Welcome to the May 2015 edition of ETD’s Technology Newsletter.

At ETD we have been busy so far this year, completing numerous projects globally, including in Indonesia, the UAE, North America and, of course, our base the UK. Recent projects have included life assessment, failure analysis and on-site NDT using, amongst others, our specialised Electrical Discharge Sampling Equipment (EDSE) and Integrity Scanning Force Microscope (I-SFM).

We have also continued work on our long-term P91 & P92 steels group-sponsored projects – which new sponsors remain welcome to join.

At ETD we are at the forefront of our field. Our team have recently published important new Guidelines on the ‘Impact of Cyclic Operation on Maintenance Programmes for CCGTs and Conventional Power Plants’, following the completion of a worldwide study. In addition, various Recent Articles written by ETD have been featured in journals and online publications – you can read them in this newsletter by clicking on the relevant link.

We have a busy calendar of Events, Courses & Conferences, which provide unique In 2015 & 16, we have important Conferences in the UK, Poland, China and USA.

ETD continues to offer technical excellence in our Consulting Services and On-site / Outage Services. We offer high quality RCM services for power and process plants, including bespoke training for your plant. We have updated our training programmes for RCM and can now offer on-site training for your engineers of 2-5 days. If you are interested in RCM please consider registering to attend our free webinar on 10 June 2015. Contact us to register.

Benchmarking for power plants is another area in which we excel. Click here for more information.

For further information please contact: Omar Shibli | Director of Operations oshibli@etd-consulting.com Tel: +44 1372 363 111
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ETD’s 2015 & 2016 Events Calendar

6-8 October 2015
2-DAY CONFERENCE: POWER PLANT LIFE ASSESSMENT + 0.5-DAY COURSE: P91/P92 STEELS + 0.5-DAY PLANT VISIT
HOTEL WODNIK, SLOK near BELCHATOW POWER PLANT, POLAND

Two Back-to-Back events (Option to attend any or all):

24-25 November 2015
2-DAY CONFERENCE: PLANT CYCLING, FLEXIBILITY & PRESERVATION
CENTRAL LONDON (IOM3 BUILDING), UK - PROGRAMME NOW PUBLISHED
Followed by:

26-27 November 2015
2-DAY COURSE: BOILER & STEAM TURBINE REMAINING LIFE ASSESSMENT
SURREY (NEAR LONDON – AT ETD TRAINING CENTRE), UK (DATES PROVISIONAL. SUBJECT TO CONFIRMATION)
DAY 1 - BOILER RLA; DAY 2 - STEAM TURBINE RLA
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20-22 April 2016
3-DAY CONFERENCE: EXPERIENCE WITH THE MANUFACTURE, WELDING, QUALITY CONTROL & USE OF T/P91-92, T/PP23-24 STEELS
HONGYI HOTEL (WUHAN UNIVERSITY INTERNATIONAL ACADEMIC COMMUNICATION CENTER), WUHAN, CHINA
Call for Abstracts open

THIS CONFERENCE WILL BE PRECEDED BY A 2-DAY TRAINING COURSE ON P91 AND P92 ISSUES, APR 18-19 2016. PLEASE SEE CONFERENCE PROGRAMME FOR DETAILS.

Sept 2016
3-DAY CONFERENCE: LIFE / DEFECT ASSESSMENT & FAILURES IN HIGH TEMPERATURE
USA - (EXACT DATES & VENUE TO BE CONFIRMED)
Call for Abstracts open

If you wish to discuss anything regarding our Training Courses or Conferences please contact us.

P.S. We also offer in-house Training courses
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Some of the Recent Projects

ETD are pleased to announce the successful recent completion of various projects, examples include:

1. **COMPLETED ‘HRSG REMAINING LIFE ASSESSMENT’ PROJECT, INDONESIA**
   ETD completed a project at a power generation plant based in Jakarta. Work involved remaining life assessment on three HRSG units. To find out more about our life assessment services [click here](#).

2. **ELECTRICAL DISCHARGE SAMPLING EQUIPMENT (EDSE) NDT PROJECT, UK**
   EDSE successfully removed two axial samples from the interstage gland area of a Steam Turbine Rotor to study the tips of growing cracks and thus determine the root cause of cracking. The EDSE cutting head was mounted in the confined space between the rotor discs using a bespoke magnetic mount.
   EDSE samples ranging from 1 to 20mm thickness, width 20 to 40mm and length 20 to 120mm can be machined out from thick section pressure vessels, rotors or other industrial structures for root cause cracking analysis, small punch testing, miniature specimen creep rupture and fatigue testing, microstructural studies, hardness testing, material quality checks in new built or life assessment in ageing plants etc. For more information on EDSE [click here](#).

3. **IMPACT OF CYCLING ON POWER PLANT MAINTENANCE REGIME**
   ETD have produced new Guidelines for an international client on the ‘Impact of Cyclic Operation on Maintenance Programmes for CCGTs and Conventional Power Plants’. ETD analysed a large number of CCGTs (both GTs and HRSGs) and produced a detailed 166 page report with summary tables for the ease of understanding the changes required in the maintenance programmes. At ETD we have the expertise to assess your current maintenance programme(s) to give you a proper understanding of the cost and performance impacts of cyclic operation. We can then advise on proper measures to improve those aspects, for more cost-effective performance. If you would like your maintenance programme to be evaluated please [contact us](#).

4. **P91-P92 INSPECTION & LIFE ASSESSMENT PROJECT**
   In ETD’s group-sponsored project ‘P91-P92 Inspection & Life Assessment’, three P91 and one P92 welded pressure vessels are being tested under creep conditions. Two of the tests were recently interrupted (at 30% of expected life) to enable the study of various inspections techniques (replication, hardness, innovative UT techniques, boat sampling using EDSE, I-SFM, magnetic resonance and potential drop). Further test interruptions are planned at 50% and 70% of life in order to determine the urgently needed relationships between damage development in the ‘Type IV’ or fine grain HAZ region and remaining life of the test vessels. Partners involved in the project are from the UK, Germany, Italy, Belgium and Japan. New partners are welcome to join. For more about our I-SFM or EDSE technologies [click here](#). For more about our group sponsored projects [click here](#).

5. **‘Abnormal P91’ Project**
   ETD is now co-ordinating this 5-year duration Joint Industry Project, sponsored by European and Japanese industry, aimed at studying the behaviour and long term life expectancy of P91 aberrant base or weld metals, or both. This situation usually develops when heat treatment of P91 components, during steel production or component fabrication, is not carried out to the precise requirements and thus material creep rupture strength can fall drastically resulting in early failure. This project is aimed at generating long term rupture data for a variety of aberrant microstructures found in plants worldwide. New partners are welcome to join. For details [click here](#).

6. **BOILER TUBE FAILURE ANALYSIS PROJECT, MIDDLE EAST**
   ETD has recently carried out root cause failure analysis of a number of ASTM A213 T91 superheater tubes that had ruptured after 100,000 hours service in boiler units of two large power plants in the Middle East. Metallurgical investigations showed that some tubes failed due to the combined effects of fireside corrosion, steam side oxidation and long-term overheating. Drawing on extensive experience of boiler tube failures and T91 steel, ETD has recommended remedial measures. For about our failure analysis services please [click here](#).
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Recent Articles

ETD have prepared and published several articles including:

1. INSPECTING ABERRANT P91 COMPONENTS FOR INTEGRITY - POWER MAGAZINE
Managing Director and Lead Metallurgist Dr. Ahmed Shibli has written an article that is featured in Power Magazine. READ THE FULL ARTICLE HERE

2. BENCHMARKING: THE KEY TO IMPROVED PERFORMANCE AND LOWER COSTS - MODERN POWER SYSTEMS
An article by Dr A Shibli, Eng F Akther and Eng S Hampson, all of ETD Consulting, featured in Modern Power Systems. This article explores the benefits of Plant Benchmarking to gain a better understanding of the Operations & Maintenance cost-performance impact of plant cycling. READ THE FULL ARTICLE HERE

3. MIRACLE STEELS? – MATERIALS WORLD
Ahmed Shibli, from European Technology Development Ltd, analyses the problems caused by improperly treating high-temperature martensitic steels P91 and P92, and calls for more research into the issue. READ THE FULL ARTICLE HERE

If you would like to know more about any of the publications that were mentioned above please contact us.
New & Completed ‘Group Sponsored Projects’ (GSPs)

**Group Sponsored Projects**
ETD has excellent expertise through its in-house R&D, plant service/technical consulting and project management experience and links with plant manufacturers, plant operators, service providers and researchers from around the world. The company is thus in an ideal position to conduct such projects on behalf of project partners and bring together plant experience from best run plants and the latest technology development in Europe, Japan, USA and elsewhere.

In response to the needs of the international industry, ETD Consulting regularly launches new multi-client or joint industry projects for participation by organisations from around the world.

The benefit of joining these GSPs, in which costs are shared, is that each participant gains the results of the whole project at a fraction of the full project cost. The work is carried out by ETD experts and consultants - with some information, expertise or data contribution by the participants/sponsors on a voluntary basis.

**Active/ Running Group Sponsored Projects**
These GSPs are open for participation:

- **WELDLIFE - Avoidance of P91 Type IV failure in P91 and P92 Steels** (new proposal)
- **Creep Rupture Strength of ‘Abnormal P91’ Materials & Welds**
- **Development of Inspection, Monitoring & Life Assessment Techniques & Guidelines for welded P91/P92 in-service components**
- **Development of Guidelines for the Commissioning of Conventional Power Plants**
- **RCM / RAM Guidelines for Power Plants**

To see a list of ETD’s active and completed Group Sponsored Projects, go to [www.etd-consulting.com/group-sponsored-projects](http://www.etd-consulting.com/group-sponsored-projects).

**Completed Group Sponsored Projects**
Many of our completed GSPs have resulted in the production of industry Guidelines & Reports, which can be accessed and purchased [here](#).

If you would like further information about our completed GSPs then please do [contact us](#).
EDSE – Innovation in ‘Boat Sampling’

The Electric Discharge Sampling Equipment (EDSE) was developed by ETD in collaboration with international partners to aid in the condition and life assessment of components. The sampling of in-service components has long been seen as an effective way of determining actual material properties and subsurface material condition. However, many of the existing methods of sample removal require mechanical cutting which can deform the surface and usually require weld repair. Unlike the traditional mechanical ‘boat sampler’, with EDSE, the surface damage if any is of the level of only a few microns. ETD has recently used EDSE for the sub-surface material characterisation and quality checks of new and in-service P91 components. EDSE can also be used to cut out specimens for small punch testing and miniature creep, fatigue or tensile testing for more accurate quantitative life assessment.

Industry Need

The most accurate way of determining an aged material’s condition is through non-destructive, physical testing. For a large plant component, this is obviously impossible without taking a sample. Without care, this sample can leave the component damaged with stress concentrations and a reduced wall thickness, shortening the service life.

The Solution

Based on the EDM process, the EDSE cuts out small, thin section of samples; leaving no sharp corners and without inflicting work hardening on the component surface. These samples can then be machined down to be used in creep, fatigue, tensile, toughness and hardness tests. The EDSE can cut out small slices between 1 to 20 mm thick and approximately 20mm2 or 40mm2 or 40mm x 120mm from thick section components for their remaining life evaluation and extension. The unique cutting process leaves behind cavities with round edges that do not require repair.

Advantages of EDSE

An advantage of the EDSE system is that the resulting cavity leaves rounded edges with a 4mm radius and no stress concentrations. The process of cutting uses a consumable electrode that removes material via electric spark erosion, with purified water to remove debris and provide a cooling medium. The cutting time for a standard specimen is about 1.5 hours and the EDSE can be used on horizontal, vertical and angled surfaces by either strapping to the component or through the use of a magnetic mount.

EDSE is available for purchase or as part of ETD’s inspection services. For further details or to request a demonstration please contact us.

For more information on the Electrical Discharge Sampling Equipment, visit www.etd-consulting.com/edse

Results

This is a picture of a boat sample that can be cut out of your pipe. The maximum depth our electrodes can go is 20mm in depth, 20mm width and 35mm in length.

Client Feedback

“We were pleased to be able to use the scoop sampling technique on this rotor and believe there is a potential for use elsewhere. We were very pleased with the results as we have been able to provide substantially more information on the crack mechanism than we would have been able to do with surface metallography.”

Feedback from a European Turbine Manufacturer - for work on their steam turbine rotor. This involved cutting out samples up to 20 mm thick to investigate the root cause of crack initiation and propagation.

This is a video from a job we recently completed for a client. The EDSE was mounted in the gland area using magnetic mounts and a bespoke frame.
I-SFM Integrity – Scanning Force Microscope
A Portable Microscope for On-Site Use in Multiple Industrial Sectors – Power, Process, Aerospace etc. - for damage and microstructure studies

More Powerful than an SEM!

A revolution in non-destructive on-site examination and testing of industrial components and materials for nano or micro level defects, microstructural deterioration and other microstructural properties.

The image on the right shows the microscope scanning head (square box in the centre) mounted on a mobile frame that sits on a fixed frame which in turn is attached to the component under investigation.

What is I-SFM?
I-SFM is a portable version of the Atomic Force Microscope that has been developed for on-site damage and microstructural imaging of critical components in industry or other large structures – metallic or non-metallic.

A Portable Tool for use in various industrial sectors
I-SFM is portable and can be used on almost any material. It can be mounted at any angle on the component being scanned as long as there is a reasonable clearance around. It can be easily mounted on flat or curved surfaces.

I-SFM produces high-resolution 3D images of the surface under study, allowing users to obtain 3D images of defects, with sizes of the order of 0.01-0.1 microns, and assess their depth.

Advantages Over Current Tools
I-SFM has the following significant advantages over the other NDT and diagnostic tools currently in use:

• I-SFM can be used on-site and attached directly to the component being investigated after polishing the area under study to 1 micron level (same as for replication) and etching.

• The ability to view defects in 3D at the nanometer scale allows for early-stage damage detection that would not be picked up by most other NDE techniques. Thus very useful for P91 type in-service component investigation where micron size creep cavitation develops only late in life and thus early damage can be missed by most NDE techniques.

• I-SFM does not require the use of vacuum equipment, in contrast to electron microscopy, and is equally good for use in laboratory.

• The real-time capture of data and imagery by I-SFM on-site cuts the time needed to complete damage assessment as is the case with replication.

The video above shows the microscope mounted on a mobile frame that sits on a fixed frame which in turn is attached to the component under investigation.

I-SFM is available for purchase or as part of ETD’s inspection services. For further details or to request a demonstration please contact us.
ETD Consulting Services

Benefit from our expert services

ETD Consulting is an industry leader in root-cause failure analysis, finite element and probabilistic analysis, weld analysis, materials evaluations, repair/replacement analysis, and more.

The services that we offer include–

- Advanced Materials (P91, P92, P23 & P24 Steels)
- On-Line Monitoring
- Asset Management & Reliability Centered Maintenance (RCM)
- Plant / Asset Integrity
- Boiler Tube Assessment
- Plant Benchmarking
- Combined Cycle / HRSG Consulting & Engineering
- Stress Analysis
- Power Plant Cycling Cost & Performance Analysis
- Probabilistic Life Assessment
- Defect Assessment
- Life Assessment & Extension
- Failure Analysis
- Risk Based Maintenance
- Finite Element & Stress Analysis
- Vendor Qualification
- Fitness for Service
- Other Specialist Services

If you would be interested in discussing potential projects further please contact us at:

enquiries@etd-consulting.com  +44 (0) 1372 363111

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EPERC Board of Directors have chosen ETD to run its secretariat, help develop/ promote future European pressure equipment research and develop collaboration with major international research entities, industry, and codes/ standards bodies. The aim is to develop EPERC into a major resource for PV information and research.

You are invited to become a member of EPERC and thus be a part of this great European and international network.


EPERC Seminar: EPERC GA will be preceded by a 1-day Seminar on 22nd September. The seminar title is: “Alternatives to In-service Pressure Testing of Components in Ageing Power & Process Plant”.

Abstract submission deadline = Monday 15th June 2015.

Please submit your abstract to: Dr Ahmed Shibli at ashibli@etd-consulting.com

Details at: www.eperc-aisbl.eu
Outage Services

Benefit from our expert services during your 2015 and 2016 plant outages

The advantage of ETD over others is that we can conduct both on-site services and post-outage life assessment work. Whether your need is for one-off replication services, other on-site services or life assessment - or if you want one group to design, manage and run your entire outage and life assessment process - ETD can assist.

We can offer the following –

(1) **Pre outage planning and management**
- Includes detailed technical analysis of historical operations and maintenance data, plant drawings etc.
- Provides you the best outage plan, with the right tests at the critical test sites for your plant needs, to maximise the usefulness of any outage work.

(2) **Outage management and operations**
- You provide the safety training and plant orientation, we provide, manage and co-ordinate the testing teams, to ensure a smooth outage.

(3) **Provision of on-site services**
- Includes all NDT (visual inspection, metallographic replication, electrical discharge sampling, boroscopy, hardness testing, ultrasonic testing, phased array testing, magnetic particle testing, penetrant testing, remote field eddy current testing, rotational inspection etc).
- For sampling, our own unique NDT equipment (Electrical Discharge Sampling Equipment, or EDSE), developed in collaboration with international partners in Japan, leaves cavities with rounded edges that do not usually require repair - this revolutionises the cutting process.
- For early stage damage detection such as creep cavitation ETD can use our unique Integrity Scanning Force Microscope (I-SFM). This is a portable version of the Atomic Force Microscope, which has been designed by ETD (in collaboration with industry partners) for on-site use. It can be attached directly to metallic or non-metallic components during your outage and detects creep cavitation at the nano scale, producing real-time data and 3D images for analysis.

(4) **Post-outage analysis services and reporting**
- On all issues including life assessment (deterministic or probabilistic), failure analysis etc.
- Can include advance planning based on this information for future outages, development of operations and maintenance plans etc.

If you would be interested in discussing potential projects further please contact us at: enquiries@etd-consulting.com  +44 (0) 1372 363111
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Reliability Centered Maintenance (RCM) Services

What is RCM?
RCM is an industrial improvement approach, focused on identifying and establishing the operational, maintenance and capital improvement strategies that will manage the risks of equipment failure most effectively. In recent years, maintenance and operation performance of plants has assumed far greater importance, resulting in the development of new maintenance philosophies and techniques. Learn more at www.etd-consulting.com/reliability-centered-maintenance-rcm

ETD offers the following RCM opportunities in 2015:

1. Full Implementation of RCM programme for your power or process plant
   (Also offer to audit your own or third party RCM programme for your plant):
   RCM can be implemented for identified Plant systems or across the whole plant, to suit your Plant needs and budget. If this offer for RCM programme development and implementation is taken up by a utility plant then the fee for the 2 Hour In-house Seminar and/or the RCM Training Course, if attended, can be refunded.

   Note: ETD can undertake RCM work for both Power and Process plants. If you wish to discuss any of these options further then please contact us.

2. 2 Hour Web Based RCM Seminar
   Date & Location: Per Client Requirements (Online or Video-Conference Delivery Only)
   Cost: £200 Pounds Sterling (approximately $300 US Dollars) Per Plant (unlimited attendees)
   A 2 hour In-House Seminar, prepared bespoke for your plant, to introduce your Plant personnel to the concepts of RCM, including RAM-RCM, and consider how an RCM program can be successfully devised and implemented for your particular Plant, to increase efficiency and productivity while saving costs.

   Note: This Seminar is delivered either online or by videoconferencing to a location of your choice. You can project us directly into your training room or, if you prefer, personnel can access the Seminar using just a computer with stable internet connection.

3. 1 to 5 Days In-house RCM Training Course – Specific to Your Plant
   Date & Location: Per Client Requirements (delivered in person at your site; remote video conf. option also available)
   Cost: From £2,000 - £10,000 (depending on number of days) (unlimited attendees)
   A unique In-house Training Course on RCM for Power and/or Process Plants, (both conventional and CCGT), which could run for 1- 5 days depending on your time and budget requirements. There is no limit on the number of attendees. This is a comprehensive practical course on RCM programme development, implementation and optimisation in Power and/or Process Plants with customer specific equipment GTs, STs, HRSG, Generators, Transformers, and BOPs including RAM-RCM.
   This training course can be delivered either in person to a venue of your choice or remotely using our videoconference technology. It is tailored specifically for your plant and adjusted to suit your personnel’s prior level of RCM knowledge.

If you would like further information about any of our RCM services please click here

ETD Consulting hosted a webinar on Asset Management and RCM on 22 October 2014. If you missed it, you can now view a recording of the webinar by clicking here. The webinar is password protected - if you would like to view it just email us.

Note: ETD can undertake RCM work for both Power and Process plants. If you wish to discuss any of these options further then please contact us.