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10 CFR 50.73

January 24, 2017

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Unit No. 2  
Renewed Facility Operating License No. DPR-69  
NRC Docket No. 50-318

Subject: Licensee Event Report 2016-001, Revision 00  
Automatic Reactor Trip Due to Main Turbine Electro-Hydraulic Control Fluid Leak

The attached report is being sent to you as required by 10 CFR 50.73.

There are no regulatory commitments contained in this correspondence.

Should you have questions regarding this report, please contact Mr. Larry D. Smith at (410) 495-5219.

Respectfully,

Mark D. Flaherty  
Plant Manager

MDF/KLG/bjm

Attachment: As stated

cc: NRC Project Manager, Calvert Cliffs  
NRC Regional Administrator, Region I

NRC Resident Inspector, Calvert Cliffs  
S. Gray, MD-DNR

IE22  
NRK

**LICENSEE EVENT REPORT (LER)**

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/re3/>)

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 FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollects.Resource@nrc.gov](mailto: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.

<b>1. FACILITY NAME</b> Calvert Cliffs Nuclear Power Plant, Unit 2	<b>2. DOCKET NUMBER</b> 05000 318	<b>3. PAGE</b> 1 OF 4
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**4. TITLE**  
 Automatic Reactor Trip Due to Main Turbine Electro-Hydraulic Control Fluid Leak

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
12	03	2016	2016	- 001	00	01	24	2017		05000
									FACILITY NAME	DOCKET NUMBER
										05000

<b>9. OPERATING MODE</b>	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§:</b> <i>(Check all that apply)</i>			
<b>1</b>	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
<b>10. POWER LEVEL</b>	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
		<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A	

**12. LICENSEE CONTACT FOR THIS LER**

LICENSEE CONTACT Kenneth L. Greene, Regulatory Engineer	TELEPHONE NUMBER (Include Area Code) 410-495-4385
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**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
X	TG	CKV	W120	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b>	<b>15. EXPECTED SUBMISSION DATE</b>	MONTH	DAY	YEAR
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO				

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

On December 3, 2016, Operations was conducting a Performance Evaluation of the auto start feature of Unit 2 Main Turbine Electro-Hydraulic Control (EHC) Pumps. At 2223, the standby EHC pump started per the procedure and a normal rise in pressure was noted. At 2224, Unit 2 Main Turbine tripped automatically which was followed by an automatic reactor protection system trip. The Main Turbine tripped on a Main Generator Directional Power Relay trip following the closure of all Unit 2 Main Turbine Governor Valves and Intercept Valves. This was due to an EHC leak on 21 Main Turbine Governor Valve Actuator Emergency Trip Fluid Check Valve which caused a rapid decrease in EHC header pressure. The trip was an uncomplicated reactor trip as all safety functions performed as expected. The failed emergency trip fluid check valve was sent off site to a lab for forensic investigation. This analysis determined the check valve failed due to Inter Granular Stress Corrosion Cracking (IGSCC). The most likely cause of the IGSCC on this check valve was exposure to ammonia during some previous maintenance activity. Corrective actions include replacement of all similar Unit 2 EHC valves during the 2017 refueling outage and establishment of a preventive maintenance strategy to periodically replace similar EHC valves. Unit 2 was returned to full power at 1647 on December 5, 2016.

<b>NRC FORM 366A</b> <small>(06-2016)</small>		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>		APPROVED BY OMB: NO. 3150-0104		EXPIRES: 10/31/2018	
<b>LICENSEE EVENT REPORT (LER) CONTINUATION SHEET</b>				<small>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 FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to <a href="mailto:Infocollections.Resource@nrc.gov">Infocollections.Resource@nrc.gov</a>, 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.</small>			
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<b>1. FACILITY NAME</b>		<b>2. DOCKET</b>		<b>3. LER NUMBER</b>			
				YEAR	SEQUENTIAL NUMBER	REV NO.	
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**NARRATIVE**

**I. DESCRIPTION OF EVENT:**

**A. INITIAL CONDITIONS:**

Calvert Cliffs Unit 2 was operating in Mode 1 at full power on December 3, 2016 prior to the event.

**B. EVENT:**

On December 3, 2016, Operations was conducting Performance Evaluation (PE) #2-93-14-O-M, Auto Start Testing of Unit 2 Electro-Hydraulic Control (EHC) [TG] Pump [P]. At 2223, the standby EHC pump started per the procedure and a normal rise in pressure was noted. At 2224, Unit 2 Main Turbine [TRB] tripped automatically which was followed by an automatic reactor protection system (RPS) [JD] trip. The Main Turbine tripped on a Main Generator [GEN] Directional Power Relay [RLY] trip (load reject) following the closure of all Unit 2 Main Turbine Governor Valves [FCV] and Intercept Valves [ISV]. This was due to an EHC leak on 21 Main Turbine Governor Valve Actuator [VOP] (2CVMT-21OP) Emergency Trip Fluid Check Valve which caused a rapid decrease in EHC header pressure. Following verification that Emergency Operating Procedure (EOP) -0, Post Trip Immediate Actions, safety functions were met, EOP-1, Reactor Trip, was entered for an uncomplicated reactor trip. The failed check valve was replaced and tested prior to returning the system back to service. Unit 2 was returned to Mode 1 at 0225 on December 5, 2016 and the unit returned to full power at 1647 on December 5, 2016.

As part of the investigation into the failure, the failed check valve was sent off site to a lab for forensic investigation. The analysis determined the check valve failed due to Inter Granular Stress Corrosion Cracking (IGSCC). The most likely cause of the IGSCC on this check valve is exposure to ammonia.

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

There were no structures, systems, or components inoperable at the start of the event that contributed to the event.

**D. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES:**

December 3, 2016

2223 - During performance of PE #2-93-14-O-M, the standby EHC pump started per procedure.

2224 - U-2 Reactor trip on U-2 Main Turbine Trip due to load reject following closure of U-2 Main Turbine Governor and Intercept Valves.

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2231 - Operations completed verification that EOP-0 Safety Functions were met.

2236 - Operations implemented EOP-1 for an uncomplicated trip.

2325 - Operations exited EOP-1 and implemented Operating Procedure-4, Plant Shutdown from Power Operation to Hot Standby.

December 5, 2016

0225 – Unit 2 entered Mode 1.

1647 – Unit 2 returned to full power.

**E. FAILURE MODES:**

As part of the investigation into this unit trip, 2CVMT-21OP Emergency Trip Fluid Check Valve and two other non-failed, similar check valves were sent off site for analysis. Forensic analysis at the lab indicated the cause of the fracture, which incurred on the threaded portion of the check valve, was due to IGSCC. This fracture resulted in a large leak of EHC fluid which rapidly reduced EHC header pressure causing all the Unit Main Turbine Governor and Intercept Valves to rapidly shut. Based on the fracture characteristics observed in the lab, the most likely cause of the IGSCC in this aluminum-bronze alloy check valve is exposure to ammonia. While it is most likely that some source of ammonia was introduced to the threads of the check valve during some previous maintenance activity, the analysis is not able to determine the source or the length of time the 2CVMT-21OP Emergency Trip Fluid Check Valve had been exposed to ammonia. The non-failed check valves did not have any signs of similar corrosion issues.

**F. METHOD OF DISCOVERY:**

The method of discovery was self-revealing upon the failure of 2CVMT-21OP Emergency Trip Fluid Check Valve while it was in operation. This event is documented in the site's Corrective Action Program under IR03949100.

**II. CAUSE OF EVENT**

There were no human performance issues related to the reactor trip or the recovery following the unit shutdown.

**A. SAFETY CONSEQUENCES:**

The leak on 2CVMT-21OP Emergency Trip Fluid Check Valve resulted in a rapid decrease in EHC header pressure which resulted in a Main Turbine load reject when the Main Turbine Governor and Intercept Valves went shut. This resulted in an automatic RPS actuation due to

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**NARRATIVE**

loss of load following the main turbine trip. The loss of load trip from 100 percent power is an analyzed anticipated operational occurrence event. All core damage mitigating systems and normal heat removal systems remained available after the trip. As a result the safety consequence from this trip involved minimal nuclear risk.

This event satisfies the criteria in NUREG-1022, Revision 3 for RPS actuation. Therefore this event is reportable pursuant to 10 CFR 50.73(a)(2)(iv)(A). An immediate event notification report (52406) was also made pursuant to 10 CFR 50.72(b)(2)(iv)(B).

**B. CORRECTIVE ACTIONS:**

2CVMT-21OP Emergency Trip Fluid Check Valve was replaced and the EHC system was tested prior to returning the EHC system to service. All similar type valves in the U-2 EHC system (82 in all) will be replaced during Unit 2's 2017 refueling outage which starts in February 2017. Extent of condition is limited to U-2 Main Turbine system as Unit 1 Main Turbine is from a different manufacturer and does not have similar type valves. In addition Calvert Cliffs will establish an overhaul preventive maintenance strategy for each of U-2 Main Turbine Governor and Intercept Valve Actuators to include replacement of the actuators' associated aluminum-bronze alloy components. As part of the extent of condition review, components that contain aluminum bronze material and that are operational critical components being overhauled by vendors, will have written contract limitations specifically disallowing the use of ammonia for any part of the contracted maintenance.

A supplemental licensee event report will be submitted if additional information is subsequently developed that would significantly change the corrective actions for this event.

**III. PREVIOUS SIMILAR EVENTS:**

At Calvert Cliffs, in the last five years, there have been no similar events involving a reactor trip caused by loss of EHC header pressure.

**A. COMPONENT INFORMATION:**

COMPONENT	IEEE 803 FUNCTION ID	IEEE 805 SYSTEM ID
Main Turbine	TRB	TA
21 Main Turbine Governor Valve Actuator (2CVMT-21OP)	VOP	TA
2CVMT-21OP Emergency Trip Fluid Check Valve	CKV	TG

2CVMT-21OP Emergency Trip Fluid Check Valve was manufactured by Admiral Valve LLC.