



SAFETY EVALUATION REPORT

BY

THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR

THE FIRST INSERVICE INSPECTION AND MAINTENANCE

OF THE STEAM GENERATORS

AT THE

NORTH ANNA POWER STATION, UNIT NO. 1

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-338

BACKGROUND

The North Anna Power Station, Unit No. 1 (North Anna, 1) shutdown on September 25, 1979 for its first refueling outage after beginning commercial operation on June 6, 1978. Prior to the refueling outage, the Virginia Electric and Power Company (the licensee) had detected a minor primary to secondary steam generator leak of approximately two to three gallons per day. As required by the Technical Specifications, an inspection of the steam generators for North Anna, Unit 1 was performed during the first refueling outage.

The results of the steam generator inspection at North Anna, Unit 1 were discussed at a meeting on November 30, 1979 with the licensee, the licensee's consultant and the NRC staff and are documented in a meeting summary, dated December 19, 1979. By letter dated December 10, 1979, the licensee submitted its steam generator inspection report and resultant maintenance and cleanup procedures for the steam generators at North Anna, 1. Our review and evaluation of the licensee's inspection and maintenance actions is provided below.

DISCUSSION

The major findings of the steam generator inspection were (1) through wall defects near the tangent to the U-bend of two row 1 tubes in steam generator C which caused the small leaks prior to shutdown and (2) support plate/tube intersection corrosion and possible ligament cracking, indicative of an early stage of denting.

Approximately 1070 tubes total in all three generators were inspected using a 400 KHZ eddy current probe. With the exception of the two row 1 leaks and one tube which could not pass the 700 mil probe (all in steam generator C), no indications of tube defects were observed.

Additional inspections of row 1 and row 2 tubes were performed using 100 KHZ differential and absolute probes to supplement information gained from the 400 KHZ probe in the U-bend region. Almost all row 1 tubes were inspected using one or both of these probes. Most row 2 tubes in steam generators A and C were similarly inspected, with the result that no additional U-bend indications were observed.

Photographs taken during the inspection indicate no detectable support plate flow slot closure (hourgassing). Thus, the row 1 defects do not appear to be denting related. To preclude further U-bend leaks and potential ruptures in the row 1 tubes the licensee plugged all row 1 tubes in the three steam generators.

In addition to the 400 KHZ inspections, a 7.5 KHZ probe was used in a total of 910 tubes in all three steam generators to detect indications of support plate corrosion and possible ligament cracking. Indications were observed in approximately one third of the tubes so inspected, and appear to signal the very early stages of the denting phenomenon affecting other plants. Also, the one tube (steam generator C) which failed to pass a 700 mil probe did pass a 650 mil probe. This is evidence that denting at North Anna, 1 is at a very early stage. As a preventive measure, the licensee plugged this tube and its mirror image on the same(hot leg) side.

A review of the plant chemistry data by the licensee and its consultant showed that a major discharge of resins from the condensate polisher into the steam generators had occurred in February 1979. The licensee has concluded that the ion-exchange resins decomposed in the steam generator operating environment producing sulfuric acid which in turn led to magnitite formation within the crevices at the tube support plate intersections.

The licensee plans a program to stop this support plate corrosion by boric acid treatment during the cycle 2 startup followed by residual treatments to inhibit further deterioration. The licensee's objective is for the boric acid to chemically combine with the corrosion product magnitite to form borasite, effectively sealing the corrosion sites.

The licensee has also committed to install inspection ports in the North Anna 1 steam generators during the second refueling outage. These ports will be similar to those installed at the Surry Power Station, Unit No. 1 and No. 2 and will allow inspection of the upper tube support plate and tube U-bends.

EVALUATION

The two row 1 U-bend tangent point defects at North Anna 1 are similar to those observed recently at Trojan and, most likely at Farley, Unit 1. Detectable support plate flow slot hourgassing has not been observed at any of the units and, thus, these U-bend defects are not considered to be denting related. We find that plugging all row 1 tubes at North Anna 1 is a conservative measure in precluding future leaks or potential tube ruptures due to U-bend defects of this type. To date all defects of this type have been confined to row 1 tubes only.

The occurrence of denting, even in its earliest stages, had not been anticipated so early in the operating life of North Anna 1, based on experience at other plants using secondary water all-volatile-treatment and fresh water condenser cooling water. We find that the licensee has acted in an appropriate manner to identify the cause of the early magnitite formation on the tube support plates and has provided a satisfactory explanation. The licensee plans to implement a program of boric acid treatment in an attempt to stop further magnitite formation.. It is our belief that this program can be implemented without adversely affecting the corrosion resistance of exposed surfaces of the steam generator internals. However, regardless of the success of the licensee's program to stop magnitite formation, we conclude on the basis of the inspection results that the degree of denting is too minor to be considered a significant safety issue at this time.

We conclude that the steam generator inspection at North Anna 1 was adequate to establish the condition of the steam generators. Also, we find that the licensee has implemented conservative maintenance and corrective actions commensurate with the findings of the steam generator inspection, and that continued operation of the North Anna 1 steam generators will not impair the health and safety of the public.

OCCUPATIONAL EXPOSURE

During the recently completed first inservice inspection of the steam generators at North Anna 1, the licensee performed about 2500 eddy current tests on the steam generator tubes. As a result of these tests, 284 tubes were plugged in the three steam generators.

The licensee selected and used several techniques developed by industry for maintaining radiation exposures-as-low as reasonably achievable (ALARA), for the tube inspection and plugging. For the eddy current testing on the steam generator tubes, remote equipment was used which allowed the operators to perform most of the time consuming task in a lower radiation field than would otherwise have been possible. Also, temporary shielding was installed inside the steam generator channel head to further reduce exposures to the operators. In order to further reduce exposure time, optimum operator proficiency was developed by using a mock-up to train the operators engaged in those tube inspection and plugging procedures involving radiation exposure.

As a result of these dose reduction techniques, the operators performing the tube inspection and plugging received 68 man-rem of collective occupational dose.

Based upon the licensee's approach and the level of occupational exposure experienced, we conclude that the steam generator inspection and maintenance at North Anna 1 has been performed in a manner consistent with the Commission's requirement for maintaining exposures as-low-as reasonably achievable (ALARA).

Date: FEBRUARY 04 1980