

CreepTest - Development of a high sensitivity ultrasonic phased array NDT method for the early detection of creep damage (Type IV cracking) in alloy steels used in high temperature, high pressure steam systems of electricity generating thermal power stations

Creep is the time-dependent, thermally assisted deformation of a component operating under stress. It is often a key factor not only in the design of components used in the power generation industry, but also in the assessment of their remaining life. Pressurised components such as boiler tubing, headers, and steam piping in fossil-fuel power plants operate at temperatures of 538°C up to about 570°C and this is conducive to causing creep damage over the operating life of the component.



Although creep in this material has been known about for some time it has only become a pressing issue in recent years because:

1. Failure is occurring at a much earlier stage than previously predicted.
2. Large fossil fuelled power plants are now being expected to work beyond their original design life.

The early detection of creep damage in components which are in-service stands to aid in the better management of the power plant and to prevent often catastrophic failures which can lead to severely adverse human, environmental and economic consequences.

Project Objective

The aim of the project is to develop a prototype ultrasonic early detection system that can be readily applied in the field to inspect and diagnose the condition/integrity of creep susceptible high temperature/pressure boiler and steam pipe welds used in electricity generating power stations, such that their safe and economic service can be continued or a planned repair and maintenance schedule can be applied with the least disruption to the continued operation of the plant.

The project relates both to maintenance of existing power plant steam pipe welds and future planned super-critical plant which could be even more susceptible to creep damage. Manufacturing and installation of new pipe welds will need to recognise the future inspection technology requirements in terms of weld location, joint design, welding process and surface condition.

The objectives of the project will be to:

- develop new ultrasonic phased array NDE testing techniques for the detection of Type IV creep cracking
- determine the sensitivity of defect detection and the limits of technique/system/ultrasonic array performance
- produce a field prototype NDE ultrasonic array system, signal processing and software for the examination of power plant steam pipe welds for creep damage
- quantify results to assess the extent of creep detection and categorise into (i) cavitation formation (ii) cavitation coalescence (iii) formation of micro-cracking and (iv) macro-cracking
- demonstrate the NDE systems performance on in-service, in-situ steam pipe welds
- validate the results against representative samples containing realistic creep defects.

CreepTest will enable early stage creep damage to be detected, allowing repair procedures to be implemented that will minimise loss of plant generating availability, allow Repair and Maintenance outages to be properly planned and ensure the safer operation of the plant due to significant increase in confidence of the integrity of steam pipe welds.

For further information, please visit the project website at www.creepTest.com

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