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R. E. DENTON  
GENERAL MANAGER  
CALVERT CLIFFS

April 17, 1992

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

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant  
Unit Nos. 1 and 2; Docket Nos. 50-317 and 50-318;  
License Nos. DPR 53 and DPR 69  
Licensee Event Report 92-002

Gentlemen:

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,

RED/EPW/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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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P 530) U.S. NUCLEAR REGULATORY COMMISSION WASHINGTON, DC 20555 AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104) OFFICE OF MANAGEMENT AND BUDGET WASHINGTON, DC 20503

FACILITY NAME (1) **Calvert Cliffs, Unit 1** DOCKET NUMBER (2) **0500031171** PAGE (3) **1 OF 04**

TITLE (4) **Units 1 and 2 Shutdown Due to Emergency Diesel Generator Inoperability Caused by Design Flaw**

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 NAME(S)	DOCKET NUMBER(S)
03	19	92	92	002	00	04	17	92	Calvert Cliffs, Unit 2	050003118

OPERATING MODE (9) **1**

POWER LEVEL (10) **100**

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more of the following) (11)

<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.406(e)	<input type="checkbox"/> 60.73(a)(3)(iv)	<input type="checkbox"/> 73.71(b)
<input type="checkbox"/> 20.406(a)(1)(ii)	<input type="checkbox"/> 60.36(a)(1)	<input checked="" type="checkbox"/> 60.73(a)(2)(iv)	<input type="checkbox"/> 73.71(a)
<input type="checkbox"/> 20.406(a)(1)(iii)	<input type="checkbox"/> 60.36(a)(2)	<input type="checkbox"/> 60.73(a)(2)(iv)(A)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
<input type="checkbox"/> 20.406(a)(1)(iv)	<input checked="" type="checkbox"/> 60.73(a)(2)(ii)	<input type="checkbox"/> 60.73(a)(2)(iv)(B)	
<input type="checkbox"/> 20.406(a)(1)(v)	<input type="checkbox"/> 60.73(a)(2)(iii)	<input type="checkbox"/> 60.73(a)(2)(iv)	

LICENSEE CONTACT FOR THIS LER (12)

NAME **E. P. Wilson, Compliance Engineer** TELEPHONE NUMBER **410 260-2062**

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE)  NO

EXPECTED SUBMISSION DATE (15)

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

At 0525 on March 19, 1992, an Unusual Event was declared for Calvert Cliffs Units 1 and 2. All three Emergency Diesel Generators (EDGs) were declared inoperable when it was concluded that a degraded voltage condition on safety equipment buses could occur during certain low probability accident scenarios. It was discovered that sequential loading of the EDGs could occur in a manner not anticipated by design, allowing the possible simultaneous starting of enough loads to reduce voltage below levels required to ensure the proper operation of safety equipment. This vulnerability was caused by the specific design of the EDG Loss of Coolant Incident sequencer. A similar flaw also existed in the EDG shutdown sequencer. Modifications have been completed in Unit 2 to correct both conditions and will be completed in Unit 1 prior to the end of the current refueling outage. At the time of the event, Units 1 and 2 were operating at 100 percent power. Units 1 and 2 were shutdown in accordance with Technical Specification 3.8.1.1.e after the Unusual Event was declared.

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TEXT (if more space is required, use additional forms)

I. DESCRIPTION OF EVENT

At 0525 on March 19, 1992, an Unusual Event was declared for Calvert Cliffs Units 1 and 2. All three Emergency Diesel Generators (EDGs) were declared inoperable when it was concluded that a degraded voltage condition on safety equipment buses could occur during certain low probability accident scenarios. It was discovered that sequential loading of the EDGs could occur in a manner not anticipated by design, allowing the possible simultaneous starting of enough loads to reduce voltage below levels required to ensure the proper operation of safety equipment. At the time of the event, Units 1 and 2 were operating at 100 percent power. Units 1 and 2 were shutdown after the Unusual Event was declared.

During plant accidents the EDGs start upon receipt of either an Undervoltage signal from the 4kV safety buses or a Safety Injection Actuation Signal (SIAS). If both signals are present, representing a Loss of Coolant Accident (LOCA) concurrent with a loss of off-site power, the Loss of Coolant Incident (LOCI) sequencer is initiated. The purpose of the LOCI sequencer is to automatically load the EDGs in a controlled manner.

The safety function loads controlled by the LOCI sequencer receive start signals from either a SIAS, a Containment Spray Actuation Signal (CSAS), or a Containment Isolation Signal (CIS). The LOCI sequencer controls EDG loading by initially blocking the SIAS, CSAS, and CIS start signals to the controlled loads for 10 seconds to allow EDG start. It then unblocks them in 5 second intervals or steps, allowing them to start if their respective start signals are present. This controlled loading sequence minimizes the voltage drop associated with starting transients.

On March 18, 1992, during an Electrical Distribution System Functional Inspection (EDSFI), an NRC inspector raised the possibility that the CSAS or CIS start signal for certain sequenced loads may not yet be present when those loads are unblocked by the LOCI sequencer. His specific example considered that at Step 3 of the LOCI sequencer when the blocking signal to the containment spray pumps and coolers is removed, a CSAS start signal to these components might not yet be present. Because the containment pressure setpoint for a SIAS is lower than that for a CSAS (2.8 psi vs. 4.25 psi) this scenario might occur if a small break LOCA generated a slow containment pressure buildup such that greater than 25 seconds elapsed from a SIAS actuation until a subsequent CSAS actuation.

Should such a scenario occur, the containment spray loads would start anytime after Step 3 that a CSAS was received. Thus, a possibility exists that spray loads could start simultaneously or nearly simultaneously with loads in Steps 4, 5, or 6. EDG transient loading design only considered sequencing as expected by the step process. Later analysis which considered simultaneously starting of Step 3 loads with or near other steps indicated that the cumulative voltage drop

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associated with the starting transient would be large enough to preclude load starting or cause damage to loads.

This scenario had been evaluated in a 1987 Probabilistic Risk Assessment (PRA) and the results presented to the Plant Operations and Safety Review Committee (POSRC). Because the probability of this specific scenario was found to be extremely remote, it was found not to be safety significant and no further action was taken.

When this issue was revisited during the EDSFI, the guidelines of Generic Letter 91-18 were applied to determine the operability of the EDGs. These guidelines specifically rule out the sole use of PRAs when making operability determinations. Because EDG response could not be assured given the postulated accident scenario outlined above, at 0525 on March 19, the three EDGs were declared inoperable. As a result, an Unusual Event was declared and shutdown of Units 1 and 2 was commenced in accordance with plant Technical Specifications.

Following plant shutdown, additional investigation revealed a similar design condition with the shutdown sequencer. The shutdown sequencer controls EDG loading following a loss of off-site power when no accident has occurred. Because of its similar design, the potential also existed for sequencing of shutdown loads in a manner not previously considered.

## II. CAUSE OF EVENT

The original design of the EDG sequencer was based on mitigating the effects of the large break LOCA design basis accident. This design did not anticipate the improbable but possible sequencing of EDG loading caused by a specific range of small break LOCAs. This design flaw was the primary cause of this event.

An additional causal factor was the unavailability in 1987 of clearly defined guidance on the usage of PRAs to resolve operability and safety issues.

## III. ANALYSIS OF EVENT

The event is reportable in accordance with 10 CFR 50.73(a)(2)(i)(A), the completion of any nuclear plant shutdown required by the plant's Technical Specifications; and 10 CFR 50.73(a)(2)(v)(A through D), any event or condition that alone could have prevented the fulfillment of the safety function of structures or systems.

Given the assumed range of accidents which would result in the EDG sequencing scenario discussed above, EDG response could not be assured and would thus prevent the fulfillment of necessary safety functions. However, a recalculated PRA using conservative assumptions found that the total increase in core melt frequency due to this concern is extremely low, representing a very small

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fraction of total core melt frequency. This is not a significant increase in risk to the health and safety of the general population in and around the plant.

Although the resolution of this issue in 1977 was justifiable from an overall safety risk perspective, the clarified regulatory guidance in Generic Letter 91-18 would not allow such a resolution without NRC concurrence. Without that concurrence, modifications were required to maintain operability of the EDGs.

IV. CORRECTIVE ACTIONS

Modifications to the LOCI and shutdown sequencers to ensure correct sequencing of EDG loads have been completed on Unit 2. Similar modifications will be completed on Unit 1 prior to the completion of its current refueling outage.

We have completed an engineering review of a large number of past issues to determine whether any were improperly dispositioned based solely on event improbability. No safety or operability concerns were identified.

Current plant corrective action systems emphasize evaluation of issues for effect on operability.

V. ADDITIONAL INFORMATION

A. Identification of components referred to in this LER:

	IEEE 803 EIS Funct	IEEE 805 System ID
Emergency Diesel Generator (EDG)	DG	EK
Loss of Coolant Incident (LOCI) Sequencer	STC	EK
Shutdown Sequencer	STC	EK
Safety Injection Actuation Signal (SIAS)		BQ
Containment Spray Actuation Signal (CSAS)		BE
Containment Isolation Signal (CIS)		BD

B. Previous Similar Events.

There have been no previous similar events.