Fax: (613) 990-7444
E mail: martin.trerice@nrc.gc.ca

Mr. Jeff Mackwood, Marketing and Contracts Office
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 990-0765 Fax: (613) 952-7214
E mail: jeff.mackwood@nrc.gc.ca

Or visit our Web site at: www.nrcaerospace.com

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