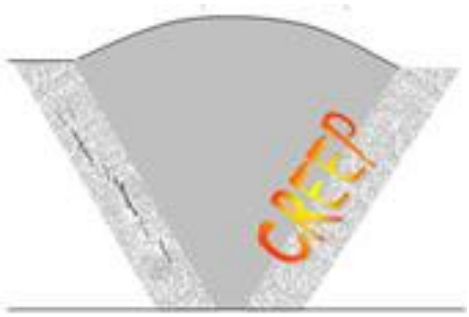
Collaborative Power



Development of a highly sensitive phase array ultrasonic non-destructive testing method for the early detection of creep damage in alloy steels used in high temperature, high pressure power station components

- **Project budget: £600k**
- **End Users: Scottish & Southern Energy**
  RWE npower

Creep is the time-dependent, thermally assisted deformation of a component operating under stress. Metal pressure components such as boiler tubing, headers and steam piping in fossil-fired power plants operate at thermal conditions (above ~1000°F [538°C]) conducive to causing creep damage over the operating life of the component.

Evidence from recent premature weld failures due to creep damage in 'Creep Strength Enhanced Ferritic' (e.g. P91 and its derivatives) steel together with long term data on cross-weld samples now suggests that the design is non-conservative for P91 steel welded pressure vessels and piping operating at elevated temperatures. In the UK, Europe, USA and Asia, incidences of cracking in P91 steel welds have been reported in times significantly less than 100,000 hours leading to safety and reliability concerns worldwide.

The aim of the project was to develop a prototype phased array ultrasonic NDT system (sensors, signal processing, data acquisition and analysis techniques) 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 alternatively a planned repair and maintenance schedule can be applied with the least disruption to the continued operation of the plant. Laboratory and field trials were used to validate the development work.

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

The project was carried out by means of a number of work packages, each with defined aims and deliverables. These represented a logical progression from the procurement of representative samples and the definition of the defect detection criteria, to the development of a suitable ultrasonic inspection technique, followed by the design and build of a prototype system and the field validation of its performance.

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