

“FOURCRACK” – PREVENTION OF PREMATURE WELD “TYPE IV” FAILURE IN ADVANCED PLANT

OBJECTIVES

The recently completed project ‘Practical Improvements in Power Plant Engineering (PIPPE)’ – part of the DTI Cleaner Coal Programme – has highlighted weld heat-affected zone ‘Type IV’ cracking as a principal concern in advanced high temperature plant. Current creep test data, inevitably obtained on a much shorter timescale than the projected life of plant, suggest that weld performance could substantially deteriorate in the longer term. Better data and extrapolation techniques are needed to assess the extent of this threat to plant reliability and thus develop effective countermeasures that will gain the confidence of prospective plant purchasers and operators.

This project will help manufacturers gain a fundamental understanding of why the weld heat-affected zone is susceptible to ‘Type IV’ cracking in high temperature service, how its susceptibility is related to steel composition and heat treatment, and, consequently, how advanced steels can best be selected and developed to minimise these risks. The main objectives are:

- to generate longer term creep rupture test data on advanced steel weldments
- to develop better techniques for the prediction of weld creep life in service from laboratory test data
- to thereby assess the long term risks associated with ‘Type IV’ cracking in welded high alloy steels for advanced plant
- to determine the optimum steel choices for welded thick section advanced PF plant components such as headers and steam pipework
- to determine appropriate limits on plant operating temperature and stress conditions to ensure the reliable long term operation of welded components

SUMMARY

Advanced coal-fired power plant can achieve substantial improvements in thermal efficiency and hence reductions in carbon dioxide emissions. However, these opportunities may be lost if plant reliability and availability cannot be guaranteed. Lack of confidence in the long term performance of welded components is one of the main technical concerns which make advanced plant less attractive in the commercial marketplace.

The FOURCRACK project will produce and assess cross-weld creep rupture test data on welds in advanced high temperature steels. The leading competitor materials will be critically compared. New welds will also be compared with simulated service aged and repair welds. Weld thermal simulation and microstructural assessment will be employed to gain a better understanding of the causes of ‘Type IV’ cracking.

Design of pressure components without due allowance for weld properties may give rise to major weld inspection, repair and replacement costs during the lifetime of power plant. Conversely, conservative design based on inadequate information may lead to inefficient and uncompetitive plant. Project FOURCRACK aims to overcome these uncertainties, establish the effective limits on power plant design conditions and operating temperature, and thereby improve the market prospects for cleaner coal technology in the UK and world-wide.



Type IV cracking in an E911 steel cross-weld creep test specimen

COST

The total cost of the project is £304 000 with a contribution of £152 000 from the DTI

DURATION

4 years – January 2001 to December 2004

CONTRACTOR

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