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CRACK GROWTH AND FATIGUE IN REACTOR WATER (Panel Discussion)

Introduction

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Keith Miller brings a comprehensive state-of-the-art understanding of the fatigue process to this 1995 Pressure Vessel and Piping conference. he is a leading researcher in the interdisciplinary science of fatigue who has the engineering perspective needed to develop new concepts useful to the design community. He and his colleagues at the Structural Integrity Research institute, University of Sheffield, (SIRIUS), have produced many of the most important contributions to the understanding of crack initiation as the growth of microcracks to a size which can be treated using continuum mechanics. Keith is Editor-in-Chief of the International Journal "Fatigue and Fracture of Engineering Materials and Structures," a quality journal in the mechanics of fatigue and fracture. While this Journal is not widely circulated in the States, it contains analyses of immediate use in the design analysis of components and systems. Dr. Miller describes the improved understanding of fatigue crack growth that has developed from worldwide research over the past two decades and how this improved understanding can be used to more accurately quantify solutions to complex fatigue problems.

Dr. Van Der Sluys, a leading researcher in environmental fatigue, presents an overview of what is known concerning the interactions of the reactor environment that affect the fatigue properties of pressure boundary materials. As Chairman of the Working Group on S-N Data, he summarizes current activities within the Pressure Vessel Research Committee (PVRC). He describes the important parameters affecting reactor water fatigue and the work needed before environmental effects can be quantified in the analysis of reactor structures.

Dr. Tom O'Donnell describes his analyses of stress intensity values for fatigue cracks growing in conventional S-N fatigue specimens. Such values are needed to understand the macro-crack growth phase of fatigue failure which dominates the total life of such specimens in the low-cycle regime. As crack growth progresses, bending in the cracked section becomes very important and straightens the crack front. The constraints imposed at the ends of the specimen are included in the 3-D study. a directly related paper "Cyclic Rate-Dependent Fatigue Life in Reactor Water" by Thomas P. O'Donnell and William J. O'Donnell, presented at this 1995 PVP conference, is printed in another PVP Volume. This related paper quantifies cyclic rate effects on the S-N fatigue life of pressure vessel steels in reactor water.

Dr. Brian Tomkins very appropriately completes the panel presentations with a discussion on the applicability of laboratory data to plant components. Dr. Tomkins has extensive worldwide experience in the safety evaluation of nuclear power plant components, and is well known for his contributions to design criteria and Codes. He discusses the use of data from conventional fatigue tests, K and J fracture mechanics parameters, validation by more complex laboratory tests and the testing of samples taken from the plant to determine the rate of, and susceptibility to, degradation. Dr. Tomkins points out that more realistic assessments of plant life can be made using thermodynamic (mechanics, chemistry and materials) limits to failure processes, and considering the kinetics, i.e., rate of crack/damage development.