

## TRAINING COURSE in "DEFECT ASSESSMENT"

21 - 22 June 2010, Guildford (near London), UK [www.hida5.com](http://www.hida5.com)  
(back-to-back with the HIDA-5 Conference)

### *Theory and Practical Examples -* **DEFECT ASSESSMENT APPLICATIONS IN RELATION TO INTEGRITY, FITNESS-FOR-SERVICE AND LIFE ASSESSMENT IN HIGH TEMPERATURE PLANT**

### **Power, Petrochemical, Oil, Gas and other Industrial Applications**

The three-day HIDA-5 conference will be preceded by this *optional 2-day Training Course* (LMF3) in damage and defect assessment under creep and/or fatigue conditions. This LMF3 course is one of a series of ETD Life Management Foundation (LMF) courses (LMF1, LMF2 and LMF3). The other two courses are: *Plant operation, damage and life assessment* (LMF1) and *Failure Avoidance and Advanced Assessment of Complex / Welded Components* (LMF2).

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.

Experts on defect/life assessment from research organisations and from industry will give interactive lectures. They will demonstrate the new **commercial 'Crackfit' Defect Assessment Procedure and Software [developed jointly by ETD (UK) and Laborelec (Belgium)]**, and will demonstrate its use for sensitivity analysis and probabilistic assessment in creep and fatigue crack growth. This Training Course, though optional, will be a good preparation for the Conference which will consist of research and industry specific papers.

#### **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

#### **Course Certificates**

These will be awarded to attendees on the completion of the course.

## LMF3 Training Course in 'Defect Assessment'

**21-22 June 2010**  
(2 - days)

HIDA-5 Conference  
**23 - 25 June 2010**  
(3 - days)

#### Venue

University of Surrey  
Guildford, UK  
(close to London)

---

#### **Organiser**



**European Technology  
Development (UK)**

#### *Technical enquiries:*

**Dr Sarinova Simandjuntak, ETD, UK**  
**Phone: + 44 1372 363 111**  
[ssimandjuntak@etd1.co.uk](mailto:ssimandjuntak@etd1.co.uk)

#### *Registration, accommodation & admin. enquiries:*

**Mrs Yoli Sim, ETD, UK**  
**Phone: + 44 1372 363 111**  
**Fax: +44 1372 363 222 Email:**  
[ysim@etd1.co.uk](mailto:ysim@etd1.co.uk)

#### *For sponsorship and product publicity (exhibition/ wallet service etc.)*

[ashibli@etd1.co.uk](mailto:ashibli@etd1.co.uk)  
**Phone: + 44 1372 363 111**

## Defect Assessment (LMF3) Training Course PROGRAMME

REGISTRATION ---- 0840 – 0900 h

**DAY 1 (21 JUNE) 0900 – 1700 (Including Breaks/Lunch)**

### **Lecture 1: Continuum Damage Mechanics**

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:* Damage Micro-Mechanisms, How damage develops, Damage models.

### **Lecture 2: Fracture Mechanics Concepts**

Basic elastic fracture concepts will be presented, then expanded to encompass complex loading situations and material property considerations. This will be developed to elastic/plastic, fully plastic and creep concepts.

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

### **Lecture 3: Defect Assessment Procedures**

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

**DAY 2 (22 JUNE) 0900 – 1700 (Including Breaks/Lunch)**

### **Lecture 4: Creep, Fatigue, Creep/Fatigue Crack Growth**

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

**Lecture 5: Defect Assessment Procedures, Their Application and ‘CRACKFIT’ Software Demo. for Sensitivity Analysis and Probabilistic Assessment.** This Lecture will review, compare and discuss various available defect assessment codes and procedures. A general approach to defect assessment will be presented step-by-step and then applied to specific case studies.

---

### **The benefits offered**

- 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.

### **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.

## The Lecturers are:

### Dr S Simandjuntak

*ETD Ltd, UK*

Sarinova Simandjuntak gained her qualifications in metallurgy and materials, and corrosion engineering, at Imperial College, London. She has extensive experience in materials and mechanical engineering aspects of high temperature plant, FE analysis, probabilistic assessment and component stress analysis. She is currently working on the further development of ETD's software for (i) Risk Based Maintenance and (ii) crack assessment for high temperature plant components, and contributing to the development of ETD's Remaining Life Assessment Procedure for boilers, turbines, electrical components and auxiliary equipment, which incorporates both deterministic and probabilistic life assessment.

### Prof A Saxena

*University of Arkansas, USA*

Ashok Saxena is Dean of Engineering, Distinguished Professor and Irma and Ray Giffels' Chair in Engineering in University of Arkansas, USA. Prof is well known internationally for his distinguished academic and research interests in Fracture Mechanics, Creep, Nanostructured Materials, Fatigue, Microstructure – Property Relationships, Composite Materials, Reliability and Risk Analysis, and Life Extension of Aging Structural Components.

### Prof D Smith

*University of Bristol, UK*

David Smith is Professor of Engineering Materials. His academic and research interests are strength and performance of engineering materials; high temperature fracture and fatigue; and locked-in stresses in engineering components. He is the head of the Solid Mechanics Research Group which has extensive research activities primarily funded by industries, European Commission and EPSRC ([www.men.bris.ac.uk/research/solids.html](http://www.men.bris.ac.uk/research/solids.html)). He is also the Director of the Systems Performance Centre, and recipient of a Royal Society Research Wolfson Merit Award.

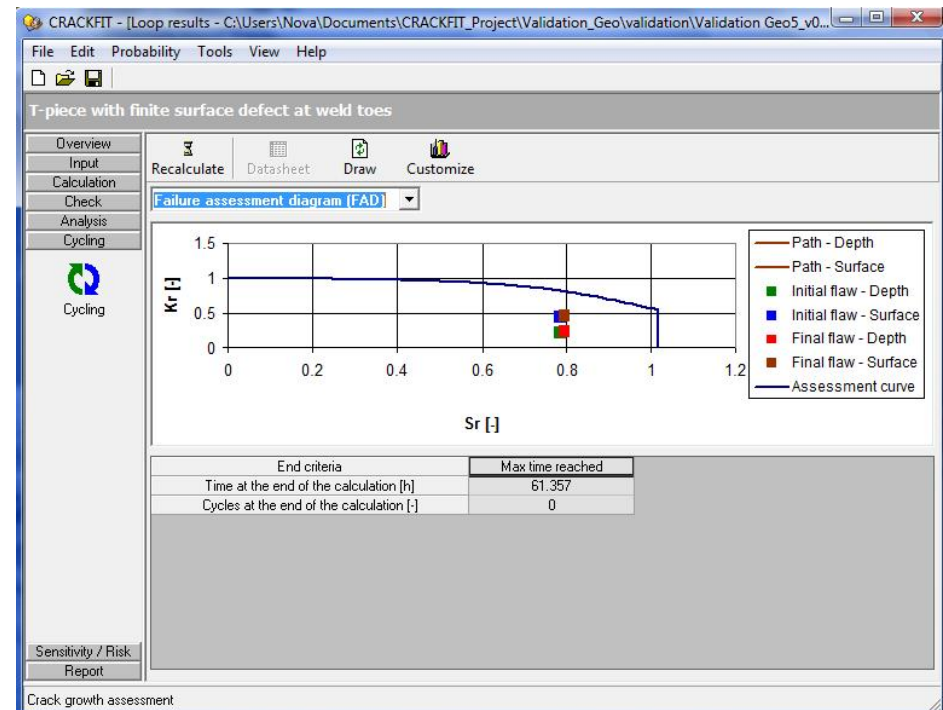
### Dr -Ing A Klenk

*MPA Stuttgart, Germany*

Andreas Klenk is Head of the Materials Department at MPA Stuttgart. He is well known for his expertise in high temperature fracture mechanics and has led a number of European Commission, German government and industry initiatives in the understanding and strength estimation of materials for high temperature plant. More recently Dr Klenk has been involved in the European formulation of rules for high temperature crack initiation and growth.

## 'CRACKFIT' Procedure and Software Demonstration

The day-2 afternoon of the Training Course will be devoted to the understanding of the commercially available Defect Assessment Procedures. As a part of Lecture 5 the recently developed commercial Software 'Crackfit' will also be demonstrated including its functions as a sensitivity analysis and probabilistic assessment tool. This Software has been jointly developed by ETD and Laborelec/Electrabel (Belgium) and is based on the original HIDA Procedure. It covers a number of power and petrochemical plant component geometries and provides option of the use of other available procedures to analyse defect initiation, growth and probability of failure in high temperature plant. In this module the Crackfit software will be used to solve problem examples related to defect containing components in high temperature plant.



## Course enquiries

Dr Sarinova Simandjuntak

Tel: + 44 1372 363 111 [ssimandjuntak@etd1.co.uk](mailto:ssimandjuntak@etd1.co.uk)

# Registration Form

**Registration Fee** - For events held in the UK, overseas delegates also need to pay UK applicable VAT 'value added tax' at 17.5%. All figures are in **UK pounds**. (Registration Fee covers Conf. Proceedings, Refreshments, Lunches, and Conf. Dinner).

* Concessionary fee applies only to the author presenting the paper. ** Please 'tick (v)' in appropriate box.		Until 21 May 2010			After 21 May 2010		
		Fee	Amount Payable (Fee + VAT)	**	Fee	Amount Payable (Fee + VAT)	**
Training Course	Any attendee	600	705.00		650	763.75	
	Delegate	550	646.25		600	705.00	
Conference	Author	500	587.50		550	646.25	
	All	1000	1175.00		1100	1292.50	
University Accommodation (only during the conference) – limited number of en-suite 'single' rooms (with shower) have been reserved		£55 + £9.63 (VAT) per night = £64.63 (including Breakfast & Dinner)					
Please show check-in and check-out dates for University accommodation		Check-in date:		Check-out date: Total payable for accommodation: £			
<b>Total amount payable to ETD</b>		<b>Registration + Accommodation = £</b>					

**Accommodation:** Only single room University accommodation (with en-suite shower) is available. Those wishing to use other type of accommodation need to look for 'hotel' links on the Conf. Website [www.hida5.com](http://www.hida5.com) and book directly with the hotel.

**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 'HIDA- 5'**. (Please state below how and when the fee was paid or will be paid) .....

**Credit Card Payment:**

**By Paypal:** For payment by Paypal using credit card please go to the Conference website: [www.hida5.com](http://www.hida5.com)

**Direct to ETD:** Payment can also be made by sending the following credit card details (Visa, Mastercard, Switch, JCB, etc., except Diners Club) to ETD **by fax or post** (for security reasons you are advised not send these by email).

Name of account holder: Security code:  
 Credit card number: Expiry date:  
 Amount payable: Signatures of the cardholder:

Your title and name:  
 Company: Position (optional):  
 Address:  
 Phone: Fax: E-mail:

Please state special dietary/access requirements (if any): .....

Please copy and post / fax / e-mail to the Registration Address below:



Registration Section, ETD, 6 Axis Centre, Cleeve Road, Leatherhead, Surrey KT22 7RD, UK.  
**Tel:** + 44 1372 363 111 or + 44 1372 363 112, **Fax:** + 44 1372 363 222, **E.mail:** [ysim@etd1.co.uk](mailto:ysim@etd1.co.uk)