Thermally Induced Bore Cracking

Case study

EASL has carried out a range of analysis of predictions for safety cases, including coal-fired power stations across the UK. Due to our expertise in the niche area of creep fatigue initiation, we can provide these relevant services to clients at a higher and more cost effective level than training and developing an in-house team.

Above other competition

It was for this reason, as well as our historical relationship with British Energy (now EDF), that we were approached for prediction consultation regarding a potential concern of thermally induced tube bore cracking with a number of fossil-fuelled power stations.

Widespread cracking of steam tube bores has been found at fossil-fuelled power stations. To date, the cracking has been found in ½Cr½Mo¼V pipework with 2¼Cr1Mo welds and is generally associated with thicker pipework operating in the creep regime.

As there are two different materials used to connect the pipes together, there was a concern that the welds could lead to cracking across a range of stations.

These cracks usually occur in butt or branch welds or in areas where stress is associated with the end of the counter-bore close to pipe butt welds.

These are usually fully circumferential, radial and very straight and are often deep. Where cracking is found it is often extensive.

This cracking can be explained by fatigue or creep mechanisms, or a combination of creep fatigue given the thermal aging of the parent material of the pipe.

As the pipework is exposed to fluctuating steam temperatures over its life time, rapid expansions and contraction will occur with the material as a result of routine operations of the station.

This can also be the case during warm through operations after extended shut downs.

The client approached EASL to see whether this cracking was of a safety case concern, and what potential actions or consequences could occur as a result.

PREDICTIONS OF THE POTENTIAL FOR TUBE BORE CRACKING HAVE BEEN CARRIED OUT BY FOR A NUMBER OF UK POWER STATIONS. THESE INVESTIGATIONS INCLUDE:

- Gathering data on the operation of the relevant power stations including steam temperature and conditions during plant transients;
- Transient thermal analysis and stress analysis of both plain pipe and branch geometries and establishing bounding load cycles; and
- Assessment of the bounding loading cycles for creep fatigue crack initiation using a range of material data assumptions.

The project

Due to a scatter of materials data and uncertainties of aging effects, predictions for tube bore cracking can be imprecise.

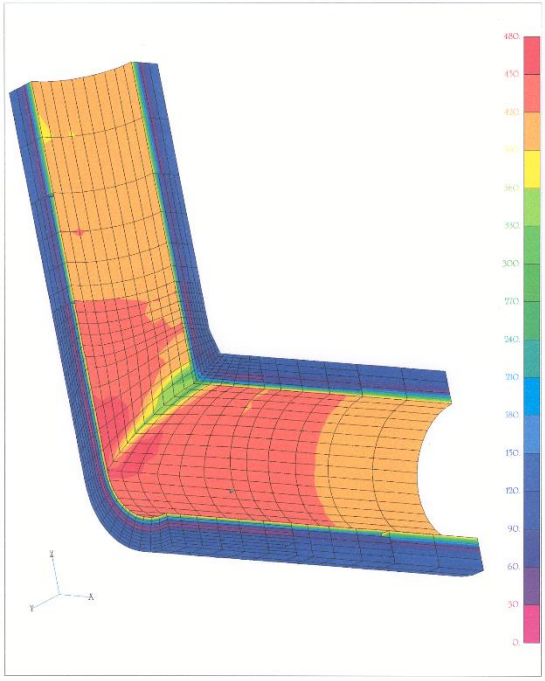
However, assessment is useful in giving an overall view of the threat presented by thermally induced tube bore cracking to identify what plants are most at risk, and what events may contribute to these effects.

Over the course of this work, EASL was able to advise British Energy on the potential realisation of this threat, allowing them to safely implement appropriate procedures.

Due to the high cost of inspection, the concern was low enough that no further actions needed to be taken.

EASL is working on the concept that the uncertainties involved in predicting thermal tube bore cracking can be reduced by compiling a database of observed tube bore cracking assessments.

This has allowed us to take ownership of the problem, and provide a long term solution to our client beyond the initial consultation, producing results and information for more precise and informed processes in the future.



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