

1-Day Training Course aimed at **Industry**



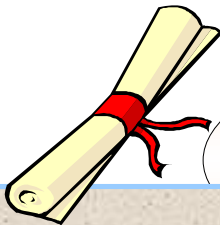
CRACK ASSESSMENT & FITNESS-FOR-SERVICE: HOW TO ASSESS CRACKS IN COMPONENTS OPERATING UNDER CREEP AND/OR FATIGUE CONDITIONS & THEIR FFS



Note: This course on 12th Nov. will be run back-to-back (at the same venue) with the following **Optional** events (you can attend one or more events):

- 1) 2-day Training Course on **P91/T91** (8-9 Nov),
- 2) 1-day **Seminar & Discussion** on the use of new steels (P91, P92, P122, P23) in high temperature plant (10 Nov).
- 3) 1-day Training Course on **Life Assessment & Damage Mechanisms** (11 Nov).

>> To see further information and programme details please visit: www.etc1.co.uk



1-Day Training Course

Venue: BALI HYATT SANUR, BALI,
INDONESIA

Dates: 12 NOVEMBER 2010

Full understanding of the intricacies of evaluating the effect of defects in complex structures can only come from a good understanding of the principles underlying materials behaviour. The modules in this course present the theory behind the main damage and crack growth models. The course also critically reviews the main Defect Assessment procedures currently in use worldwide.

The new **industrial 'Crackfit' crack assessment Procedure and Software [developed jointly by ETD - UK and Laborelec - Belgium]** will be demonstrated for its use for crack assessment in various type of industrial components and its use for sensitivity analysis and probabilistic assessment in creep and fatigue crack growth.

This popular course has been in the past conducted in the UK with delegates from many countries and different industrial sectors and technical organisations attending.

Training for Success

WHY THIS COURSE ?

Crack growth and accurate assessment of the behaviour of high temperature plant components containing defects and operating under steady and/or cyclic load conditions has become an area of urgent need and interest especially to plant engineers. The understanding of defect assessment process and procedures is important for the engineers especially when designing/modifying, installing components or in the operation of plant.

Removing/replacing components with defects would be costly. Other financial implications related to downtime, or forced outage will also be endured by plant management. Before deciding to remove the faulty components, management may want to perform a fracture analysis assessment in order to see if the components in the presence of defects are still fit-for-purpose. The defect sizes assessed could be determined by various factors e.g. the sensitivity of the current NDT equipment or in the case of welds, the type and/or size of the electrode wire. Results showed that up to a certain defect size, the components were still fit to be used in plant. In the presence of defects, correct inspection and monitoring of the component followed by life assessment are recommended as a good practice.

The course will provide attendees with:

- The opportunity to understand the procedure of defect (hence life) assessment of various components which contain defects like lack of fusion/penetration in welds (defect at weld toes), internal and external surface emerging or embedded defects in straight pipes, defects at stress concentrations such as sharp corners (T-piece, nozzle) and standard laboratory specimens. This includes failure analysis (fast fracture, plastic collapse and ligament rupture) and evaluation of damage mechanisms such as creep, fatigue, and creep-fatigue interaction.
- Hands-on application of Crackfit© for industry engineers who would like to carry out defect assessment without having to go through different established codes or national/ in-house defect assessment practices.
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Crackfit© introduces

The *Material* module allows the user to select different materials commonly used in high temperature plant, such as: martensitic steel ASME P91 including the weld metal and HAZ properties; traditional low alloy steels such as 2.25Cr1Mo (P22) steel, rotor steels such as 1CrMoV, and the austenitic steels such as 304 and 316. The material properties included are tensile strength, stress rupture, rupture ductility, fatigue and creep crack growth data from established sources like HIDA and ECCC datasheets.

- The *Cyclic Loading* module provides algorithm for the user to apply up to four scenarios of cyclic loading of different maximum and minimum load, temperature and dwell time values for the case of creep-fatigue interaction.
- *Sensitivity and Probabilistic analysis*: In reality, input data required for the defect assessment can be varied and may be obtained from well scattered data tending to produce large deviation of the input values, hence reducing the confidence in the quality of the results. CRACKFIT© accommodates the two types of analyses by allowing the user to simply choose the confidence level for different type of input data. The outcome of the evaluation (such as 'time to failure', 'cycles to failure', 'number of cycles required for a specific crack growth' etc.) is represented in CRACKFIT© in a simple tornado or bar diagram for the sensitivity analysis case, and the 'probability of failure versus time' curve can be derived from the probabilistic analysis using Monte-Carlo Simulation.

Course Presenters

Dr Sarinova Simandjuntak, Dr David Robertson are of *international repute* who work for industry and have a well-established track record in the understanding/ study/ practice of Crack Assessment and Fitness-For-Service .

Who Should Attend?

All those who have responsibility for assessing the condition of plant, making run/repair decisions or ensuring safe and uninterrupted operation, or are intimately involved with any of the following functions in Power Generation or Petrochemical industries.

- O Engineering Planning
- O Maintenance Service Providers
- O Inspection - assessing defect significance
- O Insurance
- O Research and Development
- O All those involved in High Temperature Defect Assessment

Technical Enquiries to:

Dr Sarinova Simandjuntak Tel: + 441372 363 111 ssimandjuntak@etd1.co.uk

Who Are We ?

European Technology Development Ltd. (ETD) is a UK based engineering advisory, consulting and R&D company specialising in high temperature plant life assessment/extension, maintenance, materials and engineering issues in all type of power generating and process plant. ETD has, in the recent past, organised various international workshops/ courses/ conferences in the UK, a number of other European countries (Germany, France, Portugal etc.) and Asia, mainly on the issues such as: plant life assessment/extension, high temperature plant materials, plant component safety and durability, performance of in-service welds, power plant cycling and power plant risk based maintenance (RBM). The company is leading and co-ordinating a number of large leading edge international industry initiatives (supported by the industry from North America, Japan, Europe and elsewhere or by funding agencies such as the European Commission) on issues related to the assessment and improvement of high temperature plant performance, materials and design, and maintenance and inspection strategies. The company has carried out/ participated in some leading edge projects on P91 weld repairs, crack assessment, integrity issues and has carried out reviews of P/T91 performance in plant worldwide.

DAY - 12 November 2010

REGISTRATION & WELCOME 0830 – 0900

Module 1: Fracture Mechanics Concept

0900 – 1100 h (with 30 minutes break)

Presenter

Dr Sarinova Simandjuntak, ETD, UK

Objectives

To develop a better understanding of the underlying concepts and basis of Fracture Mechanics and its development to elastic/plastic, fully plastic and creep concepts.

Specific topics will include:

Fracture theory, Material influences, Elastic/plastic fracture mechanics models, Fully plastic and creep fracture mechanics concepts.

Module 2: Creep, Fatigue, Creep-Fatigue Crack Growth

1100-1230 hrs (with 30 minutes break)

Presenter

Dr David Robertson, ETD, UK

Objectives

To build understanding and awareness that high temperature crack growth is a complex phenomenon. Determination of the behaviour of a component containing a crack / defect at a given time is dependent on the interpretation of numerous material and loading parameters and their interaction. In this module both the underlying principles and the influencing parameters will be examined. Like any component assessment, defect assessment requires reliable input data such as operation, inspection and material data. In practice such data are rarely available for a particular defect location, material cast etc. Hence the use of sensitivity analysis and probabilistic approach to defect assessment are essential to reliably predicting plant integrity by taking into account uncertainty in the input data and variability in material properties.

Specific topics will include:

Creep crack growth models, Determination of materials parameters, Creep/Fatigue interaction models, Introduction to sensitivity analysis / Probabilistic approach, Problem examples/discussion.

LUNCH	1230 – 1400 HOURS
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Module 3: Continuum Damage Mechanics

1400 – 1500 hrs (followed by 30 min break)

Presenter

Dr Sarinova Simandjuntak, ETD, UK

Objectives

To understand that there are numerous models for determining the development of damage in structures. The main damage models and the underlying micro-mechanisms will be described and the methods will be critically examined relative to their ability to accurately predicting component behaviour.

Specific topics will include:

Damage Micro-Mechanisms, How damage develops, Damage models - Kachanov-Rabotnov etc.

Module 4: Defect Assessment: Procedures/Standards/Codes + Crackfit demo

1530 – 1700 hrs

Presenter

Dr Sarinova Simandjuntak, ETD, UK

Objectives

This part of the course aims to bring the foregoing theory into practice. After briefly reviewing and comparing various codes, a general approach to defect assessment will be presented step-by-step and applied to specific case studies.

Specific topics will include:

Defect Assessment procedures, UK BS7910 (R6 and R5), French RCCMR-A16, API 579, HIDA, Crackfit.



The END



REGISTRATION FORM (Please copy and e-mail / fax / post)

**New High Temp. Materials Seminar (10 Nov) + P91 Training Course (8-9 Nov)
+ Life Assessment & Damage Mechanisms Training Course (11 Nov) + Crack
Assessment & FFS Training Course (12 Nov) - Bali Hyatt Sanur, Bali**

REGISTRATION FEE *:

➔ Please circle in the table below the amount relevant to you. The fee will be charged in pound sterling. For general guidance the conversion rate on 1st January 2010 was: £1 = US\$1.50. *Please feel free to register for one or more events.*

	Reduced Fee (until 1 st October 10)	Full Fee (from 2 nd October 10)
<i>Seminar: New High Temperature Materials (10 Nov. 2010)</i>	£200	£225
<i>Course: P/T91 Advanced Steel (8-9 Nov. 2010)</i>	£700	£750
<i>Course: Plant Life Assessment & Damage Mechanisms (11 Nov. 2010)</i>	£400	£450
<i>Course: Crack Assessment & Fitness-for- Service (FFS) (12 Nov. 2010)</i>	£400	£450

* **Note:** 20% discount for attending any 3 or more events or for group booking of 3 or more attendees from the same organisation.

PAYMENT

By bankers draft, or bank to bank transfer to:

European Technology Development

(For payment by bank to bank transfer, account details will be supplied on request. Contact details are shown at the bottom of this form). *Please quote reference 'Bali Events 10' with the payment and state here how you paid or intend to pay:*

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By Credit Card: Major cards such as Visa/ Master Card/ JCB/ American Express/ Switch are accepted with the exception of Dinners Club. For security please *fax or post* this information.

Name of Account Holder		Amount to pay	£ Sterling
Card Type and No.		Expiry date	
Authorisation signature		Security code	

Venue: Bali HYATT Sanur, Bali, Indonesia (www.Bali.Resort.Hyatt.com)

Accommodation: Information on local hotels can be acquired by email to: bali@matta-tour.com

Delegate Details: (Required for your badge)

Your **title** and **name:**

Company:

Position:

Address:

Phone:

Fax:

E-mail:

REGISTRATION ADDRESS: Please copy and post/ fax/ e-mail to address below:

Registration Section, European Technology Development, 6 Axis Centre, Cleeve Road, Leatherhead, Surrey KT22 7RD, UK

Enquires for registration or accommodation: registration@etd1.co.uk

Tel: + 44 1372 363 111 or + 44 1372 363 112 Fax: + 44 1372 363 222