CHARLES H. CRUSE
Vice President
Nuclear Energy

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, Maryland 20657
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BGE

March 28, 1996

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
10 CFR Part 21 Follow-up Report Concerning Failures of Gould-Shawmut Fuses

REFERENCE: (a) Letter from Mr. C. H. Cruse (BGE) to Document Control Desk (NRC), dated May 8, 1995, 10 CFR Part 21 Interim Report Concerning Failures of Gould-Shawmut Fuses

Please find attached the subject follow-up 10 CFR Part 21 report concerning failures of Gould-Shawmut A25X 10-15 ampere fuses at our facility that we committed to in Reference (a). The interim 10 CFR Part 21 report discussed the discovery of a higher than expected failure rate of Gould-Shawmut A25X 10-15 ampere fuses over a five-month period.

The initial investigation into the issue revealed a certain percentage of these fuses had developed cracks in their fuse elements. As the cracks propagated, the fuse element failed to carry current, creating the appearance that the fuse was blown.

At the time Reference (a) was submitted, the failure mechanism of the failed fuses had not been verified and a metallurgical evaluation was still in progress. The metallurgical evaluation is complete, however, its results were inconclusive. The metallurgical evaluation did not positively determine the cause of the fuse element cracking. However, it did find that a probable cause of the fuse failures was that corrosive flux residues caused the fuse element to weaken, embrittle, and eventually crack in at least some of the fuses that were analyzed. Changes have been implemented to minimize similar failures in the future at our facility.

Our findings and recommendations surrounding this issue are detailed in Attachment (1).

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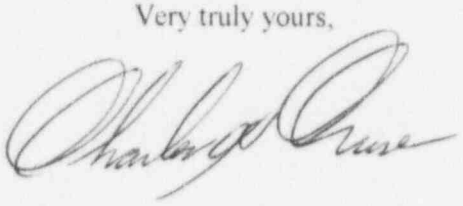
Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,



CHC/CDS/bjd

Attachment

cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
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J. H. Walter, PSC

ATTACHMENT (1)

10 CFR PART 21 FOLLOW-UP REPORT CONCERNING FAILURES OF GOULD-SHAWMUT A25X 10-15 AMPERE FUSES DUE TO CRACKING OF THE FUSE ELEMENT

Calvert Cliffs Nuclear Power Plant, Units 1 and 2

Docket Nos: 50-317 and 50-318

(i) Name and address of individual making notification:

C. H. Cruse, Vice President - Nuclear Energy
Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

(ii) Basic Component Affected:

Gould-Shawmut A25X (10-15 ampere) fuses

(iii) Firm Supplying Component:

Gould Electronics Incorporated
374 Merrimac Street
Newburyport, MA 01950-1998
Telephone: (508) 462-3131

(iv) Nature of Defect:

Between November 1994 and March 1995 Calvert Cliffs Units 1 and 2 experienced five failures of Gould-Shawmut A25X 10-15 ampere fuses. The fuses are not manufactured as safety-related but are bought commercial grade and dedicated as safety-related. When tested with an ohmmeter the fuses read open but with pressure exerted on the ends of the fuse barrel, causing the barrel ends to be pushed together, the fuses read in the 100-1000 ohm range. Based on the high failure rate and unusual failure characteristics, a metallurgical evaluation was initiated.

Gould-Shawmut provided information indicating that a possible cause of the cracking was an old manufacturing process. Prior to January 1993, this type of fuse was manufactured utilizing an external soldering process on the fuse barrel end to attach the zinc fuse element to the fuse barrel. The process utilized an acid core flux. If the soldering process was not hot enough, the acid core flux did not completely burn away and a semi-corrosive flux residue was left on the zinc element. In time, this semi-corrosive flux residue may have led to the development of cracks at the residue line on the zinc element.

The old soldering process was used at least as far back as the early 1980's according to the Gould-Shawmut. In January 1993, Gould-Shawmut changed the soldering process and solder to improve the yield of the fuse manufacturing process. The soldering flux was changed from the acid core flux to a non-corrosive paste.

Our analysis found the thin and flat fuse elements cracked all the way through the element thickness and half way through the element width. On May 8, 1996, Calvert Cliffs issued an interim 10 CFR Part 21 notification concerning the high failure rate of these fuses. Since issuance of the interim report on May 8, 1995, we have experienced no additional failures of these fuses at Calvert Cliffs.

(v) Date on Which Defect was Identified:

On March 7, 1995 an Issue Report was prepared documenting that five Gould-Shawmut A25X 10-15 ampere fuses had failed since November 1994. It remains unclear if these fuses could have failed in a manner that would have rendered redundant trains of safety-related equipment inoperable and created a substantial safety hazard at Calvert Cliffs. However, since we strongly suspected the fuses would fail during a design basis seismic event or certain electrical transients, we issued this report under 10 CFR 21(a)(2).

(vi) Number and Locations of Components:

This problem has been found in only a certain small percentage of A25X 10-15 ampere fuses that were examined. It is not known exactly how many defective fuses were in the plant at the time this defect was discovered. Each Calvert Cliffs Unit has 240 A25X 10-15 ampere fuses installed in circuits associated with the Vital AC busses. All of these 240 fuses for each unit have been replaced since this problem was discovered.

(vii) Corrective Actions Taken:

A metallurgical analysis of some of the failed fuses has been completed by our Materials Engineering and Inspection Unit. The analysis could not positively determine the cause of the fuse element cracking. However, it is considered probable that corrosive flux residues caused the solder and the zinc element to weaken, embrittle, and eventually crack in at least some of the fuses analyzed. Corrosion is consistent with many of the characteristics observed during the metallurgical analysis.

All of the Units 1 and 2 A25X 10-15 ampere fuses in the vital AC system have been replaced. All of the spare A25X 10-15 ampere fuses in this system have also been replaced.

We communicated the problem to Gould-Shawmut, who indicated that they have had no previous indication of this fuse failure mechanism from their other customers.

We have initiated an addition to our preventative maintenance program that will replace the fuses in the 120 VAC systems once per 10 years.

An INPO Nuclear NETWORK message has been issued to make other industry personnel aware of this potential problem.

(viii) Other Advice Related to Purchasers or Licensees:

Although the Manufacturer changed the manufacturing process in January 1993, the older type fuses are still being received from fuse suppliers, and may be held in stock by other licensees. A new non-corrosive type flux and solder is now used to manufacture these types of fuses and the method of soldering has changed. The new generation fuses may be distinguished from the old by observing the barrel end. The new fuses have no trace of solder puddles or grinding marks.