



**European Technology Development Ltd**

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**DEVELOPMENT OF A PROCEDURE & SOFTWARE -  
INTEGRITY AND REMAINING LIFE ASSESSMENT OF  
*PETROCHEMICAL, PROCESS AND REFINING PLANT***

Acronym: **PetRef Lifting Procedure**

ETD Project No: **1102-gsp-prop08**

A Brief of the Project Proposal

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## I. INTRODUCTION

The principal **objective** of this Group Sponsored Project (GSP) is to prepare a Procedure which provides step by step guidelines for the Integrity and Remaining Life Assessment (IRLA) of high temperature components in petrochemical, process and refining plant.

This Procedure will be based on:

- a) a vast amount of experience gained from conducting IRLA work on plant worldwide,
- b) experience gained from research and development work in IRLA of high temperature plant where many of these projects have been/are being conducted in collaboration with leading international organisations and world experts from Europe, North America, Japan and elsewhere,
- c) knowledge and experience gained from conducting training courses and seminars on life assessment and extension of high temperature plant (both power and petrochemical) worldwide,
- d) conducting tailor made courses on plant life assessment for industry worldwide.

The experience referred to above not only involved industrial components made from the traditional alloys (2.25Cr1Mo, 1CrMoV, etc.) but also those involving relatively newer materials (such as P91, P92, P23 etc.) and special alloys for petrochemical and refining application. and special alloys, like those designed for petrochemical application, chemical process and refining.

In this project the results of the activities referred to above will be critically assessed, organised and summarised in a form that can be relatively easily understood and applied by plant engineers for a systematic integrity and life assessment of their plant. Most of the information needed for IRLA work is scattered between various sources of published papers, books, conference proceedings, codes and standards (such RTD, VGB, BS, ASME, API etc). Similarly the sources of material property data are also varied and a good life assessor needs to know which values to use under what circumstances. All of this is even more true for the relatively newer materials for higher temperature plant where the long term material strength values have recently been re-evaluated and new sources of data have evolved. Also, a number of publications have recently appeared dealing with the lifing issues unique to the components made from these steels. The procedure will thus also take into account the lifing of P91 components, based on the new plant and R&D experience on this material.

Some of the procedures and/or software for issues such as high temperature plant defect/crack assessment, plant maintenance, HRSG maintenance and repair, and plant monitoring etc. have already been prepared by ETD Ltd. The concept of the preparation of a Procedure and accompanying Software for the integrity and lifing of petrochemical and refining plant came as a result of the need by industry engineers for a single user friendly and up-to-date document to bringing together vast amount of data, information and experience gained so far. The encompassing of the Procedure in a software could make its use much more easy both by the novice and the expert plant and service engineers and life assessors. Such software could, for example, contain an atlas of micrographs for various materials used in chemical, refining and petrochemical plant, making it easy for the life assessors to compare their plant material condition with various degrees of deterioration observed in the standard micrographs. New information appears regularly from new R&D work and plant experience and a software format for such a Procedure will make it easy to update and include this new information on regular

basis. A software could also show the demonstration of on-site IRLA work making it much more easy for the integrity and life assessors to understand the practical aspects of life assessment.

New NDE inspection and monitoring tools have recently appeared on the market such as portable Scanning Force Microscopy, Ultrasonic Phased Array Probes, Long-range Guided-Wave, Laser Guided Portable Hardness Tester, Wireless Sensors, High Temperature UT Probes, XRD etc. Furthermore, new techniques of long term data extrapolation for design and life assessment of high temperature components, data quality check procedures (e.g. Post Assessment Tests or PATs, developed by European Creep Collaborative Committee (ECCC)), etc. have recently appeared on the horizon. Many other developments such as probabilistic life assessment, risk based procedures etc. are also now contributing to the more realistic (and less conservative) life estimates of high temperature plant. These and similar techniques and methodologies will be reviewed in this Procedure to provide the latest and up-to-date guidance to the sponsors of this project.

Plant services/consulting and collaborative R&D projects are also essential to provide best advice and innovative solutions to the industrial problems dealt in this IRLA procedure. Numerous standards and codes for evaluation of remaining life, e.g. ASME VIII, BS 5500, API 530, API 579, etc. are considered to give a broad understanding of the potential damage mechanisms in plant and the expected materials behaviour.

*Technical staff and plant consultants of international repute will be involved in formulating this Procedure.*

## **II. DEVELOPMENT OF THE ‘PetRef LIFING PROCEDURE’**

The Procedure proposed will consist of the following:

### SECTION 1

## **Overview of Component Life Assessment & Damage Mechanisms**

### **Introduction to life assessment**

- 1. Design life of petrochemical, process and refining plant**
- 2. Materials of construction**
- 3. Damage mechanisms and component failure**

## SECTION 2

### Life Assessment Methodologies and Available Tools

4. Analytical assessment methods
5. Metallographic methods
6. Hardness measurement method
7. Strain measurement method
8. Methods based on temperature estimation
9. Post exposure (ex-service) creep rupture testing
10. Miniature specimen testing techniques
11. Creep-fatigue life consumption software
12. Advanced techniques

## SECTION 3

### Component Life Assessment

13. Heat exchangers
14. Chemical reactors
15. Furnaces
16. Topping Units
17. Cracking Unit
18. Reforming Unit
19. Piping
20. Weld repairs

## SECTION 4

### Plant Life Management

21. Cost-effective plant life management strategies
22. Risk-based approaches
23. Financial risk optimisation (FRO)

## III. DELIVERABLES AND COSTS

The *deliverables* will be:

- a) A Procedure containing guidelines on a systematic approach to the integrity and life assessment of petrochemical, process and refining plant. This procedure will be based on the various available codes and standards both for design and life assessment. It will further draw on the experience of the actual plant life assessment by engineers and the more recent research findings and the new materials data.
- b) A software will be prepared for the ease of the use of the Procedure both by novice and expert plant engineers and service providers. The software will also help with performing life assessment calculations.

*The benefit of a Group Sponsored Project (GSP) is that as the cost of the project is shared between a number of sponsors, each sponsor pays a fraction of the total cost while receiving the full benefits. The cost for participation in the project/ sponsorship will be sent to those interested in participation.*

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