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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

MID-CYCLE STEAM GENERATOR TUPE INSPECTION

Background

Prior to the March 1984 refueling outage, the Fort Calhoun steam generators were operating with a primary to secondary leak in B steam generator. During the outage, efforts were made to locate the leak, but were unsuccessful. Helium leak detection and a hydrostatic test wi'h dyes were used. Eddy current inspections were done, with 4 tubes in A generator and 5 tubes in B generator requiring plugging. Further eddy current inspection did not identify any other tube that required plugging. In preparation for return to power, the licensee performed another hydrostatic test during heatup. During this test a large tube leak developed and the plant was brought to shutdown conditions.

The failed tube was removed, analyzed and evaluated. The failure location was within a 4" wide vertical support strap at the top of the U-bend on the hot leg side of the generator. The failure resulted in a fish-mouthed axial tube rupture ~1 1/4" long at the six o'clock position in the tube. Post tube-failure eddy current testing was then conducted on all remaining accessible tubes. Two hundred seventy-six (276) tubes in Steam Generator B and 150 tubes in Steam Generator A were examined using profilometry to characterize denting in vertical and batwing strap areas.

In our SERs of June 21, 1984 and August 16, 1984, we concluded that the Technical Specifications requirement for tube inspections and plugging had been met. We also accepted the licensee's conclusion that the tube failure was due to outside diameter initiated intergranular stress corrosion cracking caused by a concentration of caustic at the tube support of the vertical strap.

Discussion

The licensee speculates that low level condenser in-leakage concentrating in the steam blanketed areas of the steam generator would cause a caustic environment in those areas. The licensee also contends that while normal operating stresses in straight lengths of steam generators tubes are relatively low, additional stresses may be imposed through support-tube interactions. There were smaller crackes oriented at 45° to the tube axis. This crack orientation may have been due to a torque imposed upon the tube due to a minor modification to the steam generator assembly procedure.

In a previous submittal, the licensee proposed increased condenser in-leakage surveillance and condenser tube inspections and general upgrading of their secondary side chemistry program. Temperature soaks during heat-up to maximize impurity solubility for blow-down removal were also being considered as corrective actions to reduce the probability of future tube failures.

In the submittal of February 2, 1985 the licensee provided information on the plant's up-graded secondary water chemistry and control program. The secondary water chemistry program follows the recommended EPRI guidelines insofar as the plant staff's ability to measure and control the parameters. The licensee has committed to install upgraded analytical and monitoring equipment in a relatively short timetable to enable the plant staff to fully implement the EPRI guidelines. The present chemistry program requires mandatory correction of parameters within fixed time frames or a reduction in power or shutdown. The program also requires the repair of condenser leakage within the fixed time frames. On the contrary, low level condenser leakage was previously tolerated for an indefinite time period. Note that, to date, no condenser in-leakage has been experienced during this Cycle 9 operation and no steam generator tube leakage has been observed. An additional corrective action mandated in the plant procedures are chemistry hold points during plant startups.

Finally, the licensee has imposed a slight (8°F) reduction in $T_C$, the cold leg temperature, which results in slight performance penalty. The corresponding reduction in the hot leg temperature might reduce the propagation rate of any continuing caustic induced IGSCC.

Conclusion

We have concluded that the licensee has provided sufficient information on changes in operational procedures to warrant a waiver of the requirement for a steam generator tube inspection after nine months of power operation in cycle 9. This conclusion is based upon our review and acceptance of the upgraded secondary water chemistry monitoring and control program. We have also reviewed and agree with licensee's enhanced mandatory condenser inspection and repair program with its required actions. We agree with the program of hold and soaks during plant startup. The imposition of a slight temperature reduction in the area of possible caustic IGSCC should reduce the rate of any ongoing degradation.

We recommend that the licensee implement, during the October 1985 refueling, the inspection progam as detailed in the letter of February 2, 1985. We also recommend that the primary-to-secondary leak limit of 0.3 gpm total for both steam generators be continued.

We therefore conclude that a waiver of the mid-cycle tube inspection requirement is warranted, provided that (1) the upgraded secondary water chemistry and control program which is based on the EPRI recommended guidelines, (2) the enhanced condenser inspection and repair program with its required actions, (3) the tighter leakage limit of 0.3 gpm total for both steam generators, and (4) the October 1985 tube inspection as detailed in the February 2, 1985 submittal are orwill continue to be implemented.

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Principal Contributors:
Paul Wu, DE
Bernard Turovlin, DE