

DOWNLOAD PDF PRESSURE AND LEAK-RATE TESTS AND MODELS FOR PREDICTING FAILURE OF FLAWED STEAM GENERATOR TUBES

Chapter 1 : Plastic Limit Load Solutions for Cracks in Steam Generator Tubes

This report summarizes the models used for predicting failure pressures and leak rates in unrepaired steam generator tubes with axial and circumferential cracks that developed under normal operation and design-basis accident conditions.

The unloading spring-back of tubes during its manufacturing process shows a strong nonlinearity, which greatly influences the precision of parts. In this paper, the strain distribution of bending tubes was analyzed based on the elasto-plasticity theory, and the theoretical equation for spring-back of tubes was derived. The 12Cr1MoV and 20G tubes were used to analyze the effects of bending angle, bending radius and bending speed on the spring-back of tubes. The prediction equation of spring-back was built, which shows that the spring-back tendency was in accordance with theoretical analysis results. The simulated results show that the spring-back angle is linearly proportional to the bending angle within a certain range. In addition, it is proportional to the relative bending radius and the bending speed. Air bending of wide-punch large radius of curvature, as a special bending mode, has been widely applied in the production of large diameter pipeline JCO forming. The JCO forming process is accomplished by several air bending processes. The quality and shape of pipe are greatly influenced by the air bending. During the present work, the bending is investigated into using the finite element FE method and orthogonal design of experiment. Experiments are carried out and the experimental result is very close to the result simulated by finite element analysis. Springback, forming force and residual stress are discussed. The aim of this research is to investigate the influencing degree of parameters, such as sheet material, sheet thickness, bending angle, lubrication and punch radius; in particular the effect of springback, forming force, residual stress on air bending parameters are also discussed. The bending of plates on rubber pad is a relatively new method used for roll bending of thin plates in recent years. In the present work the problem of plastic deformation of thin plates was analyzed. An analytical-numerical solution to these equations was subsequently presented. In addition, the equations were solved for a given problem and the effect of indentation depth of plate on its bending radius was investigated. A relationship has been proposed to correlate these parameters. This relationship is a powerful tool in controlling the process and process planning. This tool helps the operator set the indentation depth to a predefined amount in order that the plate to be bent by a given radius, without any try and error effort. The results were verified by experiment. The linear elastic problem for two welded thin-walled steel tubes containing circular arc weld defect subjected to bending load is analyzed in the present paper. The welding defect is firstly simplified as a circular arc crack and then the finite element based technique is used to calculate the corresponding energy release rate J-integral, which is related to stress intensity factor directly. Finally, the arc length of welding defect is changed to investigate the variation of stress intensity factors.

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Chapter 2 : Analysis and testing of rupture of steam generator tubing with flaws. - Digital Library

NUREG/CR ANL/23 Pressure and Leak-Rate Tests and Models for Predicting Failure of Flawed Steam Generator Tubes Argonne National Laboratory.

Various forms of degradation have resulted in the plugging of well over , tubes to date around the world. In addition, 68 steam generators in 22 U. Environmentally induced degradation through intergranular SCC and intergranular attack is the most serious degradation process at present. This degradation commonly occurs in crevice regions at tube support plate and tube sheet locations or under sludge piles, although intergranular SCC has also been observed in the free span of the tubes. Because of its variable and often complex morphology, this cracking can be difficult to detect and size by conventional inspection techniques, and the failure pressure and leak-rate behaviors of degraded tubes are not readily predictable. One of the objectives of this NE program is to evaluate and experimentally validate models to predict potential degradation modes and provide guidance for operational assessments. Model development requires better understanding of crevice conditions and SCC initiation, evolution, and growth. The models will be validated by comparing the predictions from field experience with respect to SCC of Alloy steam generator tubes. The methodology benchmarked by Alloy field experience will then be used to predict the behavior in the field of Alloy steam generator tubes based on the laboratory data for Alloy and and the field experience for Alloy An integrated mechanistically based model has also been developed under a subcontract with Dr. Staehle to predict the secondary-side SCC failure of steam generator tubes under normal operating conditions. This effort is continuing with development of a quantitative model that is physically based on the prediction of secondary-side SCC initiation for the different submodes of SCC in given environments. An autoclave facility for corrosion and stress corrosion initiation tests has been constructed. The facility consists of two independent recirculating loops. Each loop has an 8-L 2. The vessels are rated for a design pressure of Crack growth rate experiments are also planned on tubular fracture mechanics specimens under various stress intensities. The results from the autoclave tests will be utilized in model boiler experiments, and in the development of predictive models. Mechanisms of Pb-induced SCC are also being studied. A variety of microscopic analysis techniques are being used to elucidate how Pb affects the protective films on the steam generator tubes, and to identify the particular valence states and compounds that do form. Measurements of anodic polarization and potentiostatic electrochemical impedance spectroscopy were performed with deaerated solutions of pH 4. The results indicated that lead was incorporated into the Alloy specimen surface and enhanced electronic conductance. Incorporation of lead on the surface was examined for specimens tested at different electrochemical potentials ECP. Lead is observed up to 23 at. Further electrochemical tests, AES , and XPS will be applied to specimens produced at higher temperature and pressure in the autoclaves. Intergranular cracks and attacks were observed at the secondary side, at the roll transition zone underneath crud deposits. To estimate the crevice chemistry that was present under operating conditions of the McGuire steam generator, we performed chemical and microstructural analyses for the deposits within the tube-to-tube sheet crevices in sections removed from the McGuire plant. The copper was present in the deposit as metallic copper. The steam generator unit had operated initially with Ni-Cu moisture separator reheaters. It was not possible to identify whether lead was present. Additional microscopy is continuing to check for very local lead deposits at the crack and metal-metal oxide interfaces. Corrosion and Mechanics of Materials:

Chapter 3 : results in SearchWorks catalog

Pressure and leak-rate tests and models for predicting failure of flawed steam generator tubes.