CHARLES H. CRUSE Vice President Nuclear Energy Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant 1650 Calvert Cliffs Parkway Lusby, Maryland 20657 410 495-4455



June 16, 1998

U. S. Nuclear Regulatory Commission Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318 Clarification of Response to NRC Generic Letter 97-05: Steam Generator Tube Inspection Techniques

**REFERENCES**: (a) NRC Generic Letter 97-05, "Steam Generator Tube Inspection Techniques," dated December 17, 1997

(b) Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated March 16, 1998, Response to NRC Generic Letter 97-05: Steam Generator Tube Inspection Techniques

By Reference (a), the Nuclear Regulatory Commission requested all addressees to submit a written response providing the following information:

- (1) whether it is their practice to leave steam generator tubes with indications in service based on sizing,
- (2) if the response to item (1) is affirmative, those licensees should submit a written report that includes, for each type of indication, a description of the associated nondestructive examination method being used and the technical basis for the acceptability of the technique used.

By Reference (b) we responded that it is not our practice to leave steam generator tubes with indications in service based on sizing. That response was based on the assumption that the focus of the Generic Letter was on indications of cracks in steam generator tubes. It is not our practice to return tubes with indications of cracks to service. However, during preparations for the 1998 Unit 1 steam generator eddy current inspection, it came to our attention that we had previously identified mechanical wear at tube support structures as a degradation mechanism. Indications caused by this degradation mechanism are



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returned to service based on sizing with eddy current. Accordingly, we hereby submit Attachment (1) to this letter as an amendment to our response in Reference (b).

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

Very truly yours,

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#### STATE OF MARYLAND : : TO WIT:

COUNTY OF CALVERT

I, Charles H. Cruse, being duly sworn, state that I am Vice President, Nuclear Energy Division, Baltimore Gas and Electric Company (BGE), and that I am duly authorized to execute and file this response on behalf of BGE. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other BGE employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

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Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of \_\_\_\_\_\_, this 10th day of \_\_\_\_\_\_, 1998.

WITNESS my Hand and Notarial Seal:

2/1/2002 Date

My Commission Expires:

CHC/GT/dlm

Attachment (1): Clarification of Response to NRC Generic Letter 97-05, "Steam Generator Tube Inspection Techniques"

cc: R. S. Fleishman, Esquire J. E. Silberg, Esquire S. S. Bajwa, NRC A. W. Dromerick, NRC H. J. Miller, NRC Resident Inspector, NRC R. I. McLean, DNR J. H. Walter, PSC

Notary Public

# **ATTACHMENT (1)**

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# CLARIFICATION OF RESPONSE TO GENERIC LETTER 97-05,

# **"STEAM GENERATOR TUBE INSPECTION TECHNIQUES"**

## ATTACHMENT (1)

# CLARIFICATION OF RESPONSE TO GENERIC LETTER 97-05, "STEAM GENERATOR TUBE INSPECTION TECHNIQUES"

## Required Information (1):

[Is it Baltimore Gas and Electric Company's] practice to leave steam generator tubes with indications in service based on sizing [?]

#### **BGE Response:**

It is the practice of Baltimore Gas and Electric Company to leave mechanical wear indications in service based on depth sizing with eddy current. Calvert Cliffs Nuclear Power Plant (CCNPP) Technical Specification 4.4.5.4 defines the steam generator tube plugging limit as an imperfection depth at or beyond 40% of the nominal tube wall thickness. All tubes with indications of wear that reach or exceed the Technical Specification defined limit are plugged. No other service-induced indications are returned to service following detection by eddy current examination.

## Required Information, Item 2:

[If] the response to item (1) is affirmative, [Baltimore Gas and Electric Company] should submit a written report that includes, for each type of indication, a description of the associated nondestructive examination method being used and the technical basis for the acceptability of the technique used.

#### **BGE Response:**

#### Background

The nuclear power industry recently voted to adopt an initiative requiring each utility to implement the guidance provided in Nuclear Energy Institute's NEI 97-06, "Steam Generator Program Guidelines" (Reference 1), no later than the first refueling outage starting after January 1, 1999. As specified in Reference (1), each utility is required to follow the inspection guidelines contained in the latest revision of the Electric Power Research Institute's "PWR Steam Generator Examination Guidelines" (Reference 2).

Appendix H, "Performance Demonstration for Eddy Current Examination," of Reference (2) and earlier revisions of Reference (2) provide guidance on the qualification of steam generator tubing examination techniques and equipment used to detect and size flaws. Damage mechanisms are divided into the following categories: thinning, pitting, wear, outside diameter intergranular attack/stress-corrosion cracking, primary-side stress-corrosion cracking, and impingement damage for qualification.

For qualification purposes, test samples are used to evaluate detection and sizing capabilities. While pulled tube samples are preferred, fabricated samples can also be used. If fabricated test samples are used, the samples are verified to produce signals similar to those being observed in the field in terms of signal characteristics, signal amplitude, and signal-to-noise ratio. Samples are examined to determine the actual through-wall defect measurements as part of the Appendix H qualification process.

The procedures developed in accordance with Appendix H specify the essential variables for each procedure. These essential variables are associated with an individual instrument, probe, cable, or particular onsite equipment configurations. Additionally, certain techniques have undergone testing and review to quantify sizing performance. The sizing data set includes the detection data set for the technique, with additional requirements for number and composition of the grading units.

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## ATTACHMENT (1)

# CLARIFICATION OF RESPONSE TO GENERIC LETTER 97-05, "STEAM GENERATOR TUBE INSPECTION TECHNIQUES"

#### **Calvert Cliffs Steam Generator Description**

The Calvert Cliffs Unit 1 and 2 Steam Generators are Combustion Engineering, Model 67 steam generators. Each steam generator contains 8519 tubes in a triangular pitch configuration. The tubes are 0.75" nominal outside diameter with a 0.048" wall thickness and are expanded into the tubesheet. The tube material is high temperature mill annealed Alloy 600. The lower eight tube supports are of an egg crate lattice configuration, the upper two support plates are drilled solid supports. Tubes in rows 1 through 18 are U-bend tubes. All other tubes have two square bends. The horizontal portion of these tubes is supported by vertical and diagonal support straps.

#### Wear Sizing

Wear sizing is applied to mechanical wear indications at tube supports and support straps. In accordance with Technical Specification 4.4.5.4, tubes with indications of wear are plugged when the wear depth reaches 40% of the nominal tube wall thickness. The steam generator eddy current examination is performed in accordance with the CCNPP Quality Assurance Program and follows the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Sections XI and V, as well as the NRC Regulatory Guide 1.83. Additionally, wear depth sizing at CCNPP is performed consistent with ETSS 96004 of Appendix H of Reference (2). The Appendix H wear sizing technique was qualified with 64 sample data points ranging in depth from 4% to 78% through-wall. The root mean square error associated with the applied sizing technique is 4.9% through-wall with a correlation coefficient ( $r^2$ ) of 0.95. Sizing is accomplished using a bobbin probe 400/100 kHz differential mix channel. A calibration curve is developed from a wear standard that replicates the wear scar geometry identified from a CCNPP steam generator tube pulled in 1983 (References 3 and 4). The calibration standard encompasses the range of wear depths experienced.

#### Conclusion

Baltimore Gas and Electric Company has reviewed the types of eddy current indications present in steam generator tubes and determined that all service-induced indications, with the exception of mechanical wear, are not returned to service. Based on NRC and industry guidance and ASME Code requirements, depth sizing of mechanical wear indications by eddy current technique, and repairing them in accordance with CCNPP Technical Specifications, is acceptable. Wear at Calvert Cliffs is relatively inactive. The measured increase in wear depth over an operating cycle is small, less than 10% per cycle for wear indications over 20% through-wall. Additional assurance that sizing of mechanical wear at Calvert Cliffs adequately manages tube degradation is the defense-in-depth provided by primary-to-secondary leak rate monitoring.

#### References

- 1. Nuclear Energy Institute NEI-97-06, "Steam Generator Program Guidelines," December 1997
- EPRI TR-107569-V1, "PWR Steam Generator Examination Guidelines," Revision 5, September 1997
- Combustion Engineering Report, "Destructive Examination Calvert Cliffs Unit 1 Steam Generator Tubing for Baltimore Gas and Electric," February 1984
- Southwest Research Institute Report, "Metallurgical Evaluation of Steam Generator Tubes, Calvert Cliffs Unit 1," September 1988