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NRC Aerospace
Institute for Aerospace Research

NRC-IAGT Collaborative Forum on Future Gas Turbine Challenges and Opportunities

National Research Council Canada | Conseil national de recherches Canada

Canada

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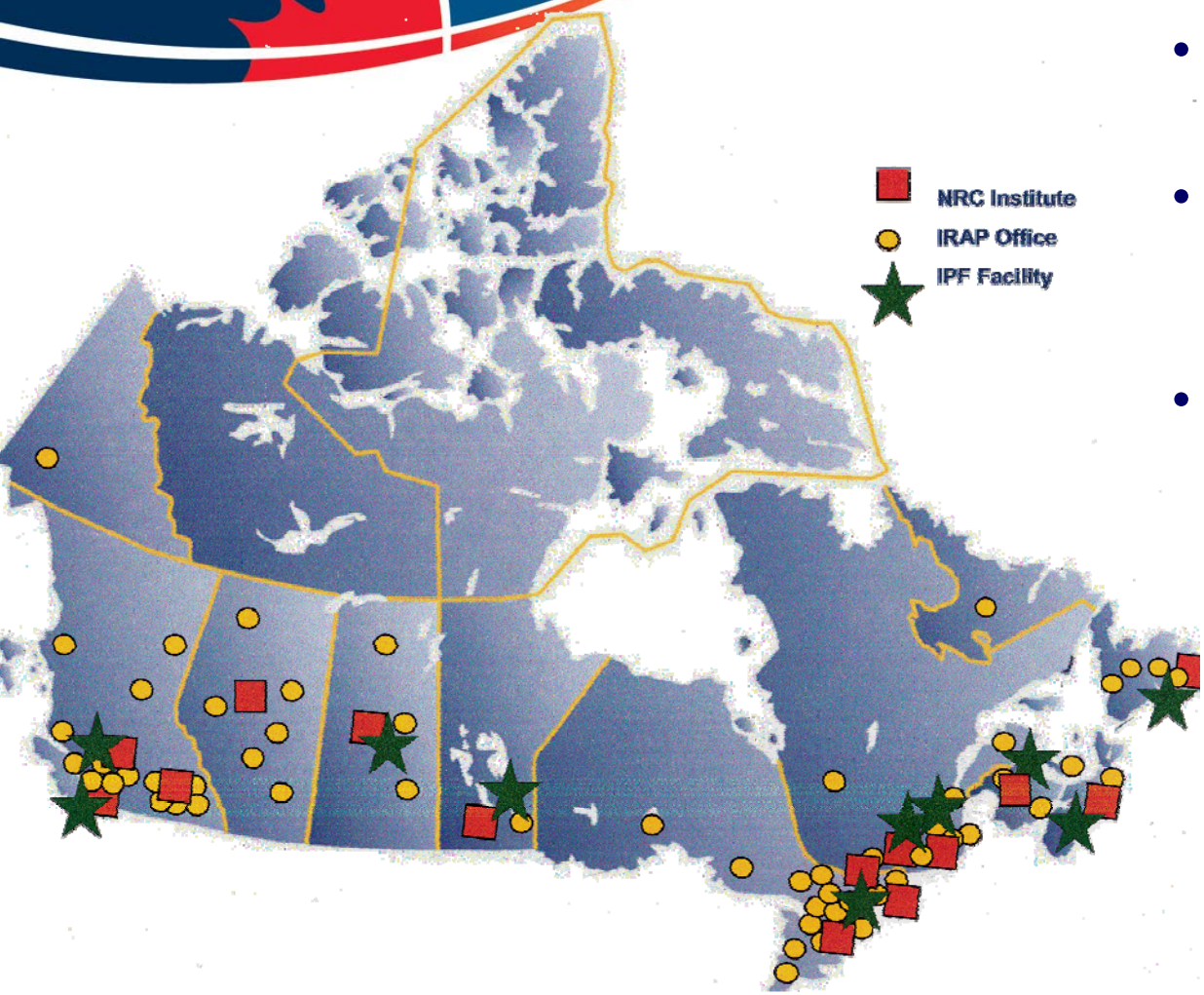
NRC: A National Institution



- Federal government agency
- Provides essential elements of national S&T infrastructure
- Labs and facilities across the country
  - 20 research institutes
  - Industrial Research Assistance Program or NRC-IRAP
  - Industrial Partnership Facilities
  - CISTI

Staff: Approx. 4,300 employees; 1,500 visiting / guest workers
Total expenditures 2005-06: **$835 M**
Total Income 2005-06: **$166 M**

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NRC will focus its program activities in four main areas

1 Key Industry Sectors

- Sectors that are important or will be important to the Canadian economy
- R&D and knowledge intensive sectors, where innovation plays a key role in their success
- Sectors in which NRC's innovation impact can make a significant positive contribution to Canada's economy

2 Regional / Community Innovation

- Community clustering initiatives and innovation activities that help build sustainable communities

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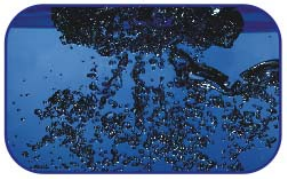
3 National Priorities



- Enduring issues that are critical to Canada's future:
  - Health & Wellness
  - **Sustainable Energy**
  - **Environment**

4 National Science & Innovation Initiatives

- Help industry manage risks as new products processes, and practices are developed
- Offer S&T information and intelligence to industry
- Offer R&D and innovation capacity-building support to SMEs
- Offer comprehensive commercialization support
- Develop and update national codes

Focusing our efforts will enable us to maximize our impact and permit us to concentrate our resources on areas of critical social and economic importance to Canada.

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9 Key Sectors: - Progress to date
- Future opportunities
- Common issues

Aerospace

Agriculture

Automotive

Manufacturing

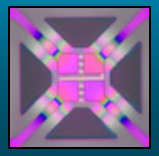
BioPharma

Chemical Industry

Construction

ICT

Medical Devices



"To contribute to the global competitiveness of Canadian industry in key sectors"

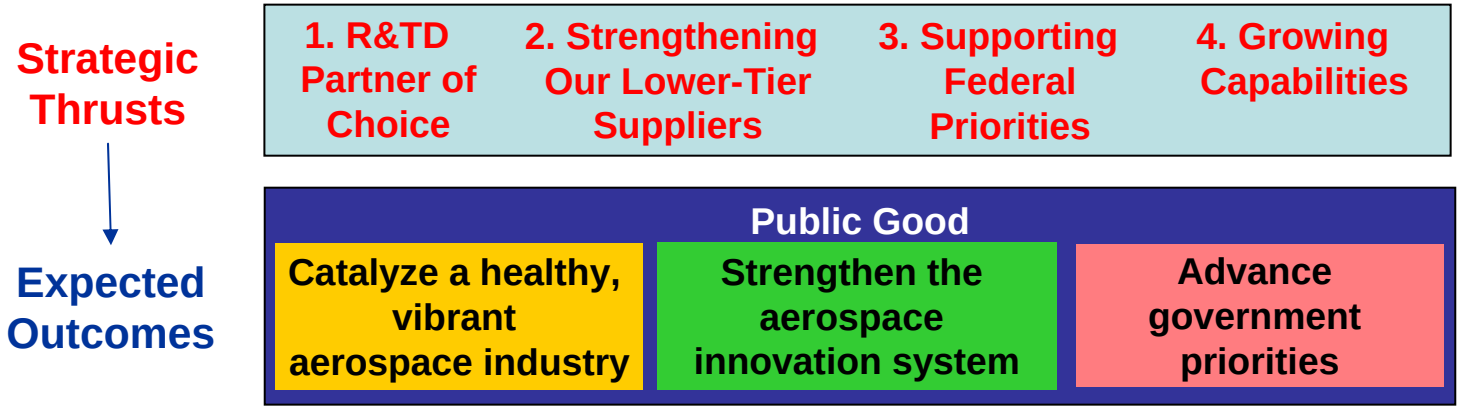
Criteria

- **Important to the Canadian economy**
- **Research essential for their success**
- **Sectors where NRC can make a significant contribution**

Vision & Goals IAR

Our vision:

To be the premier organization developing and applying leading technologies, in partnership with industry, academia and OGDs, for the benefit of Canadian aerospace and related sectors.



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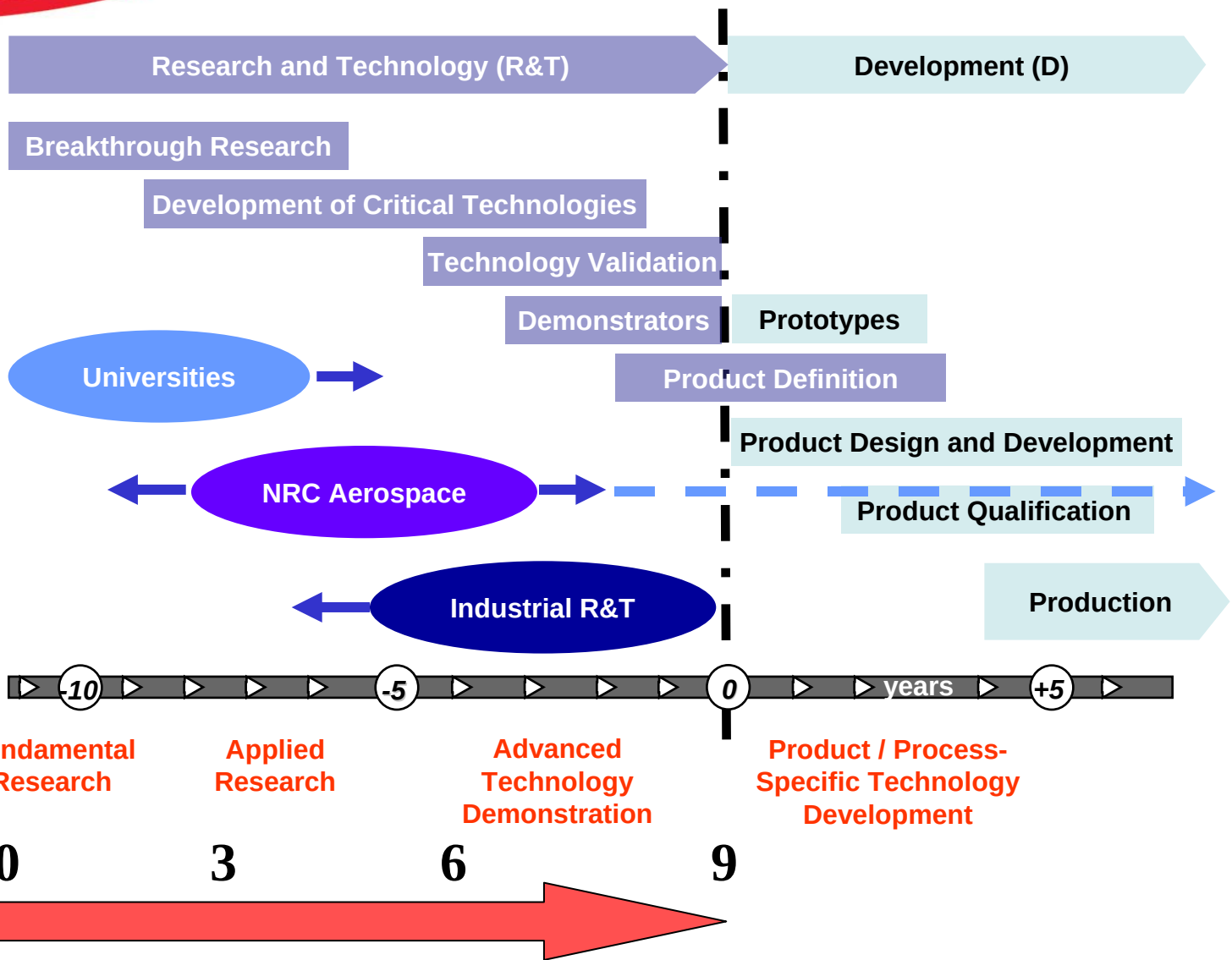
Our role in the R&TD continuum



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Our buildings and facilities

- 4 sites (2 in Ottawa, 2 in Montreal)
- 15 buildings (565,000 sq.ft.)
- Major facilities:
  - 8 wind tunnels
  - 9 research aircraft
  - Full-scale structural test rigs
  - Engine and combustion test cells
  - Materials characterization and testing equipment
  - Aeroacoustic reverberant chambers
  - Lubrication/tribology test rigs
  - Flight Recorder Playback Centre
  - Manufacturing research facilities

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Our resources

2007/08:

- Approx. 370 staff members
- 75 guest workers, 100 students
- $60M Canadian annual budget
  - $33M of which is from external sources

As Canada's foremost centre for aerospace research, the Institute for Aerospace Research undertakes and promotes research and technology development **in support of** the Canadian aerospace **civil and defence community** in matters affecting the design, manufacture, performance, use, and safety of aerospace and related applications.

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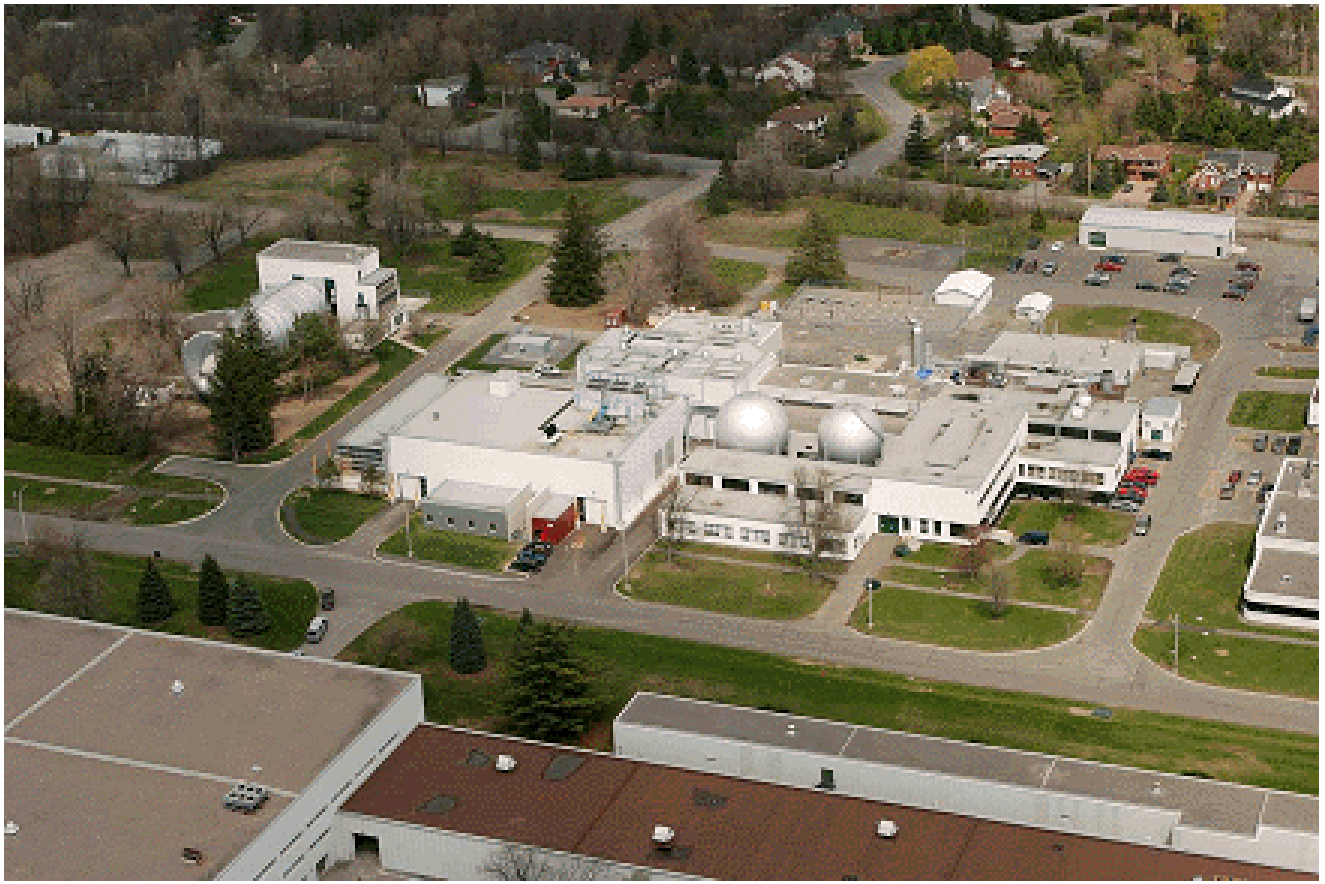
Alternative Fuels Facility fOr Research and Development



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Building on Existing Capability

Conventional fossil fuels

Alternative Fuels

Bench-scale demo & validation
- Fuel properties
- Spray characterization
- Material compatibility
- Modeling
- Laser based diagnostics

Rig demo & validation
- Combustor operability
- Validation experiments (Laser based diagnostics)
- Realistic pressure & temp
- Modeling

Engine test & certification
- Engine performance
- Certification

(Sea level, Altitude/Icing/etc.)

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Program Description

Fuels storage and supply

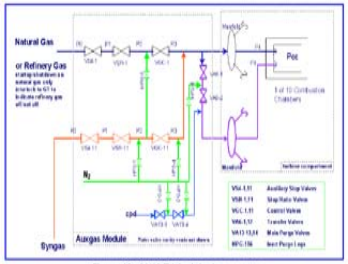

Figure 13. 90/10 Tri-fuel dual gas system

Blending Station

Characterization & validation

Technology demonstration

VOC incinerator

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Facility Features

- **Air moving facility**
  - 25 kg/s @ 21 bar, 650 ^{o}C
- **Fuels (conventional and alternative)**
  - NG, Jet A-1, Diesel
  - LPG (C2, C3 & C4), DME
  - N_2, CO_2 , H_2, CO, Bio-diesel, Ethanol, FT Kerosene
  - Online blending station
- **Test cells**
  - Flexible configuration for quick turn-around
  - More than 1000 channels process and fast data acquisition channels
- **High altitude engine test chamber**
  - 9.8m length, 2.5m diameter
  - 12.5 kg/s, 4.5 kg/s @ 0.25 bar, -50 ^{o}C
  - 13,500m altitude condition
- **Hi-pressure, hi-temperature spray rig**
  - N_2 @ 4.5 kg/s, 35 bar
  - Jet A @ 35 bar, 475 ^{o}C
  - State-of-art laser diagnostics

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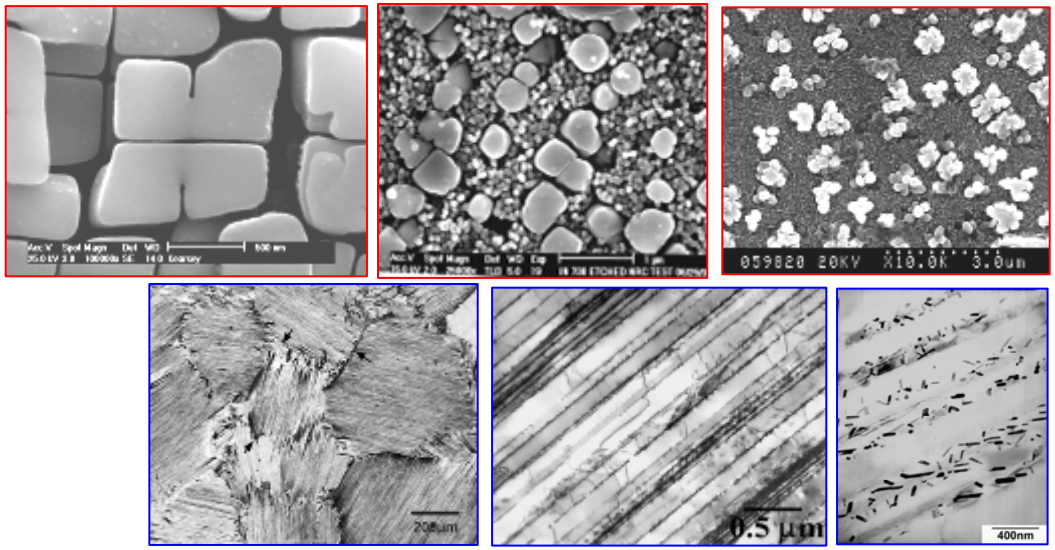
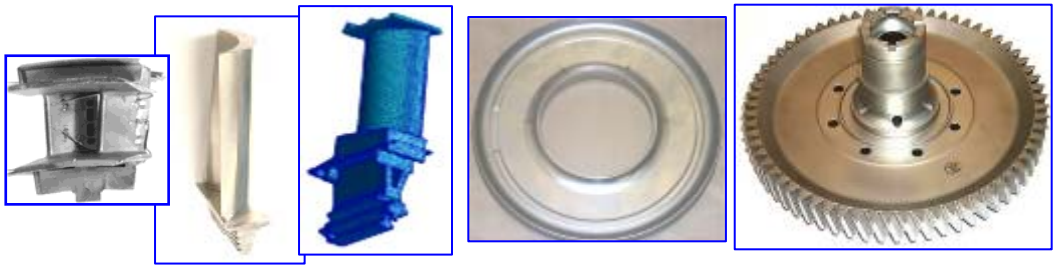
Gas Turbine Materials Research





- Cover a wide range of activities: from materials fundamental properties and coupon testing to component evaluation
- Work closely with OEMs and materials producers to qualify new materials and coatings for engine applications
- Support DND in managing its aging fleets to reduce operational and maintenance costs

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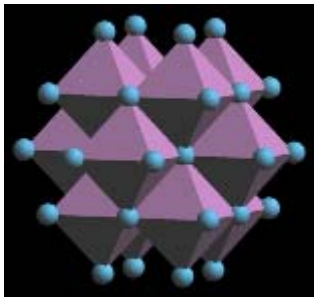
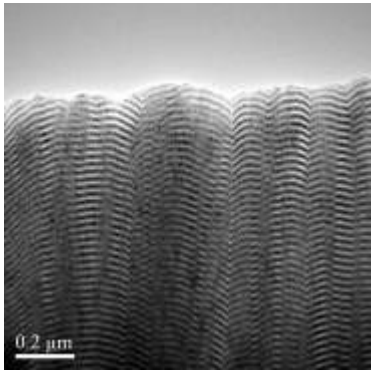
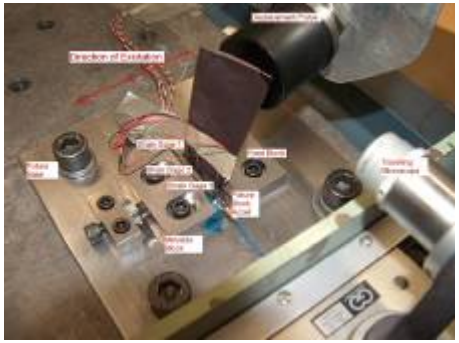
Gas Turbine Coatings Research

- Design and fabricate advanced coatings for erosion, corrosion, oxidation and thermal protection of gas turbine components
- Work closely with SMEs to develop coating processes for real engine parts
- Provide a wide range of coating qualification testing to support airworthiness certification
- Transfer coating technologies developed in the laboratory to industry for commercialization







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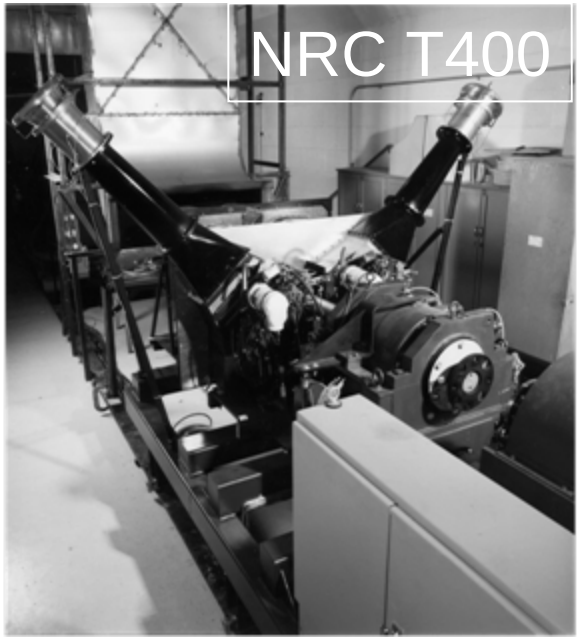
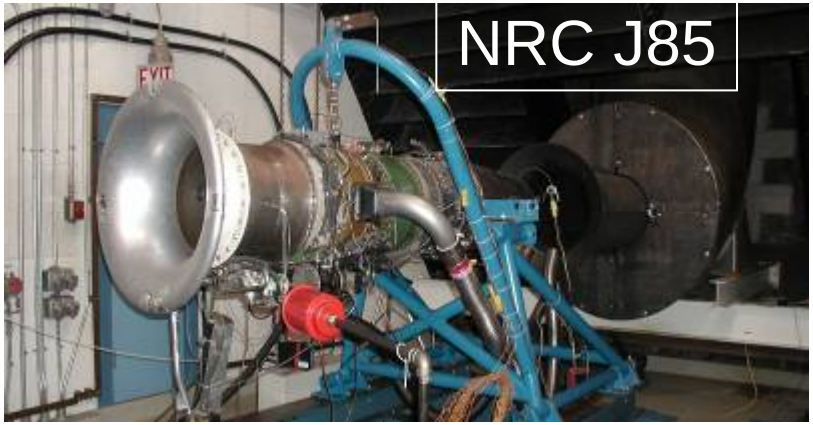
Health Management Challenge

- Modeling and sensor system development to support O&M decisions
- GT technology demonstration engines (J85, T400, microturbine):

  turbojet, turboshaft, gearbox

- How do we gather field experience data for validation and evaluation?
- How can you get involved and benefit?
  - Needs identification
  - Monitoring sites and test opportunities
    - Endurance tests, overhaul/pass off data
  - Demonstration projects
  - **DPHM** Working Group
  - **IVHM** Technology Demonstrator Project





Diagnostics, Prognostics and Health Management

Industry-government DPHM initiative over 4 years and 4 workshops to:

- Identify DPHM needs
- Build collaborative teams of OEMs and technology integrators
- Launch projects

PWC, Bombardier, Bell, RR, Honeywell, SAL, GasTOPS, Casebank, DND, NRC, Industry Canada and others
www.dphm-canada.org

Current projects

- FMEA/Field Diagnostic Interoperability
- Interpretation of Trends and Correlations
- Demonstrate DPHM Benefits on Legacy Fleet
- Maintainability Tracking and Rapid Maturing
- Maintenance Intervention Planning
- *$: NSERC, SADI, CRIAQ, Industry*

Integrated Vehicle Health Management

- System level integration in flight
- Technology for low weight and cost
- Impact
  - O&M and life cycle management
  - new design processes at the air vehicle level

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Integrated Vehicle Health Management (IVHM) Technology Demonstration

Business Case

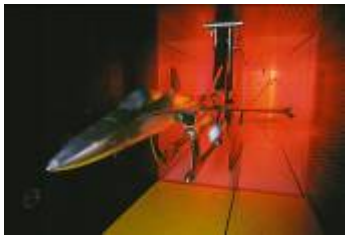
- Deliver an infrastructure for technology demonstration & transition
- Leverage Technology Insertion Road-mapping results to promote DPHM R&D in Canada and internationally
- With Industry Canada, coordinates Canadian activities and facilities

Technical Approach

Phase 1: Systems Level Demonstrations

- New infrastructure: structural, engine, mechanical, aero, flight
- Mission-relevant demonstrations to transition mid TRL technologies
- New design for IVHM-enabled vehicle

Phase 2: Vehicle Flight demonstrations









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NRC Tools

- National Network – AIAC, AQA, OAC, CASI, AeroMontreal
- IRAP – offices, support for SMEs
- Collaborations with Universities
- CRIAQ (C) – NRC is a board member and strong participant in the consortium
- Collaborations with OEMs linking OEMs and SMEs (i.e. Bell-Bombardier-NRC-CAL composites work)
- Strong partnership with DRDC (NRC as delivery organisation) and other OGDs
- NRC visiting workers
- Control Goods Program, ITARS, ISO certification
- International Network – RTO, TTCP, significant role in international professional societies

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Questions?