

CAME-GT

Workshop : Brussels - 16 February 2001

**UK UNIVERSITIES IN
GAS TURBINE RESEARCH.**

**ROLE OF UNIVERSITY LARGE
SCALE
EXPERIMENTAL
RESEARCH PROGRAMMES.**

SOME UK UNIVERSITIES ACTIVE IN GAS TURBINE RESEARCH

Bath

Birmingham

Cambridge

Cranfield

Imperial

Loughborough

Nottingham

Oxford

Sheffield

Southampton

Strathclyde

Sussex

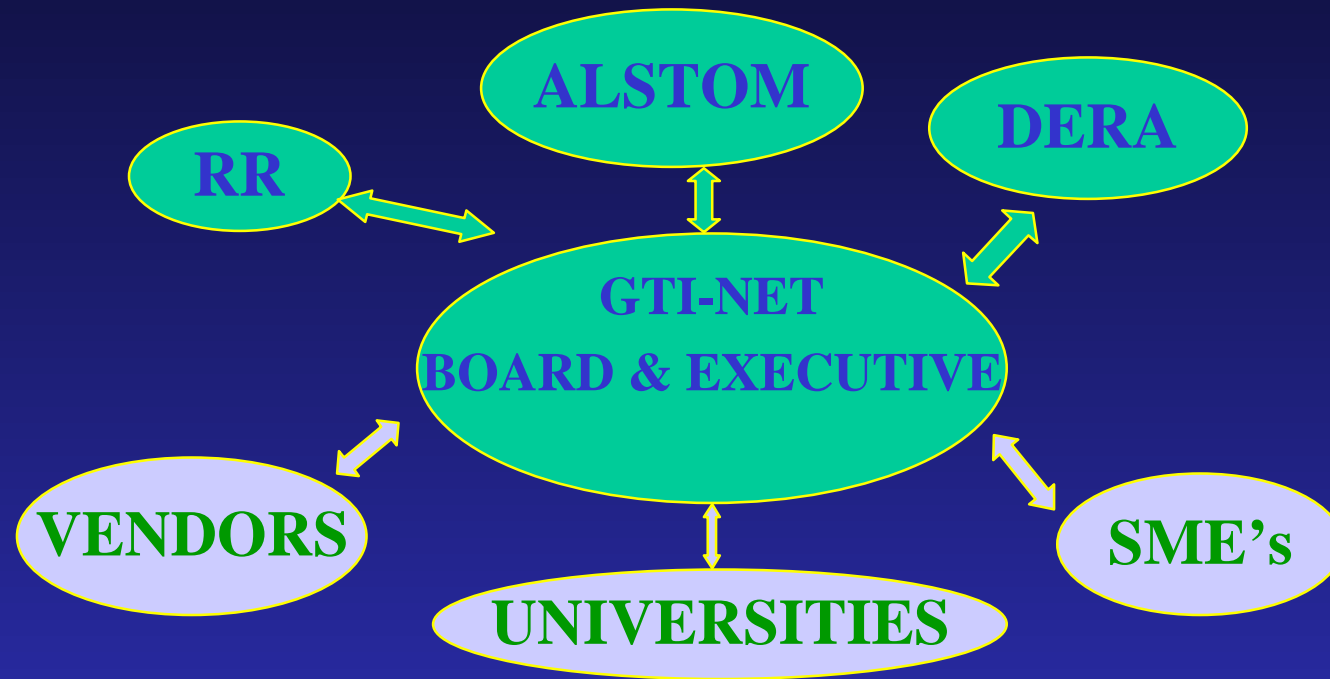
Swansea

UMIST

Wales

York

GAS TURBINE INSTRUMENTATION NETWORK



**EUROPEAN VIRTUAL INSTITUTE FOR
GAS TURBINE INSTRUMENTATION
DEVELOPED OUT OF CURRENT UK MODEL**

AEROTHERMAL RESEARCH FACILITIES AT CRANFIELD - capacities & typical usage (1)

- **High Pressure Air: to 24 bar and 4.3kg/s, steady flow**
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- **Air Heaters**
 1. **Steady flow, unvitiated, to 740K (approx 20pr simple cycle equivalent) usable to 17bar at full flow: GT combustor research**
 2. **Discontinuous, unvitiated, to 1800K, 16bar, at flows between 0.5 - 2.2kg/s with operating durations ~ 15 - 45mins depending on flow rate: simulation of high stagnation enthalpy flows (~ M2) for high flux heat transfer or supersonic combustion or high inlet temperature GT combustors, eg regenerative cycles**

AEROTHERMAL RESEARCH FACILITIES AT CRANFIELD - capacities & typical usage (2)

Fuel Supplies

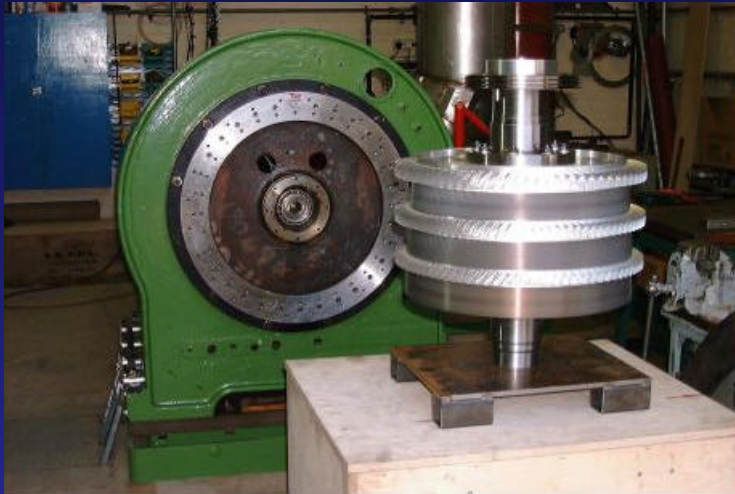
1. Liquid

- Jet A1
- No2 Distillate

2. Gaseous

- Line Natural gas and blends
- Low and Medium CV gases based on CO, H₂, CH₄ with N₂, CO₂ and H₂O ballast
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- All to 12MWt, extendable
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HIGH SPEED AXIAL COMPRESSOR RESEARCH



- Detailed measurement of performance and flow in high hub tip ratio axial compressors.
- Representative of industry compressor in terms of geometry and aerodynamic parameters – pressure ratio, loading mach number.
- Provide measured data from a realistic Environment for validation on latest CFD predictions.
- 1 MW compressor rig driven by gas turbine.
- Focus for research on instrumentation
- On going programs funded for the next three years

CRANFIELD ICING WINDTUNNEL

A Joint Research Equipment Initiative (JREI)
costs ~ 1.57 MECU

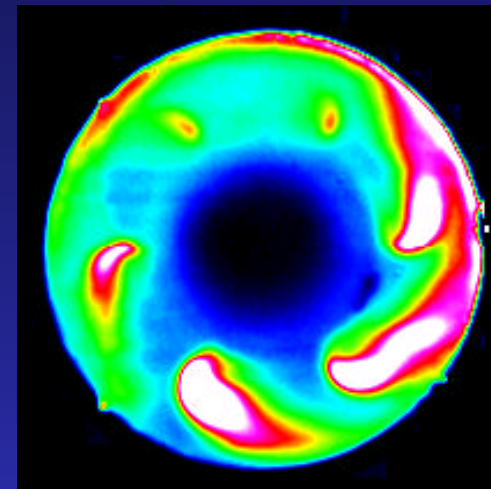
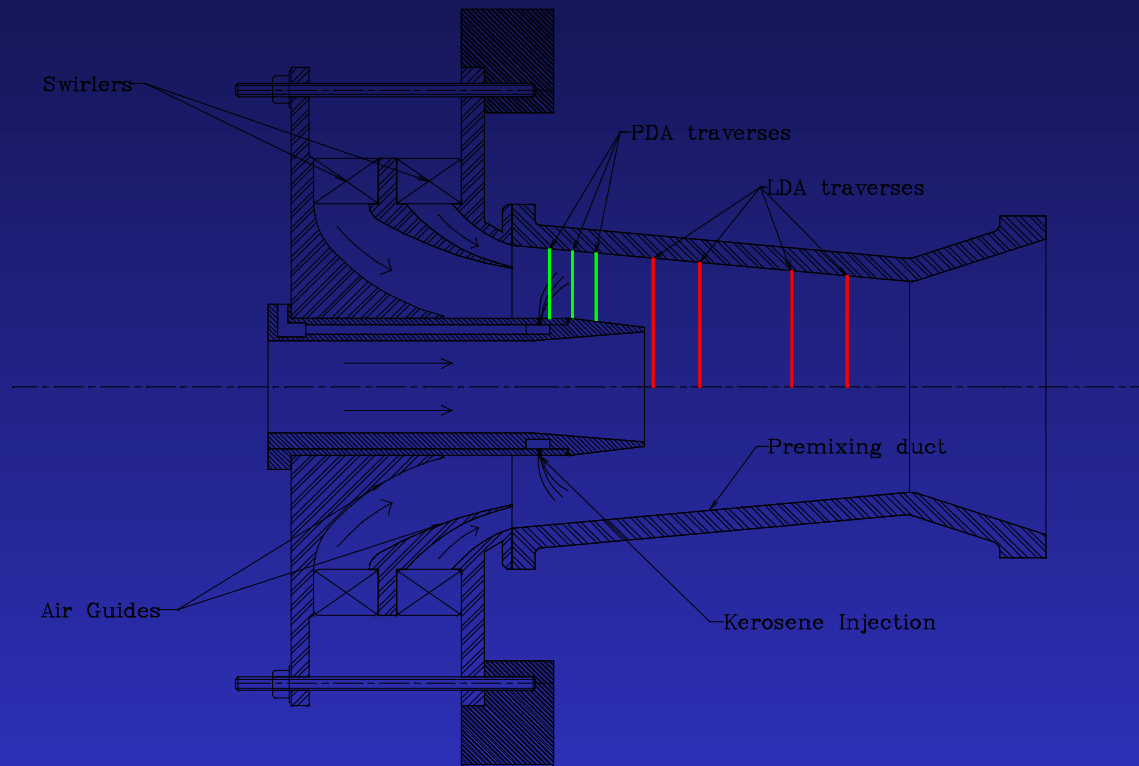
Objectives:

- To build a quality tunnel dedicated to icing research
- To maintain and promote icing research activities
- To support both short and long term icing research

ADVANCED INSTRUMENTATION & DIAGNOSTIC

- Modern instrumentation provides a comprehensive diagnostic capability. New imaging methods can reveal high speed 3-D imaging of reacting flows detailing the flow physics and the chemistry.
- Experiments to designed to consolidate the available expertise on well chosen experiments are required to support advanced computational methods such as LES/DNS.
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CRANFIELD LPP DUCT AND LIF IMAGE OF LIQUID FUEL JETS



CATALYTIC COMBUSTION IN GAS TURBINES ⁽¹⁾

Advantages

- Low emissions for premium fuels at -
 - gas turbine conditions
 - wide range of engine pressure ratio
- Stable combustion over a wider range of mixture strengths than turbulent flame combustors
- Low pressure drop

Disadvantages

- Lighting of catalyst may require precombustor
- catalyst durability and selectivity issues
- Gas turbine combustor geometry may change

CATALYTIC COMBUSTION IN GAS TURBINES ⁽²⁾

Current Position

- Demonstrated single digit emissions of NO_x, CO and UHC on natural gas
- Engine demonstration and pre-serial production offered on some gas turbines for natural gas
- Application to derived fuels (biomass, coal etc) focussed on control of nitrogen oxides formed from fuel bound nitrogen. No clear demonstration of achievement levels similar to those on natural gas.