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Mr. John T. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Steam Generator Tubing Inservice
Inspection Report

Gentlemen:

Attached are the results of the steam generator tube inservice inspection performed during the 2R3 refueling outage. This report is issued per ANO-2 Technical Specification 6.9.1.5.b.

Very truly yours,

John R. Marshall

John R. Marshall
Manager, Licensing

JRM:SAB:sc

Attachment

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ARKANSAS NUCLEAR ONE - UNIT TWO

STEAM GENERATOR TUBING INSERVICE
INSPECTION REPORT FOR 2R3 REFUELING OUTAGE

INSPECTION SUMMARY

An inservice eddy current inspection was performed on a selected sample of tubes in the Arkansas Nuclear One Unit 2 Steam Generators "A" and "B" during the period from October 14, 1983 through October 17, 1983. Since the previous test was concluded in September 1982, the inspection frequency requirement (24 months per Technical Specification 4.4.5.3.a) was satisfied.

The inspection was conducted in accordance with Technical Specifications 4.4.5.1 and 4.4.5.2. The sample included a 3% random sample from the steam generators with exceptions as provided in Technical Specifications 4.4.5.2.a and 4.4.5.2.b.

In total, approximately 3.5% (297 tubes) of the tubes in the "A" Steam Generator and 2.9% (243 tubes) of the tubes in the "B" Steam Generator were inspected from the hot side, over the "U" bend, and partially down the cold leg side past the numbers 10 and 11 drilled support plates. Of the 297 tubes tested in "A" Steam Generator, 125 tubes were tested full length. Ninety-four(94) of the 243 tubes tested in the "B" Steam Generator were tested full length. The multi-frequency method of eddy current testing was utilized during this inspection accumulating dent, flaw, and sludge depth data simultaneously. Details of the inspection methodology and equipment used are given in the attachment.

INSPECTION RESULTS

Minor tube wall degradation indications were observed during the data analysis for both "A" Steam Generator and "B" Steam Generator in both the hot and cold leg sides. No defective tubes ($\geq$40% through-wall degradation) were found.

Tables 1 and 2, attached, give a complete list of tube wall indications found in the "A" and "B" Steam Generators.

TABLE 1

LIST OF TUBES CONTAINING INDICATIONS

S/G A HOT SIDE

LINE	ROW	% INDICATION	LOCATION
89	59	24%	12" Above #8 Hotleg Eggcrate
103	91	38%	18" Above #5 Hotleg Eggcrate
103	91	37%	1" Above #5 Hotleg Eggcrate
103	91	25%	22" Above #4 Hotleg Eggcrate
103	91	<20%	10" Above #4 Hotleg Eggcrate
107	91	35%	17" Above #5 Hotleg Eggcrate
107	91	24%	4" Above #5 Hotleg Eggcrate
73	121	36%	4" Above #4 Hotleg Eggcrate

LIST OF TUBES CONTAINING INDICATIONS

S/G A COLD SIDE

LINE	ROW	% INDICATION	LOCATION
105	135	27%	14" Above #8 Coldleg Eggcrate
105	135	22%	25" Above #4 Coldleg Eggcrate

TABLE 2

LIST OF TUBES CONTAINING INDICATIONS

S/G B HOT SIDE

LINE	ROW	% INDICATION	LOCATION
93	69	25%	22" Above #6 Hotleg Eggcrate
93	83	22%	15" Above #1 Hotleg Eggcrate
78	132	20%	2" Above #1 Hotleg Eggcrate
105	135	20%	18" Below #3 Bat Wing
107	117	20%	10" Above #1 Bat Wing
92	86	20%	5" Above #3 Hotleg Eggcrate
93	89	30%	30" Above #2 Hotleg Eggcrate
96	82	20%	1" Below #5 Hotleg Eggcrate

LIST OF TUBES CONTAINING INDICATIONS

S/G B COLD SIDE

LINE	ROW	% INDICATION	LOCATION
122	20	30%	14" Above #1 Coldleg Eggcrate
93	69	24%	7" Above Coldleg Tubesheet

ATTACHMENT

METHODOLOGY

The inspection program satisfied the requirements of the US NRC Regulatory Guide 1.83, Revision 1, (July 1975), "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes." The inspection program was conducted in accordance with approved vendor-supplied procedures and the ANO-2 Technical Specifications.

The inspection program consisted of utilizing multi-frequency eddy current techniques to collect steam generator tube dent and defect data with the testing frequencies of the multi-frequency eddy current tester setup as follows:

- Channel 1 Frequency at 400 KHZ
- Channel 2 Frequency at 200 KHZ
- Upper Mixer for Minimum Tube Support Plate Response
- Channel 3 Frequency at 400 KHZ (low gain)
- Channel 4 Frequency at 10 KHZ ABS

During the conduct of the inspection, the signal generated by the eddy current probe was fed into an eight channel tape recorder which permanently recorded on magnetic tape all four frequencies (two channels each) of the multi-frequency tester.

Channel No. 1 of the eddy current tester was set at 400 KHZ. Based on past experience, this frequency provides for optimum response for tubing of the diameter and wall thickness of that used in the Arkansas Nuclear One Unit 2 Steam Generators. The 400 KHZ frequency constitutes a data base for these steam generators to which future inspections can be compared. The sensitivity of this channel was adjusted to allow for calibration to a standard containing known defects.

Channel No. 2 of the eddy current tester was set at 200 KHZ. The output of this channel and the 400 KHZ output from Channel No. 1 was fed into the upper mixer unit for the purpose of suppressing the tube support plate signals. A section of drilled carbon steel plate simulating the tube support plate was superimposed over the dent calibration standard. The mixer was then adjusted such that the signal generated by the tube support plate was eliminated. After adjustment and calibration the output of the mixer provided only the signal originating within the tube itself. Therefore, any flaw indication generated by the tube in the area under the tube support plate would be more easily detectable.

Channel No. 3 of the eddy current tester was set at 400 KHZ for detection of denting. The sensitivity of this channel was adjusted to a dent standard signal of known dimension.

Channel No. 4 of the eddy current tester was set at 10 KHZ absolute. This data was used for sludge depth mapping and will be used later to investigate support plate cracking.

One 4 channel strip chart recorder was utilized. The vertical and horizontal components of the signal from Channel No. 1 of the tape recorder, corresponding to the 400 KHZ signal from Channel No. 1 of the eddy current tester, were fed to Channel No. 1 and Channel No. 2 of the 4 channel strip chart recorder. The data displayed on these channels provided the annalyst with the vertical and horizontal components of the primary test frequency.

The data from the inspection program was recorded on magnetic tape and on strip charts. These recordings were analyzed to evaluate the extent of tube wall anomalies and the results were recorded.

EQUIPMENT

The complete eddy current inspection system can be broken down into two categories, inspection equipment and probe positioning equipment. The eddy current inspection equipment consists of the following:

- Zetec MIZ-12 Multi-Frequency Eddy Current Tester with dual mixers
- 1 - 4 Channel Strip Chart Recorder (Gould 2400) or equivalent
- 1 - 8 Channel Hewlett-Packard Magnetic Tape Recorder or equivalent
- Eddy Current Test Probes (A560SF) or equivalent
- Calibration Standards (Defect Standard per ASME Section XI plus Dent Standard)
- A Supply of Magnetic Tape and Strip Chart Paper
- Zetec Digital Data Analyzer (DDA-4)

The probe positioning and drive system consists of the following:

- SM-4 Positioner and Templates
- A Closed Circuit Television System
- A Probe Drive Mechanism
- A Communication System

The MIZ-12 multi-frequency eddy current tester uses eddy currents as the probing media to measure variations in effective conductivity and/or permeability of the tube being tested. In non-magnetic materials, such as inconel, conductivity is usually the only significant variable. When the effective conductivity decreases due to a discontinuity in the tube wall, the test coil voltage increases in direct relationship with the effective conductivity change. Thus, the amount of increase in coil voltage is related to the size of the discontinuity. The coil voltage is sinusoidal, thus it can be described with a single vector having magnitude and phase. The MIZ-12 system provides a method for reading out two quadrature components of the test coil voltage vector. In addition, the MIZ-12 multi-frequency eddy current tester is a highly versatile and compact eddy current inspection system. Utilizing a "Time-Sharing" technique the operator may test up to four(4) frequencies simultaneously. The MIZ-12 contains two mixing circuits, giving the operator the ability to subtract out most undesirable data (i.e., noise, support signals, etc.). The CRT display allows the operator to view the mixer output as well as the test signals.

The response from the eddy current tester is fed through the memory oscilloscope to the tape recorder and then to the strip chart recorder. Audio input (microphone) is also provided to record the identity of the tube under test at the start of each test. The recorded data can be analyzed with the aid of the Zetec digital data analyzer.

Special sensing probes fabricated for the specific tubing to be tested and designed to negotiate the bends in the tubing are used. The probes are attached to nylon tubing which is used to insert and withdraw the probe. The instrument leads and a stainless steel safety wire pass through the nylon tube.

The defect calibration standard is a length of Inconel-600 tubing 0.750 OD by 0.050 wall thickness in which artificial (machined) defects have been introduced. This standard was made in accordance with the ASME Code, Section XI.

A dent standard is also used for the assessment of dent sizes at the support plate intersections. This dent standard has one zone in which the tube radius is reduced approximately uniformally around the circumference. Measured dent signal voltages are compared directly to an empirical curve relating signal voltage to radius reduction obtained from scanning the dent standard. The denting observed in the steam generators is assumed to be reasonably uniform around the circumference.

The probe positioning device (SM-4) is a remote control mechanical arm which can be positioned to feed the probe into any tube in the steam generator. It consists of a mounting stanchion and two mechanical arms driven by stepping motors. A remote camera and lighting system is mounted on the SM-4 allowing the operator to see probe insertion and to identify the tube being tested. A tube sheet template is installed and removed in sections and is held in place on the tube sheet by template plugs which are forced into particular tubes. The SM-4 and templates provide a fast and easy means of

positioning the probe and identifying the tube being tested. Test speed and probe positioning accuracy is of benefit when using this system on a large testing program.

The probe insertion and withdrawal mechanism is a device which ensures a constant probe speed when recording the eddy current test results. This is important in that accurate location of any eddy current indication is dependent on constant probe speed since tube length is correlated with strip chart speed.