Material Integrity Solutions, Inc.

PROJECT BULLETIN

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# Reinspection Interval for Seam-Welded Piping

## BACKGROUND

Cracking of seam-welded hot reheat piping is of major concern to power plants (*Fig. 1*). Despite an immense amount of research, a comprehensive method has yet to be developed that can determine remaining life of such components accurately. Uncertainties in plant operation, material, inspections, stress behavior (*Fig. 2*), and the complexity of crack initiation and growth mechanisms contribute to the lack of accuracy of any such methodology. To prevent premature failures of these lines, utilities typically inspect all or parts of their seam-welded piping at predetermined intervals. This is a costly and labor- intensive operation. MIS developed a program to determine reinspection intervals of a plant's seam-welded hot reheat piping using a number of approaches, including probabilistic fracture mechanics.

*Figure 1: A seam-weld failure*

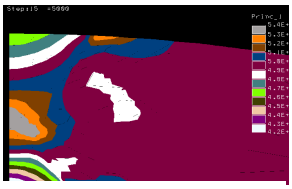

*Figure 2: Creep stress contour plots at seam-weld*

## DISCUSSION

To evaluate seam-welded piping, a number of sources, including EPRI and MPC, have issued guidelines and procedures for inspection and calculation of remaining life. Most of these procedures can provide reasonable estimates for the remaining life of components if accurate information regarding operations, material properties, and inspection findings were available. But such information is rarely available and, furthermore, small variations in any of these parameters can significantly affect the remaining life estimate *(Fig. 3)*.

By treating variations and uncertainties in unit operation, flaw sizes, and material properties probabilistically, MIS developed a method for estimating the remaining life of a seam-welded piping system in the form of failure probabilities at selected locations. The probabilities of failure for the full line (*Fig. 4*) are estimated for two extreme assumptions, one considering that all piping materials behave similarly (homogeneous) and the other that each location within the system is completely independent of other locations (nonhomogeneous).

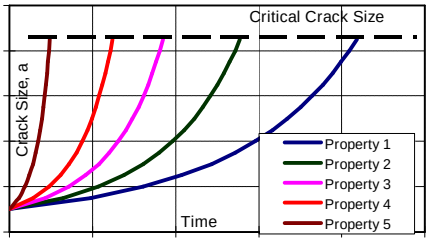


*Figure 3. Crack depth vs. time for various assumed creep properties*

A very important finding of this study was the effect of plant operation on remaining life. For example, daily cycling of a unit vs. baseloads can decrease life by about three times. This points to the need for on-line monitoring of the operating parameters for a more accurate estimate of its remaining life.

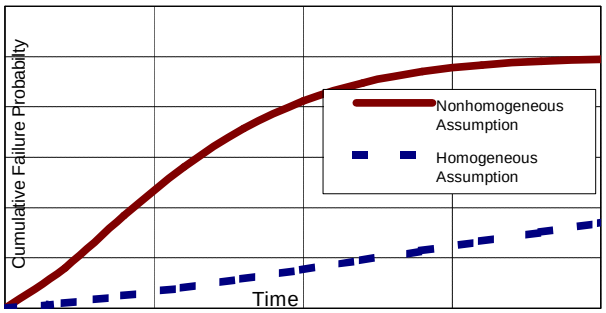


*Figure 4. Overall pipe failure probability*

The probabilistic results of this analysis were used in an economic decision analysis model to determine the optimum inspection interval and technique.

## CONCLUSION

Determining the remaining life of a seam-welded pipe in creep regime is still an art. But proper consideration of the uncertainties and operating parameters allow a fairly accurate probability of failure to be calculated for the system. The program developed by MIS allowed a major power plant to devise an optimum inspection program for its hot reheat system.