UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION REPORT

OF ACTIONS TAKEN TO ELIMINATE FEEDWATER PIPING CRACKS AT

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

Introduction

On June 9, 1979, H. B. Robinson Unit No. 2 was shut down after refueling to facilitate the repair of a CRDM canopy seal weld leak. Since the licensee was aware of the cracks previously discovered at D. C. Cook and San Onofre, the licensee performed radiographic inspection of the feedwater nozzle to reducer welds and found circumferential cracks in the machined area of the large end (18 inch OD) of the reducers.

A meeting was held with the licensee on June 27, 1979 to discuss the following items regarding feedwater piping cracks:

1. Nature and extent of the cracking
2. Metallurgical evaluation of the cracking including identification of the mode of failure
3. Stress Analyses
4. Operating History
5. Feedwater Chemistry
6. Corrective Actions
7. Safety Implications

By letter dated July 10, 1979, the licensee provided details of the inspection and corrective actions taken.

Discussion and Evaluation

The licensee performed stress analyses in an effort to identify the mechanism of the observed cracking. The analyses were:

1. Structural analysis of the feedwater line including the effects of thermal, deadweight, and pressure. The licensee reports that results show the stresses are within the allowable code limits.

2. 2D finite element fatigue analysis of the feedwater nozzle/elbow configuration. The licensee reports that the results show an acceptable usage factor using the allowable cycles for a peak stress range from the ASME Section III S/N curves.

3. Frequency analyses of the feedwater line and steam generator. The licensee reports that the results of the feedwater line could be in resonance with the steam generator thereby causing high enough stresses to cause the observed cracks. Results from the instrumentation program are required to confirm or disprove this possibility because of uncertainties in the analyses.

The results of the metallographic evaluation by the licensee of the reducer from Loop C confirmed that the cracks were 360° around the component at the transition between the counterbore and taper. The deepest penetration was 0.750 inches at the 9 o'clock position. The cracks were rather straight on the macroscopic scale with the "beachmarks" present on the fracture face. The mode of failure was identified by the licensee as corrosion fatigue. Shallow cracks were identified in the crevice between the backing ring and component. The mode of failure of these cracks was identified as stress corrosion. Also, shallow cracks, identified as probable thermal fatigue, were located in the nozzle in the vicinity of the thermal sleeve.

The reducers were removed and replaced on all steam generators. All cracks were removed and, when required, repaired in the nozzle bore. Stress risers in the counterbore section of the reducer were minimized in the replacement components as were residual stresses from welding. The nozzle to fitting welds were fully radiographed and ultrasonically inspected following completion of welding and stress relieving operations. The licensee has committed to perform radiography and ultrasonic examinations of the nozzle to fitting welds at the next refueling outage. In addition, the licensee has installed instrumentation to measure pressure, thermal and mechanical transients during startup and operations. Acceptance criteria for the transients have been established as a basis for continued operation and are identified in the July 10, 1979 letter.

Based on our review of the licensee's report, we conclude that the actions taken and proposed augmented inspection are sufficient to ensure that the piping integrity will be maintained. If the causes of cracking cannot be determined by the next refueling outage, we will then decide what further actions, if any, are necessary.

We have determined that this action does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the action involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with this action.