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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION UNIT NO. 1

DOCKET NO. 50-285

STEAM GENERATOR TUBE DENTING

1.0 INTRODUCTION

By letter dated February 21, 1986, Omaha Public Power District (OPPD) submitted a special report on Steam Generator (SG) tube denting derived from 1985 eddy current inspection data for the Fort Calhoun Station. This report was submitted to fulfill eddy current reporting requirements in accordance with Technical Specification 3.3(2)e(ii) and a commitment made to the staff regarding SG tube integrity. At the end of the inspection program, a total of three tubes in SG A and four tubes in SG B had flaws greater than 20%. In steam SG A, one tube was evaluated as UDS (Undefined Signal). Thus, intergranular stress corrosion cracking (IGSCC) does not appear to be a major problem at Fort Calhoun. A comparison of the number of restrictions encountered to a 0.560 inch probe in the 1985 inspection to the number from the 1984 inspection showed a significant growth rate of tube denting. The data from the upcoming 1987 inspection will be significant in determining the trend in the rate of denting. In addition it will also show whether or not actions taken by the licensee to alleviate the denting problem have proved successful.

2.0 DISCUSSION

Eddy current and profilometry inspections of both SG's at Fort Calhoun conducted during 1985 included (1) 100% of the tubes in the vertical strap (VS) region; (2) all tubes with previous indications greater than or equal to 20%; and (3) 50 tubes in the tight radius U-bends (steam blanket region) in each SG for a total of 977 tubes in SG A and 1010 tubes in SG B. Included in these numbers were 50 tubes that were tested to the 1st support in the sludge region of SG B.

All tubes determined to have deformation sufficient to restrict the passage of the 0.560-inch diameter probe were reinspected with a 0.540-inch diameter probe to determine presence of tube wall degradation and dent deformation. Those tubes restricting the passage of both 0.560- and 0.540-inch diameter probe were plugged. By comparing the number of restrictions identified during 1985 to the number restricted during the 1984 inspection, it is evident that the denting in the vertical support (VS) region is progressing.

The multi-frequency eddy current data was used to evaluate average radial dents for all tubes in the VS region in both SG's. The results show that both the magnitude and frequency of tube denting is greater in SG B than in SG A. Also, tubes at VS1 displayed more severe denting than VS2 or VS3. A comparison with the previous dent analysis results showed a definite increase in average radial dent size.

Results from the profilometry examination with an eight coil probe showed significant positive growth over the last cycle. The average growth at VS1 was 2.9 mils in SG A and 8.6 mils in SG B, which are 26.7% and 51.8% growths, respectively.

## 2.1 Corrective Actions

A number of corrective actions have been taken by the licensee to arrest the denting observed during the last cycle. Eddy current testing is scheduled during the next refueling outage later in 1987. Results from this examination should determine whether or not the remedial actions taken by the licensee have proven effective. The corrective actions include:

- (1) More restrictive secondary chemistry guidelines and operating limits, which are virtually identical to the current recommendations of Steam Generator Owners Group II, have been formally adopted. Hold points for chemistry during startup and shutdown have been mandated to ensure optimum chemistry conditions in the SG's.

These guidelines and limits include corrective action levels, shutdown levels, and the actions necessary to return chemistry parameters within specifications.

- (2) Steps have been taken to reduce ingress of contaminants from the condenser. OPPD is committed to prompt and prudent corrective action in the event that chemistry limits relating to condenser in-leakage are exceeded. In addition to the traditional visual examinations performed during each outage, a condenser eddy current surveillance program was initiated during the 1985 refueling outage and will continue to be a part of future outages. There were no indications of condenser water in-leakage problems during the last operating cycle.
- (3) Copper alloy low pressure feedwater heater tubing was replaced with stainless steel tube bundles during the 1985 refueling outage. This will reduce future deposition of copper and copper oxides in the SG's.

- (4) Laboratory data by both Combustion Engineering and Westinghouse indicates that boric acid may effectively neutralize caustic-induced denting and/or IGA/IGSCC. OPPD has performed an acid soak during low power startup (approximately 30% power) following the 1985 refueling outage. The low power soak is being followed by on-line boric acid injection during the ensuing cycle. Secondary system boric acid concentration was maintained at approximately 50 ppm during the 30% power soak and will be maintained at 5 to 10 ppm through the balance of the cycle by varying the injection rate with the SG blowdown rate. In addition the licensee is committed to evaluate new developments concerning denting rate reductions and these will be implemented on an on-going basis.

### 3.0 CONCLUSIONS

Although there are only two data points for monitoring SG dent growth rates (those obtained from the 1984 and 1985 inspections), it is apparent that denting has progressed. The staff concurs with the corrective actions taken to date by the licensee, i.e., improving secondary chemistry limits; implementing a condenser integrity program; utilizing chemistry holdpoints during startups and shutdowns to flush contaminants from the secondary side; replacing feedwater heater tube bundles to reduce copper deposit levels in the SG and implementing a boric acid treatment program for the secondary side to retard dent growth. The results of the 1987 examinations will determine the effectiveness of the boric acid program and provide the third data point for monitoring dent growth rates. The staff further concludes that the SG's are acceptable for continued operation and the subject report submitted by the licensee has satisfied the requirements for reporting of eddy current testing results as stated in Technical Specification 3.3(2)e(ii).

Date: February 14, 1987

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