Corrosion Lifing Methods And Testing (CLIMATE)

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Business objectives

- To develop technology that enables industrial gas turbines for power generation to be operated at higher temperatures and pressures
  - Improving their efficiency
  - Reducing fuel consumption
  - Reducing CO_2 emission

- Develop and verify methods for predicting the safe cyclic life of turbine discs in industrial gas turbines under corrosion-fatigue conditions

- Optimise plant performance whilst maintaining commercially acceptable component lives and overhaul periods.

- Provide the foundation for understanding component corrosion behaviour in new and advanced low emissions concepts such as SSIGTs (where the steam injection through the combustor complicates the material degradation process)

Exploitable outputs

- Facilities for performing high temperature corrosion-fatigue tests in hazardous environments that reproduce the corrosion attach seen in service

- A fundamental understanding of corrosion behaviour in Ni based superalloys

- Methods for prediction component lives in the presence of high temperature corrosion.

Introduction to Problem

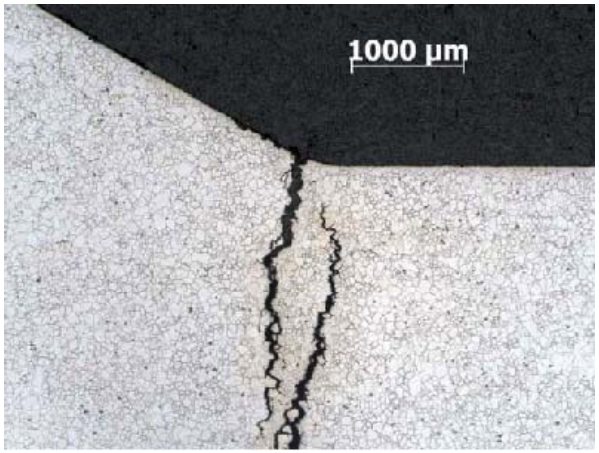
- The project aims to reduce carbon emissions from gas turbines used for power generation by allowing them to run at higher temperatures, improving efficiency.
- Industrial gas turbines currently run at lower temperatures than civil aerospace. Increased temperature capability is to be achieved by changing to Ni superalloys
- No experience of such alloys in industrial environments, available yet
- This programme aims to understand the differences between the industrial and civil environments and learn from civil experience.
- By understanding test parameters needed to replicate service corrosion, models can be created to predict damage given a range of environmental conditions.

Background

- As service temperature increases, corrosion fatigue is becoming one of the main mechanisms limiting disc life
- Corrosion has been seen on service engines on HP turbine disc firtrees and diaphragms
- The traditional approach of using fracture mechanics to describe corrosion fatigue lives will produce low lives and therefore an improved approach that includes incubation is required
- Our overall understanding of corrosion fatigue behaviour is poor
- Currently only two facilities capable of running fatigue tests in a corrosive environment exist – Cranfield University and Swerea Kimab (Sweden)

Industrial Gas Turbines

RT48S power turbine
- 61,735 hrs / 436 cycles
- Failure attributed to type II corrosion
- High chloride, sulphur and sodium detected



Project Scope

Objectives

- Develop facilities for performing fatigue tests in an environment that reproduces the corrosion seen in Ni Critical parts on a cycle by cycle basis
- Run smooth bar fatigue, crack growth and firtree H-specimen tests to understand corrosion fatigue behaviour of alloy studied
- Develop corrosion fatigue life prediction models

Deliverables

- Report on corrosion kinetics to inform choice of test environment and contaminants
- Build and commission rig test facilities
- Complete specimen and sub-element tests
- Report initial corrosion fatigue lifing models the Ni alloy investigated