Material Integrity Solutions, Inc.

PROJECT BULLETIN

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Turbine Rotor Disk Keyway Reinspection Program

BACKGROUND

Low-pressure (LP) turbine rotors of fossil and nuclear power plants may experience stress corrosion cracking at their high stress areas such as disk keyways (*Fig. 1*). In response to this problem, the utility industry has adopted a comprehensive inspection program, typically based on the manufacturer's very conservative recommendations. As an alternative, MIS developed a program to calculate failure probabilities using finite element and probabilistic fracture mechanics. The results are used in an economic-based decision analysis program to optimize the inspection interval.

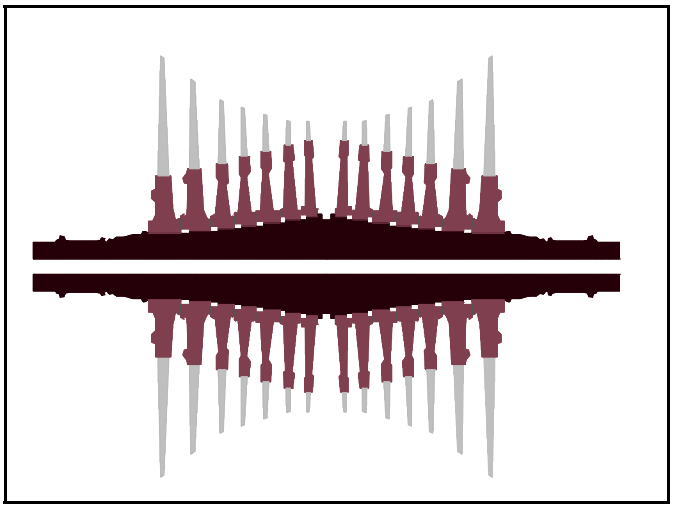

Figure 1. A Typical Low Pressure Rotor

DISCUSSION

MIS developed the methodology and an easy-to-use software package for performing probabilistic fracture mechanics using operating stresses, the environment, the operating history, and inspection results. This program estimates the remaining life of each disk by considering the uncertainties in material properties, stresses, environments, measurement of flaws, and operating conditions using Monte-Carlo simulations. Probability of failure (*Fig. 2*) is calculated for the rotor by combining the probabilities of initiation and growth to failure of every disk. By using this approach and software, the utility engineer knows the risk of operating these rotors as a function of time, which can be used in a decision analysis program to establish the optimum re-inspection interval. This approach was applied to a set of LP rotors at two major power plants where the OEM had recommended a re-inspection interval of only 18 months. Our work showed that such a short interval is not warranted and that, economically, the inspection intervals can be extended as long as 6 years. This was adopted by the utility which resulted in large savings.

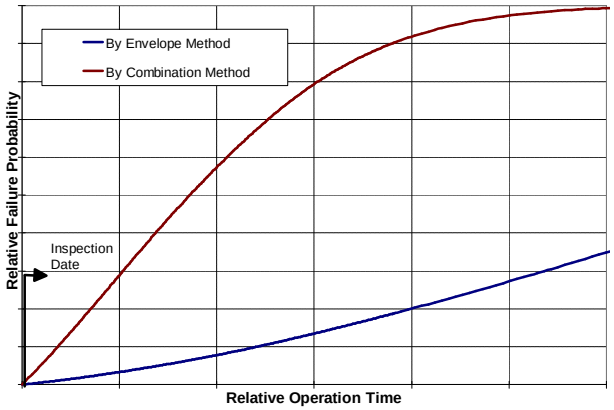

Figure 2. Probability of Failure for an LP Rotor

CONCLUSION

This novel approach to analyzing stress corrosion cracking in LP rotors can be used to determine optimum component re-inspection intervals, thus saving millions of dollars in unnecessary overhauls. It also provides engineers with insight into evaluating turbine manufacturers' recommendations for components.