Boiler Tube Damage, Failure and Life Assessment

Materials, Damage Mechanisms, Inspection, Root Cause Failure Analysis, Life Assessment and Risk Based Management

Venue: TNBR, Bangi, Selangor, Malaysia
Dates: 16-17 May 2023 (2-days)

The contents of the course would emphasise the current and latest understanding, supported by *notes* and *references* for further reading and will be accompanied with Worked Examples.

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DAY - 1

(Start 9 am – finish 4.30 pm - total time 7.5 hours)

Materials of Construction, Damage Mechanisms & Tube Inspection

Module 1: **Materials** (2 hours session + 15 min. break) *(Morning)*

Various materials in use will be reviewed and their pros and cons discussed. Materials for the new generation of higher efficiency plant (such as T23, T91, T92, 12Cr steels) will also be discussed and their welding and oxidation issues elaborated.

- Furnace Wall Tube Materials (C, C-Mn Steel and low alloy steels for the new generation of higher efficiency plant), their use and characteristics will be discussed.
- Reheater and Superheater Tube Materials (CrMoV, High Cr and Stainless Steels) will be discussed and reviewed.

Module 2: **Damage Mechanisms** (2 hours session + 1 hour Lunch break)

Understanding the life influencing damage mechanisms and possible remedial actions are a key element for a successful tube life assessment and extension. A detailed review will be made of the damage mechanisms, and how to recognise them. Following tube damage and failure mechanisms will be discussed.

- Creep (both short and long term failures)
- Fatigue (especially important in the plants subjected to cyclic operation)
- Corrosion (steam side and flue side)
- Flow Assisted Corrosion (FAC) in HRSGs
- Erosion
- Above mechanisms in combination

Module 3: **Tube Inspection** (2 hours session plus 15 min. break)

This will discuss tube inspection for wall thinning, pitting corrosion, bore oxide thickness, flue deposits, hardness testing and replication.

- Tube inspection (borescopy, UT etc.)
- Bore oxide thickness measurement
- Preferential thinning
- Portable hardness testing and what does it tell us
- Measurement of corrosion pits
- Tube replacement (under what circumstances and with what materials)

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DAY - 2

(Start 9 am – finish 4.30 pm - total time 7.5 hours)

Root Cause Failure Analysis & Life Assessment

Module 4: **Root Cause Failure Analysis & Case Histories of Tube Failures in Boilers & HRSGs**

(Morning)

(3 hours session + 1hr15 mins coffee & lunch breaks)

This module will show various cases of tube failures and how root cause failure analysis (RCA) of these was carried out:

- Furnace wall tubes
- Reheater tubes
- Superheater tubes
- HRSG tube failures due to Flow Assisted Corrosion (FAC)

Module 5: **Life Assessment and Risk Based Management**

(Afternoon)

(3 hours session + 15 min. break)

This part will show a number of cases of how tube remaining life is calculated for various type of damage mechanisms such as creep, corrosion, oxidation. This module will also cover risk-based tube failure management and how to reduce tube failures in a power plant boiler/ HRSG.

- Tube life due to creep
- Tube life calculation from oxide thickness measurement
- Safe remaining tube life due to thinning from corrosion.
- Risk based management of boiler tube cracking and failures (steps needed to reduce and manage failures in a power plant / HRSG boiler).

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COURSE PRESENTER

Dr David Robertson, Lead Metallurgist, ETD Consulting, UK

Experience

Dr Robertson has over twenty years of experience of materials used in the power, petrochemical and other industries. Since 2004, Dr Robertson has been working for ETD Consulting on projects related to high-temperature plant integrity and life assessment, materials and welding issues, and root cause failure analysis. Through his work, Dr. Robertson has gained extensive experience of the materials used and damage/ failure mechanisms in high-temperature plants. He also has considerable experience in examination and interpretation of metallographic replicas and microstructures in order to assess metallurgical damage and degradation (creep cavitation, spheroidisation, corrosion etc).

Boiler and HRSG tube failure analysis and integrity/ life assessment is one of Dr Robertson's speciality and he has worked in this area for about 15 years or so.

Dr Robertson is internationally known in his field and has special experience with T91 steel tubes being used in modern higher performance supercritical power plants. He is also very familiar with the issue of various alloys used for boiler and HRSG tubes and their occasional replacement with different tube materials.

Education: Dr. Robertson gained his qualifications in metallurgy at Imperial College, London.

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ABOUT THE ORGANISERS

European Technology Development Ltd. (ETD), UK

ETD is a UK based engineering and consulting company specialising in life assessment/ extension, maintenance, materials and engineering issues in all types of power generating and process plant. In addition to its ***main business of technical consulting, plant inspection and their condition and life assessment,*** ETD regularly organises training courses in power, petrochemical, oil, gas and other industrial sectors as a part of its programme on ***technology transfer to industry worldwide***. In the recent past ETD has organised various international workshops/ courses/ conferences in the UK, a number of other European countries (Germany, France, Portugal), Middle East, Far East, South East Asia, Canada and the USA. The issues involved in these courses covered lifing and failure analysis; HRSG design, maintenance and inspection; plant life assessment/ extension; high temperature plant materials behaviour; plant component safety and durability; performance of in-service welds and weld repairs; power plant cycling - technical and cost issues; boiler and turbine maintenance; petrochemical and refining plant issues; and, power plant benchmarking for performance, and risk based maintenance and inspection (RBMI).

For further information,

Please visit: www.etd-consulting.com Or, write to: enquiries@etd-consulting.com