CHARLES H. CRUSE
Plant General Manager
Calvert Cliffs Nuclear Power Plant

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, Maryland 20657
410 586-2200 Ext. 4101 Local
410 260-4101 Baltimore

BGE

April 22, 1994

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 1; Docket No. 50-317; License No. DPR 53
Licensee Event Report 94-004
Excessive Corrosion of Incore Instrumentation Flange Components

The attached report is being sent to you as required under 10 CFR 50.73 guidelines. Should you have any questions regarding this report, we will be pleased to discuss them with you.

Very truly yours,

Charles H. Cruse

CHC/WDM/bjd
Attachment

cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
R. A. Capra, NRC
D. G. McDonald, Jr., NRC
T. T. Martin, NRC
P. R. Wilson, NRC
R. I. McLean, DNR
J. H. Walter, PSC
Director, Office of Management Information
and Program Control

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NRC FORM 366 (5-92)

U. S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES: 5/31/952

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Calvert Cliffs, Unit 1	05000 317	1 OF 06

TITLE (4)
Excessive Corrosion of Incore Instrumentation Flange Components

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBERS(S)
										05000
02	21	94	94	-- 004 --	00	04	22	94		05000

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR : (Check one or more) (11)							
			20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)
POWER LEVEL (10)	0		20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)		73.71(c)
			20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)		OTHER (Specify in Abstract below and in Text, NRC Form 366A)
			20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		
			20.405(a)(1)(iv)	X	50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)		
			20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (include Area Code)
Wayne D. Maki, Engineer	410-260-3651

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	AB	PSF		Y					

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE)		NO		07	31	94

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-space typewritten lines) (16)

On February 21, 1994, we discovered higher than anticipated corrosion of three nuts on one of the Incore Instrumentation flanges on the Unit 1 reactor vessel head. The joints were known to be leaking slightly since 1993, but we deferred repairs until 1994 because the expected corrosion rate was very low. The excessive corrosion rate was apparently due to the presence of wet boric acid on some of the flange components where we expected only dry boric acid. Investigation is ongoing to determine the reasons for this increased presence of wet boric acid. There were no actual safety consequences, although the potential existed for a significant leak. Corrective action to repair the leaking flanges is complete. Further action awaits results of our root cause analysis. This report will be supplemented when the root cause analysis is complete.

I. DESCRIPTION OF EVENT

On February 21, 1994 during a refueling shutdown inspection of the Unit 1 reactor vessel head area, we discovered higher than anticipated corrosion of three nuts on one of the Incore Instrumentation (ICI) flanges. One nut had failed and two adjacent nuts were significantly corroded but had not failed. The corrosion was caused by reactor coolant leakage past the ICI detector joint assembly, leading to a build-up of concentrated boric acid on flange components.

In March, 1993, evidence of boric acid leakage was discovered on the Unit 2 ICI flanges during refueling shutdown inspections. The issue was documented via our Issue Report system and a Root Cause Analysis initiated to determine appropriate corrective actions. An operability evaluation was performed justifying the continued operation of Unit 1. The evaluation included calculation of the potential amount of wastage of the carbon steel nuts and studs, which was deemed to present an acceptably low risk. In April, 1993, the root cause analysis on the Unit 2 leakage was completed and a modification to the Unit 2 ICI flanges initiated. The cause of the leakage was determined to be a change of gasket material in 1988 which changed the crush characteristics of the gasket and allowed leakage past the ICI detector joint. The corrective modification included replacement of the gaskets with a thicker version and the placement of Belleville washers underneath the castle nut assembly to help maintain tension on the joint. This modification was implemented on Unit 2 prior to restart following the 1993 refueling outage. Thus far, we have observed no evidence of any additional leakage from the Unit 2 ICI flanges.

In June, 1993, following indications of increasing Unit 1 containment ambient temperature and decreasing performance of the containment air coolers (CACs), the Plant General Manager directed shutdown of the unit to investigate. During this shutdown, the ICI flanges were examined and seven of eight were found to be leaking. The amount of boric acid leakage was similar to the previously identified leakage on Unit 2. A team was assembled to address the issues and form recovery plans. On June 25, 1993, the Plant Operations and Safety Review Committee reviewed the operability determination for Unit 1. This evaluation had incorporated the following considerations: Technical Specification and Updated Final Safety Analysis Report reviews, evaluation of the effects of boric acid on other containment components and structures, effects of boric acid on the reactor vessel head, effects and extent of boric acid corrosion of the ICI flange studs and nuts, and the potential effects of a fuel failure in conjunction with the leaks. The evaluation concluded that continued operation of the unit was justified. The Plant Operations and Safety Review Committee recommended resumption of full power operation with repair to the flanges

deferred until the scheduled 1994 outage. On June 28, 1993, following completion of maintenance activities and a careful review of the issue, the Plant General Manager directed that Unit 1 be returned to service.

II. CAUSE OF EVENT

The apparent cause of the event was an increased presence of wet boric acid rather than dry boric acid on a few of the affected ICI flange stud nuts. In deciding in 1993 to defer repairs, we assumed that the high temperature of the vessel head components would result in rapid evaporation of moisture from the leaking coolant, leaving predominantly dry boric acid. This was consistent with the observed results of leakage on Unit 2. We therefore used an expected corrosion rate of 1.6 mils per month to support the evaluations discussed above. A root cause analysis to determine the reasons for the increased presence of wet boric acid is in progress. A supplement to this Licensee Event Report (LER) will be submitted when this analysis is complete.

III. ANALYSIS OF EVENT

Each of the eight ICI flange assemblies consists of an upper and lower half secured together with eight 13 inch long 1-3/4 inch diameter studs secured by a 1-3/4 inch heavy hex nut (see Figures). The nuts are made of ASTM A 194 Grade 2H carbon steel and the studs are made of ASTM A 193 Grade B7 carbon steel. In this specific case, three adjacent studs were degraded: one was failed, and two were significantly corroded. An engineering analysis performed by the reactor vendor conservatively demonstrated that three adjacent studs would have to be completely failed and a fourth severely degraded in order to result in a partial failure accompanied by slight rotation of the joint. The analysis further concluded that if a loss of three adjacent studs and consequent joint rotation were to occur, it would most likely occur such that gross leakage would be apparent for some time prior to catastrophic failure and thus alert operators of the condition in time to take mitigating action. In the unlikely event of catastrophic joint failure, the effects would be bounded by the Calvert Cliffs loss-of-coolant accident analyses.

Actual leakage in this case was within Technical Specification limits. We experienced no loss of pressure boundary integrity. However, the above analysis combined with our preliminary assessment of the amount of corrosion we experienced led us to conclude on March 25, 1994 that the potential had existed for a significant leak. We are therefore reporting this event under 10 CFR 50.73(a)(2)(ii).

IV. CORRECTIVE ACTIONS

Corrective action for the ICI flange leakage problem was to implement the modification discussed above. The modification was implemented on Unit 2 in 1993 and thus far we have observed no evidence of further leakage on that unit. In December, 1993, we performed a mock-up test that validated the new design. The modification was implemented on Unit 1 during the present outage. We are conducting a root cause analysis to determine the cause of the increased presence of wet boric acid and to ascertain lessons to be incorporated into our engineering decision process with respect to boric acid leakage. The results of this analysis will be reported in a supplement to this LER.

V. ADDITIONAL INFORMATION

A. Identification of components referred to in this LER:

Component	IEEE 803 EIIS Funct	IEEE 805 System ID
ICI Flange	PSF	AB
ICI Flange Stud	PSF	AB
ICI Flange Hex Nut	PSF	AB
ICI Gasket	PSF	AB

B. There have been no previous similar events.

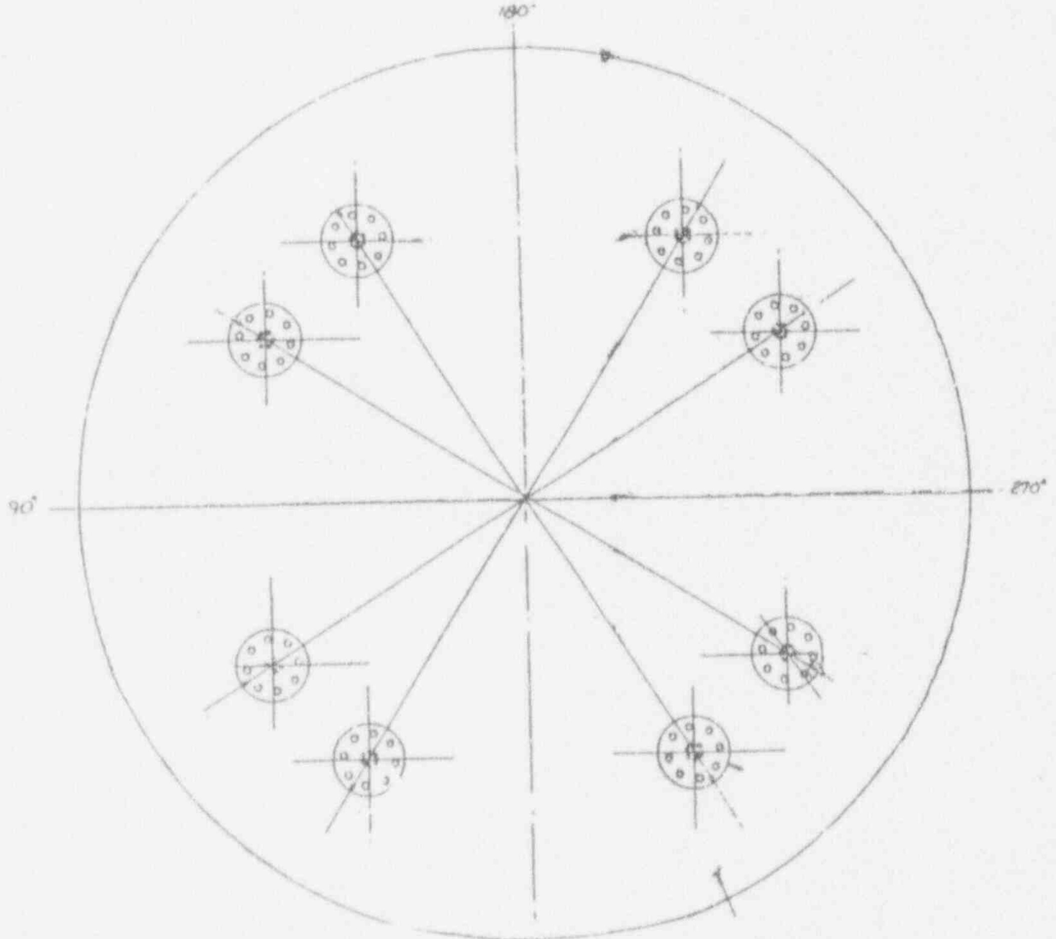

FIGURE 1

PLAN VIEW INDICATING LOCATION AND ORIENTATION
OF ICI FLANGES ON PRESSURE VESSEL CLOSURE HEAD

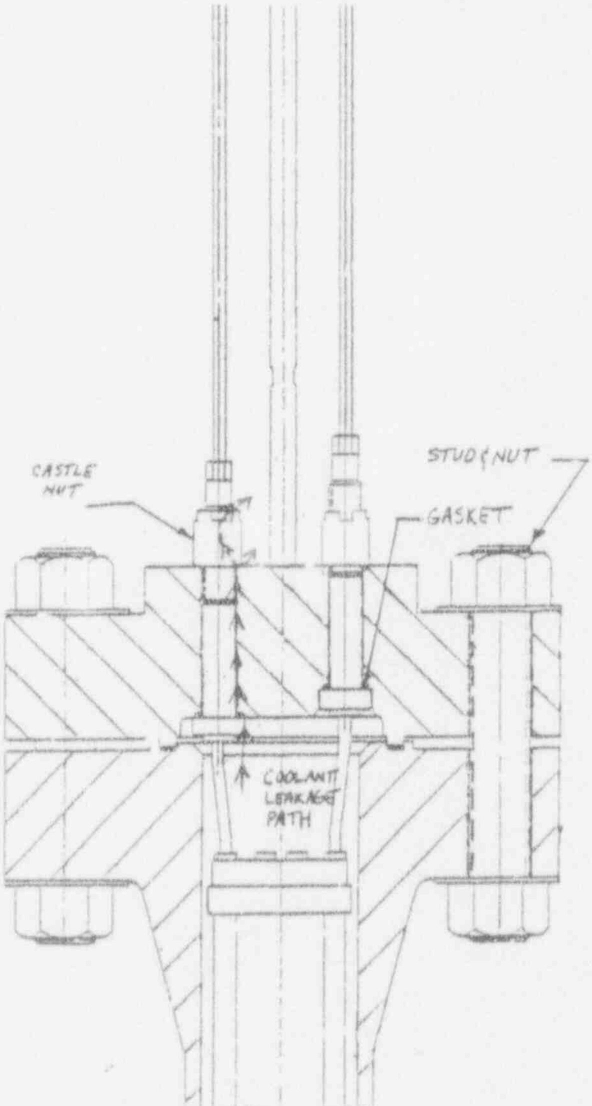

FIGURE 2

ICI FLANGE ASSEMBLY