



## CURRICULUM VITAE

**Michael Bernard Henderson, B.Met (Hons), D.Phil (Oxon), C.Eng., FIMMM**

Telephone: +65 9184 9574

Email: Michael.henderson@easthameng.com

### PROFESSIONAL CAREER

**March 2013 – Onwards**

**Consultant Metallurgist – Eastham Engineering, Singapore**

- Specialist in turbine damage assessment and root cause failure investigation, with over 30 years' experience in the field of aero and industrial turbine materials, manufacturing and life assessment.
- Areas of expertise include steam and gas turbine engineering, blade and vane life assessment, casings and bolted flanges & couplings, rotor manufacturing and life assessment, turbine materials and protective coatings, creep and fatigue damage mechanisms, oxidation and corrosion, component lifing and failure mechanisms, inspection tools, product / process developments for high temperature power generation plant.
- An extensive list of prior projects is available, but includes the following:
  - Failure assessment of a GE LMS 100 aero derivative gas turbine compressor.
  - Failure investigations into breakdown of several GE LM2500 and LM6000 aero-derivative gas turbines.
  - Failure and damage assessment of various Siemens STG steam turbines, including rotor cracking and seal damage.
  - Failure and repair assessment of a Toshiba steam turbine.
  - Inspection, repair and recovery of damage to wind turbine blades.
  - Failure assessment for several Alstom gas and steam turbine machines, including GT26, GT13E2 combined cycle stations.
  - Breakdown assessment of compressor vanes for MHI 701 and MHI 501 machines.
  - Fatigue damage to MHI 701G turbine blades.
  - Numerous investigations into compressor and turbine damages on GE Frame gas turbines including compressor blade failures, turbine bucket burning and shroud disengagement and corrosion-fatigue damage.
  - Several compressor and turbine failures for Siemens small industrial and large gas turbines, including SGT5-2000E, SGT5/6-4000F and SGT6-8000H.
  - Failure analysis of waterwall tubes and superheaters for sub and super critical boilers.

**May 2007 – February 2013**

**Principal Consultant –Materials and Power Turbine Engineering, Quest Integrity NZL Ltd., based in Wellington, New Zealand**

- Principal consultant specialising in providing independent steam and gas turbine materials and life management support services to clients within the power generation and petrochemical industries in New Zealand, Australia, South East Asia and South America.

This was an applied, field engineering role that used much of my past experience from the gas and steam turbine manufacturing industry to provide independent life extension and management expertise to plant owners.

- Developed the Quest Integrity turbine engineering consulting business and employed up to 20 members of engineering staff in a variety of roles, including component stress analysis and life assessment, structural integrity and defect assessment work, on-site inspection, condition assessment and quality management, as well as mechanical and metallurgical testing.
- Conducted numerous failure investigations on gas and steam turbine equipment and provide materials engineering consultancy services to several insurance companies, loss adjustors and power operators. In addition to root cause analysis, I also performed on-site assessments as to the condition of components for further operation or rejection during forced shutdowns. Determining the extent of damage associated with the incident or loss are key functions that I have performed on behalf of several clients.
- Projects include the following:
  - Condition and life assessment for a GE Frame 6B and 9E gas turbine rotors.
  - Stress analysis and re-design of GE Frame 9E exhaust diffuser.
  - Condition and life assessment for an Alstom GT13E2 gas turbine rotors.
  - Various failures on Alstom GT and ST machinery, MHI 701 and 501 machines.
  - Life management support for combined cycle Alstom GT26 and ST.
  - Failure of wind turbine bolted coupling flanges.
  - Failure analysis of boiler tubes.
  - Inspection and life management support for a range of small industrial machines (Solar, Siemens, Alstom).
  - Inspection and evaluation for range of GE LM aero derivative gas turbines.
  - Specification of repair acceptance criteria documents for GE Frame 6B & 9E hot gas path components.
  - Condition assessment and life extension for ageing steam turbine modules.
- Project and technical management of several life management support and development projects aimed at the further utilisation of gas and steam turbine equipment. Much of this work was conducted on behalf of the Australian Gas Turbine Users Forum (GTUF).
- Training workshops on gas turbine materials and lifing methods and failure investigation techniques for power generation companies across Australasia and South East Asia, including specialist workshops at ASME IGTI conferences.

#### **September 2004 – April 2007**

##### **Project Leader & Principal Engineer, ALSTOM Power Steam Turbines, Rugby**

- Project and Technical Management of several programmes aimed at high efficiency steam turbine plant (rotors, stainless steels and nickel alloys for blading applications, labyrinth seals / brush seals, coatings).
- ALSTOM Project Leader for DTI funded European collaborative project aimed at developing advanced rotor and pressure vessel steels for next generation plant.
- Co-ordinated several internal projects aimed at qualifying full-scale manufacture and welding of advanced high temperature steels and the development of erosion and oxidation protective coatings for steam turbine plant.
- Provided materials selection and data & life assessment analyses for the new equipment, retro-fit and overhaul steam turbine businesses within ALSTOM.
- Member of Steam Turbine Materials Steering Committee at ALSTOM.

## **April 2001 – August 2004**

### **Head of Materials Technology, ALSTOM Power Technology Centre, Whetstone, Leicester**

Principal Materials Engineer and Head of Materials Technology, responsible for the Project and Technical Management of a number of advanced gas turbine materials projects:

- Creep, thermal fatigue and crack growth modelling of gas turbine combustor alloys.
- Creep and fatigue of single crystal superalloy blades and thermal barrier coatings.
- Testing and Life Assessment of investment cast and forged titanium aluminide alloys.
- Development and manufacture of turbine disc materials/components and lifing methods.
- Development and validation of high nitrogen ferritic IGT rotor steels.
- Development of high temperature thermal and environmental barrier protection coatings.
- Numerous projects on alternative compressor and hot section materials.
- Materials evaluation for near-zero CO2 emission cycle programme (GASZEP).
- Brush seal development - fretting and wear characteristics of GT seals.
- Brazing, weld repair and overhaul of GT materials and components.
- Data analysis and interpretation (fatigue and creep life modelling).
- Industrial sponsor for several University-based, EPSRC / DTI / ALSTOM funded projects.

Management of the Materials Group at the Technology Centre, with responsibility for the Metallographic Analysis facilities. Conducted failure analysis and metallurgical inspection of production parts and field exposed parts. Direct Line Manager for 10 members of staff, with responsibility for management of more than 15 members of staff.

Management of Materials Technology development programmes as the materials expert for the Alstom Technology Steering Committee and contact point for external activities, such as the Brite EuRam EIMG Advanced Materials Cluster, NPL Industrial Advisory Group and several University materials departments involved in high temperature materials and coatings research.

## **Jan. 1995 – March 2001:**

### **Project Technical Leader and Group Head for Aero Engine Integrity, Mechanical Sciences Sector, Defence Evaluation and Research Agency (DERA)**

- Responsible for research programmes in the field of high temperature materials and gas turbine engine component life assessment. Researching the creep and fatigue behaviour of nickel-based superalloys, intermetallic alloys and coatings.
- Managed and prepared numerous bids for funding from UK MOD, DTI and the European Commission on development of high temperature fatigue and creep of high strength nickel-based disc alloys, development of advanced lifing methods and the elasto-plastic-creep modelling of turbine blades, combustor alloys and structures.
- Responsible for preparation of technical and customer reports, as well as external publications in journals and at conferences.
- Provided logistics support to HMG platform integrated project teams (IPTs) that manage the RAF's engine fleet. A key role was the analysis of component usage data, statistical modelling and risk assessment as well as advice provided to the Royal Air Force, Royal Navy and MOD/DTI on gas turbine materials and component life assessment.
- Represented HMG at MOD/Rolls-Royce engine demonstrator review meetings and international collaborative research programmes. Actively involved as technical monitor for extramural research and development programmes at Rolls-Royce and University departments within the RR UTC framework.
- Conducted investigations into gas turbine failures and was responsible for technical management of the creep and fatigue testing facilities at DERA.