8 Mar. 04

Three-Day International Conference

High Temperature Plant Integrity & Life Extension

Venue: **Robinson College*, Cambridge University, UK**

Dates: **14 – 16 April 2004**

Final Programme and Registration Form

Organiser

European Technology Development (UK)

*** Venue:** Robinson College, Cambridge University, Grange Road, Cambridge, UK
Details of the venue and travel can be found at: http://www.robinson.cam.ac.uk/conferences

CONFERENCE BACKGROUND

There has not been a conference on the specific topic of 'plant life extension' for many years. It is a good time to bring the international community together, to discuss existing developments, exchange ideas and to devise new strategies for collaboration. Plant life extension is also likely to become prominent in European Commission supported work in future. It is an opportunity to **review techniques** used in different countries and industrial sectors and to propose new advances in a forum which gives equal emphasis to **plant experience, technology development and research issues**.

The Conference has attracted excellent quality papers from the UK, Europe, North America, Japan, Hong Kong and other countries. These include state of the art papers on cracking and life assessment methodologies being studied/considered for the new 9 to 11%Cr martensitic steels, gas turbine component repair and life extension, weld repairs for life extension, novel developments in residual stress measurement, component testing etc. The contributors include major plant manufacturers, utilities, service providers, plant assessors and research organisations.

The last two decades have been noteworthy for the use of novel **martensitic and austenitic steels** for high efficiency Ultra Supercritical (USC) power plant for superheaters, steam turbine rotors and stop valves. However, there is a life assessment issue with components fabricated from these alloys. There are problems with the use of traditional techniques such as replication and more sophisticated approaches will be necessary. This is important as some plants have seen failures in P91 components well before the end of design life.

Fortunately many novel initiatives have been developed in Europe, Japan, USA and elsewhere to provide strategies for plant life assessment and extension in **fossil steam plant and petrochemical plant and advanced gas cooled nuclear reactor systems.** For example, data sheets and rules have been developed by the European Creep Collaborative Committee to help harmonise European practices. Plant life extension has been supported by **advances in plant monitoring, software for remnant life calculations** and **improvement in component repair**. Further developments have also taken place in the use of miniature creep and fracture toughness specimens to assess the condition of suspect components.

Gas turbine based systems and steam plant, whether they be of the fossil, nuclear, biomass or waste incineration type, are all susceptible to failure by creep, creep-fatigue, high temperature attack and embrittlement. One aim of the conference is to review life prediction models and to critically assess the prospects for using these models in other branches of high temperature plant engineering. Another aim is to show how developments in plant and equipment monitoring, NDT and repair techniques can be used with different types of equipment.

The need for new approaches with gas turbines is becoming critical, due to the introduction of **directionally solidified and single crystal blades**. There is evidence to show that creep fatigue models based on equiaxed materials are inadequate for the newer alloys. Life prediction of **oxidation resistant and thermal barrier coatings** is proving equally challenging, although a variety of models are under development. Blade and other hot

section costs are so high that there is now a vigorous market in **blade rejuvenation and coating repair.** Hence papers covering these subjects will be presented during the conference. Other issues include **disc fatigue** in industrial gas turbines which is becoming a vital concern.

INTERNATIONAL SCIENTIFIC AND ORGANISING COMMITTEE

PAPER PRESENTATION

Oral presentations

- LCD projector facilities (including a lap top) will be available for the presenters.
- Oral presentations will be of 20 minutes duration including discussion.
- Keynote papers will be of 30 minutes duration including discussion.

All technical enquiries to:

A Fleming, Conf. Chairman, ETD c/o 11 Wood Lea, Blackwood, Lanark ML11 9SY, UK
Tel: + 44 (0)1555 895 541 (direct) or + 44 (0)1372 229 162 Fax: + 44 (0)1372 229 164
E.mail: afleming@etd1.co.uk Web site: www.etd1.co.uk

PROCEEDINGS

- Bound copies of **Conference proceedings** will be provided at the Conference.

Day 1 Wednesday, 14th April 2004

REGISTRATION & COFFEE

(0900 - 1000 hours)

Introduction and Welcome
I A Shibli, European Technology Development, **UK** *(1000 –1005)*

SESSION 1: Life Assessment of USC Plant using Modern Steels *(1005 –1215)*

1 ***Keynote Paper:*** **Steam oxidation of chromium steels and its implications for service life of components**
P J Ennis, J Quadakkers & J Zurek, Julich Research Centre, **Germany**

2 **Full size internal pressure creep test for welded P91 hot reheat elbow**
I Nonaka, T Ito & F Takemasa, Research Laboratory, IHI Co. Ltd.;
K Saitou, Y Miyachi & Y Kagiya, Electric Power R&D Center, Chubu Electric Power Co. Inc., **Japan**

3 **Stress dependence of recovery process and long-term life prediction of 9Cr-1Mo-V-Nb steel**
K Kimura, K Sawada, K Kubo & H Kushima, National Institute for Materials Science, **Japan**

4 **Creep damage development in martensitic 9Cr steels**
K Maile & M Rauch, MPA Stuttgart, P Seliger & A Reuter, SPG Dresden, **Germany**

5 **Review of the damage mechanisms and the life assessment techniques for stainless steels**
T Lant, ERA, **UK**

6 **Full size internal pressure creep test for welded P91 hot reheat piping**
I Nonaka, T Ito & F Takemasa, Research Laboratory, IHI Co. Ltd.,
K Saitou, Y Miyachi & Y Kagiya, Electric Power R&D Center, Chubu Electric Power Co. Inc., **Japan**

Lunch 1215 – 1330 h

SESSION 2: Component Damage Development and Life Prediction *(1330 –1650)*

1 ***Keynote Paper:*** **Influence of stress state on creep damage development in components**
K Maile & A Klenk, MPA Stuttgart, **Germany**

2 **Life management of steam piping**
X Du, CLP Power HK Ltd., **Hong Kong**

3 **Life assessment of advanced P91, P92 steels: Issues arising from the development of an expert system for power plant components**
F Starr, European Technology Development, **UK**

4 **PC-based stress & strain calculation and creep life prediction of pipe bends with out-of-roundness subjected to internal pressure**
J Weber, TECHNIP Germany GmbH & A Klenk, MPA Stuttgart, **Germany**

Coffee 1500 – 1530 h

5 **Application of a general formulation approach for steady-state creep lifing of welded branched pipes**
S B Leen, T H Hyde & G Rayner, Nottingham University, **UK**

6 **Prediction of P91 life under plant operating conditions**
J Brear, SES (Europe) & A Fleming, European Technology Development, **UK**

7 **Remaining life prediction of superheater tubes**
R Mehrabani, Tehran University, **Iran**

8 **An Integrated Approach to Plant Life Extension – the Supergen Initiative**
J Oakey, Cranfield University, R Thomson, Loughborough University, T Hyde, Nottingham University, D Smith, Bristol University & D Allen, Alstom Power Technology Centre**, UK**

Panel Discussion on Life Assessment of Modern Steels

Day 2 Thursday, 15th April 2004

SESSION 3A (Parallel Session): Lifing of Gas Turbine Hot Path Components

(0840 –1050)

1 ***Keynote Paper:*** **Gas turbine hot section component life assessment and life extension: status and issues**
M Wood, ERA Technology, **UK**

2 **Hot corrosion of coated single crystal superalloys**
N J Simms, A Encinas-Oropesa & J R Nicholls, Cranfield University, **UK**

3 **Microstructural & microchemical analysis of aluminised superalloy**
F A Khalid & F Nawaz, GIK Institute of Engineering Sciences and Technology, **Pakistan**

4 **The role of oxidation in the crack initiation and propagation in CMSX-4 under low cycle fatigue and thermo-mechanical fatigue**
G L Drew & C M F Rae, Rolls-Royce University Technology Partnership/University of Cambridge, **UK**

5 **Life extension methods in aero-engines**
D Shepherd, Qinetiq, **UK**

6 **Creep data requirements for the modern life assessment of hot components**
P S White, ALSTOM Power Technology Centre, **UK**

SESSION 3B (Parallel Session): Conventional Plant Issues

(0840 –1010)

1 ***Keynote Paper:*** **ECCC findings on post-exposure testing for residual life assessment**
G Merckling, IS Breda, **Italy** & S J Brett, RWE Innogy Ltd, **UK**

2 **COMSY - a software tool for plant life management and risk-informed ISI optimization**
H Nopper, R Roessner & A Zander, Framatome, **Germany**

3 **Ensuring the integrity of a contact heater in the digestion train of an alumina refinery**
R Coade, ETRS Pty Ltd, A Tennent, R West, K Goh & J Irving, Alcoa World Alumina, **Australia**, & J Butler, Battle River Generating Station, **Canada**

4 **Cross-weld damage and fracture behaviour of P91 and P22 steels at high temperatures**
U Ceyhan & B Dogan, GKSS Research Centre, **Germany**

Coffee 1050 – 1120 h

SESSION 4: Repair and Welding of Gas Turbine Hot Path Components

(1120 –1250)

1 ***Keynote Paper:*** **Joining technologies for gas turbines**
C Bagley, TWI Ltd., **UK**

2 **Microstructure control for single crystal welding and repair of Ni-base superalloys**
S Mokadem, C Bezençon, J-D Wagnière & W Kurz, Swiss Federal Institute of Technology, **Switzerland**

3 **Adaptive machining of gas turbine components**
P Walton, TTL, **UK**

4 **EBPVD thermal barrier coatings for component life improvement**
R Wing, Chromalloy, **UK**

Lunch 1250 – 1420 h

SESSION 5: Recent Developments in Life Assessment Methodologies *(1420 –1700)*

1 ***Keynote Paper:*** **Damage development in high energy components**
J D Parker, L H Bisbee & L Nottingham, Structural Integrity Associates, **USA**

2 **Measurement of residual stresses in repair welded engineering components**
D J Smith, Bristol University, **UK**

3 **The calculation of creep damage as a function of stress and strain rate**
M W Spindler, British Energy, **UK**

Coffee 1530 – 1600 h

4 **Material assessment in industrial high temperature plant using real structure analysis by on-site X-ray diffraction**
V Kolarik, H Fietzek, M Juez-Lorenzo, L Rol1, Fraunhofer-Institut für Chemische Technologie; I Marcelles, J Ascue, Tecnatom s.a**;** S Raza, CINAR Ltd**;** V Mentl, ŠKODA Research; J Fiala, West Bohemian University; J M Armesto, G Calderón, Endesa Generación s.a J M Jimenez, Repsol YPF**;** F Hnilica & L Belovsky, ÚJP PRAHA; **Europe**

5 **Major benefits derived from the adoption of an initial state characterisation approach for main components of fossil fuel power plants**
N Timóteo & P Maia, EDPP-EM, EDP Group, **Portugal**

6 **Small punch test for assessing H_2 induced damage in steel for pressurised equipment.**
F Di Persio, G C Stratford & R Hurst, JRC Petten, **Netherlands**

Conference Dinner
1930 – 2230 hours

Day 3 Friday, 16th April 2004

SESSION 6: Welding and Repair Issues *(0900 –1200)*

1 ***Keynote Paper:*** **New European standards for high temperature welding consumables**
D J Allen, Powergen, **UK**

2 **Creep-fatigue characteristics of partial repair welds and full repair welds on aged 2.25Cr-1Mo steel**
Y Takagi & S Otsuki, The Tokyo Electric Power Company, Inc.;
T Ito & I Nonaka, Ishikawajima-Harima Heavy Industries Co. Ltd, **Japan**

3 **Effects of repair weld metal and HAZ properties on the failure behaviour of a partially repaired weld in a CrMoV main steam pipe**
T H Hyde & W Sun, University of Nottingham, & J A Williams, Consultant, **UK**

4 **Evaluation of cross-weld creep strength of 9-11%Cr steels**
M Bauer, H Theofel, A Klenk & K Maile, MPA Stuttgart, **Germany**

Coffee 1030 – 1100 h

5 **The use of Borland specimens to reproduce reheat cracking in Type 316H**
M W Spindler, British Energy**, UK**

6 **Development of welding consumables for advanced high temperature plant**
C Farrar, Metrode, **UK**, D J Allen, Powergen, **UK**, R Sturm, IMT, **Slovenia** &
M Solar, Elektrode Jesenice, **Slovenia**

7 **Unifuse® overlay cladding for surface protection against corrosion and erosion/corrosion in power boilers and refinery and petrochemical plants**
N R Blogg, Welding Services bv, **UK** & G Lai, Consultant, **USA**

Lunch 1200 – 1330 h

SESSION 7: Operation, Retrofitting, Monitoring and Failures in High Temperature Plant

(1330 –1520)

1 ***Keynote Paper:*** **Mid-life review of a repowered 660MW boiler – practical aspects from design to inspection**
S D Cameron & D J Irving, Mitsui Babcock Energy Ltd., **UK**

2 **Repowering integration fundamentals**
J Cherrie, Mott McDonald, **UK**

3 **Corrosion failure of superheaters in waste incineration plant**
J Krejcik, SVUM, **Czech Republic**

4 **Effect of warm pre-stressing on critical defect sizes in turbine rotor steels**
P Mulvihill, Powergen, **UK**

5 **On-line monitoring and control of furnace wall PF-fired boilers**
D Farrell & B Robbins, Rowan Technology, **UK**

Panel Discussion on Future Life Assessment Technology

Conference ends

REGISTRATION FORM

PLANT LIFE EXTENSION Conference

14 – 16 April 2004**,** Robinson College, Cambridge University, UK

Registration Fee: *For events held in the UK, overseas delegates also need to pay UK applicable 'value added tax' (VAT) @ 17.5%. All figures are in* ***UK pounds.***

* Concessionary fee applies only to the author presenting the paper. ** Please put x in the appropriate box.		Until 15 March 2004			After 15 March 2004		
		Fee	**Payable Fee + VAT**	**	Fee	**Payable Fee + VAT**	**
Conference	Delegates	500	588		550	646	
	Authors	450	529*		500	588*	
University Accommodation (optional)		60 +VAT = **70.50** ***per night***					
Need University accommodation for the dates							
Payable to ETD	Registration =	Accommodation =			**Total** =		

Registration Fee covers Conference Proceedings, coffee, lunches and Conference dinner.

Accommodation: En-suite accommodation will be available at the University and is payable (by those wishing to use this facility) to ETD together with the registration fee.

Payment: Registration and Accommodation Fees are to be paid into the UK pound sterling bank account: A/c Name: European Technology Development Ltd., Bank: Nat West Bank, A/C No: 26096625, Sort Code: 60-12-36. ***Please quote reference* 'Plant Life'**.
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Fax: + 44(0)1372 229 164 **E-mail:** registration@etd1.co.uk