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10 CFR 50.73

December 07, 2018

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

Calvert Cliffs Nuclear Power Plant, Units No. 1 and 2  
Renewed Facility Operating License Nos. DPR-53 and DPR-69  
NRC Docket Nos. 50-317 and 50-318

Subject: Licensee Event Report 2018-001, Revision 00  
Both Unit 2 Emergency Diesel Generators Inoperable Due to Depressurization in  
Common Air Start Headers

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,

A handwritten signature in cursive script that reads "Todd A. Tierney".

Todd A. Tierney  
Plant Manager

TAT/KLG/lmd

Attachment: As stated

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

NRC Resident Inspector, Calvert Cliffs  
D. A. Tancabel, DNR

IEZZ  
NRR

Document Control Desk  
December 07, 2018  
Page 2

bcc: J. B. Fewell, GDC  
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File # 02.09  
EDMS

318/2018-001-00



### 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/nureqs/staff/sr1022/r3/>)

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 Information Services Branch (T-2 F43), 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> 05000318	<b>3. Page</b> 1 OF 5
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**4. Title**  
Both Unit 2 Emergency Diesel Generators Inoperable Due to Depressurization in Common Air Start Headers

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
10	11	2018	2018	001	0	12	07	2018	Calvert Cliffs Nuclear Power Plant, Unit 1	05000317
									Facility Name	Docket Number
										05000

**9. Operating Mode**      **11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply)**

1	<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 checked="" 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 type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
100	<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 checked="" 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 checked="" 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**

<b>Licensee Contact</b> Kenneth Greene, Principal Regulatory Engineer	<b>Telephone Number (Include Area Code)</b> 410-495-4385
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**13. Complete One Line for each Component Failure Described in this Report**

Cause	System	Component	Manufacturer	Reportable to ICES	Cause	System	Component	Manufacturer	Reportable to ICES
B	LC	EB	---	Y					

<b>14. Supplemental Report Expected</b> <input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date) <input checked="" type="checkbox"/> No	<b>15. Expected Submission Date</b>
	Month    Day    Year

**Abstract** (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

On October 11, 2019, during a post maintenance start of Unit 1 Emergency Diesel Generator (EDG) 1B, its air start control valves failed to shut as designed. This caused air pressure in the common air start headers, shared with both Unit 2 EDGs, to depressurize to a point that rendered both Unit 2 EDGs inoperable. Operations isolated EDG 1B air start control valves which resulted in air start pressure returning to normal on both Unit 2 EDGs. This event resulted in a loss of safety system function for Unit 2 EDGs to exist for 30 minutes. The cause was due to a diode shorting in EDG 1B air start control circuitry which caused two fuses in the circuitry to fail, thus preventing relays to shut the air start control valves. The diode was installed in the air start circuitry during this EDG 1B maintenance period to suppress induced voltage observed with newly installed control relays. The apparent cause of the diode failure was due to an undetected manufacturing defect. This event revealed a previously unknown design vulnerability in the circuitry where failure of a single fuse, at a specific time in the EDG start interval, could cause loss of air start pressure to the other EDGs that share the common air start headers. Corrective actions taken included removal of the new diodes and relays from the control circuitry and installation of isolation valves in the common air start headers.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME  Calvert Cliffs Nuclear Power Plant, Unit 2	2. DOCKET NUMBER  05000318	3. LER NUMBER		
		YEAR  2018	SEQUENTIAL NUMBER  - 001	REV NO.  - 00
NARRATIVE				

**PLANT AND SYSTEM IDENTIFICATION**

Calvert Cliffs Nuclear Power Plant, Units 1 and 2, are Combustion Engineering Pressurized Water Reactors with a licensed maximum power level of 2737 megawatts thermal. The Energy Industry Identification System codes used in the text are identified as [XX].

**A. CONDITION PRIOR TO EVENT**

Units 1/2  
Date: October 11, 2018  
Power level: 100 percent/100 percent  
Mode: 1/1

There were no structures, systems, or components out-of-service that contributed to this event.


**B. DESCRIPTION OF EVENT**

Calvert Cliffs has four Emergency Diesel Generators [DG] (EDG) and one Station Blackout diesel generator. Three of the EDGs (EDGs 1B, 2A, and 2B) are Fairbanks Morse (FM) diesels. Emergency Diesel Generator 1A and the Station Blackout diesel (DG 0C) are Société Alsacienne De Constructions Mecaniques De Mulhouse CM diesels. Each unit has two EDGs that automatically provide backup electrical power to a Safety Related (SR) 4 KV bus [BU] on an under voltage signal or on a Safety Injection Actuation Signal. Diesel Generator 0C can be manually aligned to any of the SR 4 KV busses as needed.

Each of the three FM EDGs has two independent and redundant air receivers [RCV] which supply starting air to each EDG through two parallel air start control valves [CV]. The air start headers for all three FM EDGs are connected together. Emergency Diesel Generator 1A and DG 0C have their own separate air start systems and were not impacted by this event.

On October 11, 2018, Operations was performing a post maintenance slow speed start of EDG 1B, when EDG 1B's air start control valves did not go shut after EDG 1B was started. At 2303, this resulted in air pressure in the common FM air start headers to depressurize to a point where there was insufficient pressure to start either Unit 2 EDGs and thus Operations declared EDGs 2A and 2B inoperable. Operations was able to manually isolate EDG 1B air start control valves which allowed pressure in the common air start headers to recover. At 2333 pressure was sufficiently restored and EDGs 2A and 2B were declared operable.

During the maintenance period preceding this post maintenance test on EDG 1B, Calvert Cliffs replaced the existing Agastat relays [RLY] in EDG 1B air start control circuit with Allen Bradley electronic relays. Additionally, diodes [EB] were installed in EDG 1B air start control circuitry to help dampen induced voltage spikes that had occurred after the electronic relays were previously installed on EDG 2B. The air start CVs are normally closed and open on receipt of a diesel start signal when their associated solenoid valves [SV] are energized by relays in the air start control

<b>NRC FORM 366A</b> (04-2018)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>		<b>APPROVED BY OMB: NO. 3150-0104</b>		<b>EXPIRES: 03/31/2020</b>										
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circuitry. The air start CVs remain open until EDG reaches an operating speed of 250 rpm when the associated relays actuate to deenergize the air start SVs thus closing the air start CVs. During this post maintenance start, the control relays actuated on the EDG start signal thus energizing the air start SVs that opened EDG 1B air start CVs, starting EDG 1B. Before EDG 1B reached 250 rpm, one of the newly installed diodes shorted which caused two control circuitry fuses [FU] to fail, thereby removing power to actuate the relays when EDG 1B reached 250 rpm. As a result, no shut signal was sent to the EDG 1B air start SVs and the EDG 1B air start CVs remained open. Because of the original design vulnerability of the common air start headers inter-connecting all the FM EDGs, air start pressure to the Unit 2 EDGs decreased to a point where there was insufficient air pressure to start EDGs 2A and 2B should a start demand on these diesels occur. This condition existed for 30 minutes. Having both Unit 2 EDGs incapable of being started meant Unit 2 was in a condition that would have prevented fulfillment of a safety function and thus an 8 hour Emergency Notification System (ENS) report was made to the NRC at 0358 on Oct 12, 2018 pursuant to 10 CFR 50.72(b)(3)(v)(D) and pursuant to 10 CFR 50.72 (b)(3)((ii)(B) for being in an Unanalyzed Condition.

**C. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES**

October 11, 2018

2255 – Commenced a slow speed start of EDG 1B.

2303 – Declared EDG 2A and 2B inoperable following receipt of Low Starting Air Pressure alarm for both Unit 2 EDGs.

2306 – Operations shut manual valves (1DSA114 and 1DSA117), to isolate air to EDG 1B air start CVs (1CV4834 and 1CV4835). Air pressure in FM common air start headers began to increase.

2310 - EDG 1B was manually stopped locally by Operations.


2333 - Unit 2 EDGs Low Starting Air Pressure alarm cleared. Emergency Diesel Generators 2A and 2B were declared operable.

October 12, 2018

0358 – The eight-hour ENS report (ENS#53663) was made to the Nuclear Regulatory Commission (NRC).

**D. CAUSE OF EVENT**

The method of discovery for this event was self-revealing and is documented in the site's Corrective Action Program under IR 4182707. Field troubleshooting isolated the cause of failure to a newly installed diode which shorted, causing a current surge which blew two control power fuses thus interrupting power to the relays and preventing the air start SVs from receiving a signal to shut the air start CVs. The failed diode was sent to an offsite lab for analysis. Based on the lab's analysis, the most probable cause of the diode's failure was an undetected manufacturing defect. While the introduction of the diode into EDG 1B air start control circuitry caused a new equipment failure it did not cause a new failure mode. The fuses could have blown due to any other component failure in the circuitry which would have caused the same result. However, during the site's analysis of this event it was discovered that an original design vulnerability has existed since

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initial operation (IR 4183896). The vulnerability is that a single fuse failure, at just the right time in the FM EDG start sequence, would cause a similar result where the respective FM EDG air start CVs would not receive a shut signal, thus resulting in depressurizing the FM common air start headers. This vulnerability only exists in the very short time frame (less than five seconds) between the time a FM EDG is started and before the FM EDG reaches the engine speed (250 rpm) where the relays are energized to shut the air start CVs. Should the fuse fail at any other time this resultant unanalyzed condition would not occur.

**E. SAFETY ANALYSIS**

The actual consequence resulting from this identified event was causing both Unit 2 EDGs to be inoperable for 30 minutes. With both Unit 2 EDGs inoperable, Unit 2 was in an unanalyzed condition where the EDGs would have been unable to mitigate the consequences of either loss of coolant accident or loss of offsite power event. The event is reportable pursuant to the following:

- 10 CFR 50.73(a)(2)(v)(D) - Event or Condition that Could Have Prevented Fulfillment of a Safety Function
- 10 CFR 50.73 (a)(2)(ii)(B) - Degraded or Unanalyzed Condition
- 10 CFR 50.73(a)(2)(vii)(D) – Common Cause Inoperability of Independent Trains or Channels

Due to short period of time that both Unit 2 EDGs were inoperable, the probabilistic risk assessment analysis determined that the estimated increase in core damage frequency was less than 1E-07 and the estimated increase in large early release frequency was less than 1E-08 per year for the subject condition. This issue would be "GREEN" using the NRC's Significance Determination Process.

This event marks the third occurrence of the NRC Safety System Functional Failure Performance Indicator for Unit 2 in the last 12 months. Therefore, the performance indicator remains within the 'GREEN' band for this performance indicator.

**F. CORRECTIVE ACTIONS**

Immediate corrective actions were to replace the failed fuses, remove the newly installed electronic relays and diodes, and reinstall the original Agastat relays. Following completion of this action, EDG 1B was successfully tested and subsequently returned to operating status. To prevent any future failure in the air start circuitry of one FM EDG from impacting the other FM EDGs, a modification was performed to install manual isolation valves within the common air start headers so that each FM EDG air start header would be isolated from the other two FM EDGs.

**G. PREVIOUS OCCURRENCES**

The modification to replace existing Agastat relays within the FM DG air start control circuit with new electronic relays was first done on EDG 2A. No issues with the installation of the new electronic relays have occurred on EDG 2A. The same modification was then installed on EDG 2B.



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Issues were encountered on starting EDG 2B resulting from inductive voltage spikes that caused these new relays to inadvertently actuate. The new electronic relays were removed and the Agastat relays were reinstalled on EDG 2B. The issues on EDG 2B did not result in any impact to the other FM EDGs. To address this issue that was observed on EDG 2B, it was determined to add the installation of diodes to dampen the inductive voltage spikes when the modification on EDG 1B was done.

**H. COMPONENT FAILURE DATA**

Diode - Gen Semiconductor Co., Model RGP10J