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U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 2; Docket No. 50-318
Steam Generator Tube Inspection Results

In the spring of 1997, Baltimore Gas and Electric Company conducted a scheduled refueling outage at Calvert Cliffs Nuclear Power Plant Unit 2. An inspection of the Unit 2 steam generator tubes was performed during the outage. The results of the Steam Generator Tube Inspection fell into the C-3 category, as described in Calvert Cliffs Nuclear Power Plant Technical Specification 4.4.5.2. A telephone conference call was made to the Nuclear Regulatory Commission staff in Rockville, Maryland on April 9, 1997, in which the results of the inspection were reviewed. In accordance with Technical Specification 4.4.5.5.c, a written follow-up of this report, providing a description of the investigations conducted to determine the cause of the tube degradation and corrective measures taken as a result of the inspection findings, is provided below.

INSPECTION SCOPE

The examination of Calvert Cliffs Unit 2 Steam Generators (Nos. 21 and 22) consisted of bobbin coil and motorized rotating plus point (MRPP) inspection technologies.

A. Bobbin Coil Inspections

The bobbin coil examinations for Steam Generator Nos. 21 and 22 included 100 percent bobbin coil full length examination of all inservice tubes.

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B. Motorized Rotating Plus Point Inspections

The MRPP examinations for Steam Generator Nos. 21 and 22 inservice tubes included:

1. One hundred percent of the hot leg tubes at the top of the tube sheet (TTS), TTS+5" above to TTS-1" below.

2. Twenty percent of rows 1 and 2 (U-Bend Region). The vertical extent of the exam was from 6th hot leg tube support plate (TSP) to the 6th cold leg TSP.

3. Twenty percent of rows 3 through 5 and 14 through 20 from the 4th hot leg TSP to the vertical middle support.

4. One hundred percent of rows 6 through 13 from the 6th hot leg TSP to the 6th cold leg TSP.

5. Twenty percent of the upper bundle Stay Dome Region tubes from rows 35 through 59, lines 55 through 115. These inspections were conducted from the 4th hot leg TSP to the vertical middle support.

6. Twenty percent of the upper bundle Arc Region tubes from rows 60 though 120. These inspections were conducted from the 4th hot leg TSP to the vertical middle support.

7. Twenty percent of the 9th hot leg TSP from rows 121 through 140.

8. Twenty percent of the cold leg tubes at the TTS + 5" through the TTS-1".

9. Twenty percent of the dented TSP intersections that had an eddy current response signal greater than 5 volts.

10. Twenty percent of the rolled mechanical plugs.

C. Special Motorized Rotating Plus Point Inspections

All MRPP inspections were performed using the "Plus Point" probe technology. All distorted bobbin coil indications were dispositioned with the plus point probe.

EDDY CURRENT INSPECTION RESULTS

Attachment (1) contains the results of the MRPP and bobbin exams for Steam Generator Nos. 21 and 22. All steam generator tubes with crack-like indications, both circumferential and axial, and all volumetric and wear indications were removed from service.

IN-SITU PRESSURE TEST RESULTS

Two tubes from each steam generator were in-situ pressure tested. Tubes were selected that bound the distribution of flaw length and voltage for the axial, circumferential and volumetric flaw indications found during the eddy current exam. The test method used on the axial and volumetric flaw indications was a full tube length pressure test. A localized pressure test was performed on the circumferential flaw indication. The tubes tested were:

Steam Generator	Row	Line	Flaw Type	Flaw Location	Flaw Voltage	Flaw Length
21	9	27	SAI	VM	1.8	1.3"
21	22	162	SVI	04H + 0.31"	5.92	5.2"
22	8	28	SAI	VM	0.36	1.6"
22	19	29	SCI	TSH + 0.08"	0.19	2.0"

SAI Single Axial Indication
SVI Single Volumetric Indication
SCI Single Circumferential Indication

The most limiting case for Calvert Cliffs Nuclear Power Plant is pressurization without burst to three times normal differential operation pressure (3 x 1400 psi = 4200 psi). The minimum test pressure for tubes with axial indications was set at 4750 psig to account for temperature correction. The minimum test pressure for tubes with circumferential indications was set at 5300 psig to account for temperature correction and possible axial loading due to tube lock effects. All tubes tested were pressurized greater than their minimum required test pressure; no tubes burst.

All four tubes were tested to pressures in excess of the above values to further verify the substantial remaining structural integrity of the defective tubes. The test pressure achieved was limited by the test device. The test pressures reached a maximum pressure of 5750 psig. All steam generator tubes that were in-situ pressure tested demonstrated structural integrity per the requirements of Regulatory Guide 1.121.

CAUSE OF TUBE DEGRADATION AND CORRECTIVE MEASURES

No new steam generator tube degradation mechanisms were identified by the 1997 Unit 2 steam generator eddy current examination. The active degradation mechanism in both steam generators is intergranular attack/intergranular stress corrosion cracking. With the exception of four primary water intergranular stress corrosion cracking initiated flaws, all flaw indications were outside diameter initiated. All four primary water intergranular stress corrosion cracking flaws were located at the hot leg TTS.

The size of the eddy current flaw indications are best characterized as low voltage and short length. The 1997 Unit 2 examination voltage and length distribution compared favorably to that found during the 1995 Unit 2 steam generator eddy current exam. The mean and maximum flaw voltage and length were less than the 1995 values. Both examinations used "Plus Point" technology. The TTS degradation mechanism remains active. The upper tube bundle eddy current examination did not indicate upper bundle free span tube degradation to the extent found in Unit 1 steam generators during the 1996 examination. All Unit 2 steam generator tubes with crack-like, wear or volumetric indications were removed from service. Future

inspections will continue to: (1) focus on regions of the steam generators with known active degradation mechanisms and, (2) incorporate industry experience on steam generator degradation mechanisms.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Peter Katz

PEK/RCG/bjd

Attachments: As stated

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ATTACHMENT (1)

RESULTS OF THE MOTORIZED PLUS POINT AND BOBBIN TECHNOLOGIES INSPECTION OF STEAM GENERATORS NOS. 21 AND 22

The following outline summarizes the final results of this examination.

DEFECT	STEAM GENERATOR NO. 21	STEAM GENERATOR NO. 22
Total Hot Leg Top of the Tube Sheet	235	199
axial cracks	194	147
circumferential cracks	8	36
volumetric flaws	33	16
Total Upper Tube Bundle Arc and Stay Dome Regions	11	5
axial cracks	7	2
volumetric flaws	4	3
Total Steam Blanket Region	8	4
axial cracks	8	3
volumetric flaws	0	1
Other (wear, loose parts, miscellaneous)	23	6
Total Tubes Plugged, 1997	277	214
Total Tubes Plugged	704	443
Total Percent Plugged	8.3%	5.2%