Calvert Cliffs Nuclear Power Plant

1650 Calvert Cliffs Parkway
Lusby, Maryland 20657

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a joint venture of
Constellation Energy
EDF

CALVERT CLIFFS
NUCLEAR POWER PLANT

September 11, 2012

U.S. Nuclear Regulatory Commission
Washington, DC 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 2012-002, Revision 00
Reactor Coolant Pressure Boundary Leakage Due to Tubing High Cyclic Fatigue

The attached report is being sent to you as required by 10 CFR 50.73. Should you have questions regarding this report, please contact Mr. Douglas E. Lauver at (410) 495-5219.

Very truly yours,

for
Christopher R. Costanzo
Plant General Manager

CRC/KLG/bjd

Attachment: As stated

cc: N. S. Morgan, NRC
W. M. Dean, NRC
Resident Inspector, NRC
S. Gray, DNR

IE22
NRR

NRC FORM 366 (10-2010) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 | EXPIRES: 10/31/2013

LICENSEE EVENT REPORT (LER)

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

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Reactor Coolant Pressure Boundary Leakage Due to Tubing High Cyclic Fatigue

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR		DOCKET NUMBER
										05000
07	17	2012	2012	- 002 -	00	09	11	2012	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☒ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☒ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Kenneth L. Greene, Licensing Engineer	410-495-4385

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
A	AB	TBG		Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

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

On July 17, 2012, Reactor Coolant System pressure boundary leakage was determined to exist on Unit 1 11A Reactor Coolant Pump differential pressure transmitter tubing. Operators commenced a Technical Specification required unit shutdown. With reactor power at 10 percent a containment entry was made to isolate the leak. This effort stopped the steam emanating from the insulated tubing. Unit 1 returned to full power. Unit 1 leak rate data was monitored for the next several days. It was determined conditions did not improve as expected. An additional containment entry was made on July 21, 2012 which identified that Reactor Coolant System pressure boundary leakage existed past the previously shut isolation valves. Operators conducted a Technical Specifications required shutdown of Unit 1 to MODE 5. The source of the leak was a crack in the tubing side weld of the pipe to tube adapter. The cause of the leak was high cyclic fatigue. The cyclic fatigue was caused due to a vertical support for the tubing that was not connected. Corrective actions included replacement of the adapter, the affected portion of tubing, and the connection of a re-engineered vertical support. The similar welds on the other Unit 1 reactor coolant pump differential pressure transmitter tubing runs were inspected with no issues identified. Unit 1 returned to full power on July 25, 2012.

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I. DESCRIPTION OF EVENT:

A. PRE-EVENT PLANT CONDITIONS:

On July 17, 2012, Unit 1 was operating at 100 percent rated thermal power. There were no systems, structures, or components inoperable that would have impacted this event.

B. EVENT:

On June 22, 2012, Operators identified an increasing trend in Unit 1 Reactor Coolant System (RCS) gross leak rate calculations which provided indications of a possible RCS leak inside Unit 1 Containment. Operators then began an investigation to help confirm the validity of a possible RCS leak. In support of this investigation several containment entries were made to identify the source of the leak.

On July 17, 2012 a containment entry was made to get video surveillance of the suspected source of the leak. The video showed a small leak was coming from 11A Reactor Coolant Pump (RCP) differential pressure transmitter sensing line. The leak was just downstream of 1RC-142, 11A RCP differential pressure transmitter back-up isolation valve. Determination of the exact location and characterization of the leak was difficult due to installed insulation on the sensing line. After the containment entry analysis of the video, engineering review, and research of applicable licensing documents were conducted in order to assess if an RCS pressure boundary leak existed. At 1715 on July 17, 2012, Operators entered Technical Specification Action Statement 3.4.13.B, RCS Operational Leakage, due to the presence of RCS pressure boundary leakage. This Action Statement requires the unit to be in Mode 3 within 6 hours and Mode 5 within 36 hours. Shortly thereafter Operations commenced the Technical Specification required reactor shutdown. At approximately 2200 on July 17, 2012, with reactor power at approximately 10 percent power, personnel entered Containment and shut the associated manual valves located on the 11A RCP differential pressure transmitter sensing line to isolate the leak. Shortly thereafter another Unit 1 Containment entry was made and reported that no steam was sighted emanating from the location of the leak. With the leak isolated, Operators exited Technical Specification Action Statement 3.4.13.B. Operators then began to return Unit 1 to full power. Unit 1 returned to full power at 1950 on July 18, 2012.

In the subsequent days, Operations performed ongoing monitoring of Unit 1 RCS leak rate data. The leak rate data did not improve as expected, therefore an additional containment entry was planned to determine if RCS pressure boundary leakage existed. The containment entry was made on July 21, 2012 and it was determined that the RCS pressure boundary leak at 11A RCP differential pressure transmitter sensing line existed. As a result at 1210 on July 21, 2012, Operators declared that RCS pressure boundary leakage existed and entered Action Statement 3.4.13.B. Operations began the Technical Specification required unit shutdown at 1233 on July 21, 2012. Unit 1 entered Mode 3 at 1658 on July 21, 2012 and entered Mode 5 at 1758 on July 22, 2012. Personnel identified a leak at the weld connecting an adapter to the 3/4 inch tubing just downstream of manual valve 1RC-142. The tubing leak was the result of high cyclic fatigue.

The affected section of tubing and adapter were replaced. Unit 1 startup subsequently commenced and Unit 1 was returned to full power at 0920 on July 25, 2012.

C. INOPERABLE STRUCTURES, STRUCTURES, COMPONENTS, OR SYSTEMS THAT CONTRIBUTED TO THE EVENT:

The pressure boundary leak that developed on 11A RCP differential pressure transmitter tubing exceeded Technical Specification Limiting Condition for Operation 3.4.13 limit of zero pressure boundary leakage. This resulted in a Unit 1 Technical Specification required shutdown to repair the leak.

D. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES:

July 17, 2012

1049 - Entry into Unit 1 Containment to determine location of potential RCS leakage completed. Video was taken to determine source of leak. Leak was located on insulated tubing associated with 11A RCP differential pressure transmitter downstream of manual valve 1RC-142.

1715 - Leakage was determined to be RCS pressure boundary leakage. Operations entered Technical Specification Action Statement 3.4.13.B due to the presence of RCS pressure boundary leakage.

1829 - Operations commenced lowering Unit 1 reactor power. Plan was to lower reactor power to approximately 10 percent and then allow entry into Containment to isolate RCS pressure boundary leak.

2203 - Unit 1 Containment entry completed. Reactor Coolant System pressure boundary leak was isolated by shutting manual valves located on both sides of 11A RCP differential pressure transmitter.

2250 - Subsequent Unit 1 Containment entry completed. Entry was made to verify isolation of the leak. Operations exited Technical Specification Action Statement 3.4.13.B.

July 18, 2012

1950 - Unit 1 returned to 100 percent reactor power.

July 21, 2012

1145 - Containment entry was made to determine if RCS pressure boundary leakage existed.

1210 - Presence of RCS pressure boundary leakage was confirmed. Operations entered Technical Specification Action Statement 3.4.13.B for RCS pressure boundary leakage.

1233 - Operations commenced a Unit 1 reactor shutdown.

1658 - Unit 1 in Mode 3.

July 22, 2012

1758 - Unit 1 in Mode 5.

2230 - The affected portion of tubing was replaced and non-destructive testing of weld was completed.

July 25, 2012

0920 - Unit 1 returned to 100 percent reactor power.

E. OTHER SYSTEMS OR SECONDARY FUNCTIONS AFFECTED:

No other systems or secondary functions were affected by this event.

F. METHOD OF DISCOVERY:

Indication of a possible RCS leak was identified by an increasing trend of the daily calculated RCS gross leak rate over several days. For the period of June 12 through June 17 leak rates were calculated at 0.05 gallons per minute (gpm). On June 18 the leak rate rose to 0.08 gpm and remained at that level through June 22. On June 23 calculated leak rate rose to 0.13 gpm. This increased trend met the site's operating instruction criterion to take specified actions to identify the source of the leak. The leak rate subsequently remained at approximately this level until the tubing was replaced on July 22.

G. MAJOR OPERATOR ACTION:

On July 17, 2012, Operators determined the RCS leakage was RCS pressure boundary leakage and initiated a Technical Specification required shutdown. When reactor power was lowered to approximately 10 percent operators entered Containment and isolated the leak. Following this evolution Operators then returned the unit to full power.

On July 21, 2012 once it was determined that RCS pressure boundary leakage still existed, Operators began a Technical Specification reactor shutdown. Unit 1 was subsequently lowered to Mode 5 to allow personnel to repair the leak. Following repairs, Operators began unit startup and returned Unit 1 to full power on July 25, 2012.

H. SAFETY SYSTEM RESPONSES:

There were no demands for safety system actuations during this event.

II. CAUSE OF EVENT:

This event is documented in the site's Corrective Action Program under CR-2012-007012. The pipe to tube adapter and tubing weld were removed for metallographic analysis. Inspection of the components revealed a through wall crack existed where the adapter and tubing were welded together. The adapter to tubing weld showed evidence of a high cycle fatigue failure mode. A subsequent containment entry on August 15, 2012 revealed that the other Unit 1 RCP differential pressure transmitter tubing runs were supported by a vertical support downstream of the adapter to tubing weld per the design drawing. The 11A RCP differential pressure transmitter tubing did not have a vertical support at this location despite a design drawing showing the presence of a support. The absence of the vertical support allowed excessive vibration to exist during transient periods and eventually led to the weld fault. A review of design and maintenance documents, along with evidence of a support remnant found in the field, supports the premise that a vertical tubing support existed at one time, however no documented record could be found as to when it was removed. The lack of the vertical support for 11A RCP differential pressure transmitter tubing had not been previously recognized. Modeling of the sensing line for evaluating its vibrational response with and without the support demonstrated the importance of the vertical supports in controlling vibration. This resulted in re-engineering a new support and installing it on August 16, 2012 to restore proper support of the 11A RCP differential pressure transmitter tubing.

III. ANALYSIS OF EVENT:

This event is reportable in accordance with the following:

The determination on July 17, 2012 and again on July 21, 2012 that a RCS pressure boundary leak existed on Unit 1 is reportable in accordance with:

> 10 CFR 50.73(a)(2)(ii) - "Any event or condition that resulted in: (A) The condition of the nuclear power plant, including its principle safety barriers, being seriously degraded ...."

The RCS pressure boundary leak is an example of a principal safety barrier being seriously degraded. The crack in the weld is a material defect that is not acceptable under American Society of Mechanical Engineers codes. As a result this event is reportable under 10 CFR 50.73(a)(2)(ii)(A).

This event is also reportable under:

> 10 CFR 50.73(a)(2)(i)(B) - "Any operation or condition which was prohibited by the plant's Technical Specifications...."

Calvert Cliffs Technical Specification 3.4.13, RCS Operational LEAKAGE, Limiting Condition for Operation states that no pressure boundary LEAKAGE is allowed. When RCS pressure boundary leakage exists, the REQUIRED ACTION is to place the unit in MODE 3 within 6 hours and in MODE 5 within 36 hours.

In both cases where the existence of RCS pressure boundary leakage was identified, it must reasonably be concluded that the pressure boundary leakage had existed for a time period greater than the Technical Specification allowed COMPLETION TIME. As a result this event is reportable under 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by Technical Specifications.

This event is also reportable under:

> 10 CFR 50.73(a)(2)(i)(A) - "The completion of any nuclear plant shutdown required by the plant's Technical Specifications."

Operators completed the Technical Specification required shutdown on July 21, 2012 which meant it is reportable under 10 CFR 50.73(a)(2)(i)(A).

This event did not result in any actual nuclear safety consequences. The RCS leak could have been a precursor to a small loss-of-coolant accident (LOCA), had the initial weld crack propagated to a catastrophic failure of the tubing. If a small LOCA event had actually occurred, the Calvert probabilistic risk assessment model shows a conditional core damage probability of 2.6E-04 and a conditional large early release probability of 1.7E-05. However, the likelihood of an event exceeding charging capability to meet a LOCA criterion is considered low due to the following:

- There was a relatively short exposure period between when there was an indication of a leak and when the leak was repaired.

- For part of the exposure period, the potential amount of leakage, should a catastrophic failure have occurred, would have been significantly limited by the shut manual valves.

- The pipe to tube adapter and tubing where the failed weld was located were removed for metallographic analysis. The extent of the fatigue fracture surface indicated that the failed weld was not at imminent risk of catastrophic separation. The detected leakage served as a measurable and visible verification of the presence of the crack, which prompted a repair well before the crack had propagated to the circumferential extent where total separation of the joint could occur. The preliminary analysis is that the likelihood of a complete separation failure is assessed as low.

This event has limited impact on the Nuclear Regulatory Commission Reactor Oversight Process Performance Indicators for Unit 1. The performance indicator for Unplanned Power Changes per 7000 Critical Hours is projected to rise to an approximate value of 1 which will keep the indicator low in the green band. The performance indicator for RCS leakage will see a

slight increase in its value, remain green, and will maintain a large margin to the green to white threshold value.

IV. CORRECTIVE ACTIONS:

A. ACTION TO RETURN AFFECTED SYSTEMS TO PRE-EVENT NORMAL STATUS:

1. The affected portion of tubing was replaced. A re-designed vertical support was connected to the tubing.

B. ACTION TAKEN OR PLANNED TO PREVENT RECURRENCE:

1. A dye penetrant testing examination on the other Unit 1 RCP differential pressure transmitter high pressure side adapter to tubing weld was conducted with satisfactory results.

2. Establish a small bore piping/tubing inspection plan for Class 1 systems.

3. Perform engineering evaluation of both unit's sensing line supports to validate that the as built configuration meets design basis requirement of hangers and supports in reactor coolant tubing runs.

4. Perform walkdown of both unit's sensing lines containing pipe to tube adapters downstream of root isolation valves.

The formal root cause analysis is still in progress. If additional information is subsequently developed that would significantly affect the understanding of this event, a supplemental licensee event report will be submitted.

V. ADDITIONAL INFORMATION:

A. FAILED COMPONENTS:

11A RCP differential pressure transmitter tubing is 3/4 inch O.D by 0.065 inch thick, American Society for Testing and Materials A-213, Type 316 Stainless Steel.

B. PREVIOUS LERS ON SIMILAR EVENTS:

A review of Calvert Cliffs' reportable events during the last three years was performed. There were two licensee event reports (LERs) during that time period that involved RCS pressure boundary leakage although the causes for each were not similar to this event. The two LERs are:

1. LER 318/2011-001, Pressure Boundary Leakage Caused by Primary Water Stress Corrosion Cracking – This LER involved detection of dry boric acid on one

pressurizer heater sleeve during an outage inspection. Examinations determined the leak was due to primary water stress corrosion cracking in the weld.

2. LER 318/2010-002, Reactor Coolant System Pressure Boundary Leakage in Valve Leakoff Line Weld – This LER involved detection of a pinhole leak in the socket weld attaching the packing leakoff line to valve 2RC-220. Analysis indicated the cause of the leak was a latent weld defect during the original valve manufacturing.

C. THE ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) COMPONENT FUNCTION IDENTIFIER AND SYSTEM NAME OF EACH COMPONENT OR SYSTEM REFERRED TO IN THIS LER:

COMPONENT	IEEE 803 EIIS FUNCTION	IEEE 805 SYSTEM ID
1RC-142, 11A RCP differential pressure transmitter back-up isolation valve	V	AB

D. SPECIAL COMMENTS:

None.