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R. E. DENTON
GENERAL MANAGER
CALVERT CLIFFS

January 28, 1992

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 91-008

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/RCG/bjd
Attachment

cc: D. A. Brune, Esquire
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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104

EXPIRES: 4/30/92

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): 0 5 0 0 0 3 1 7

PAGE (3): 1 OF 0 7

TITLE (4): Inadvertent Actuation of the Auxiliary Feedwater Actuation System due to Circuit Design

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 NUMBER(S)
1 2	2 9	9 1	9 1	-	0 0 8	- 0 0	1 2	8 9	2		0 5 0 0 0
											0 5 0 0 0

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

OPERATING MODE (9)							
POWER LEVEL (10): 0 0 0	20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
	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)	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
Robert C. Gradle, Engineer	AREA CODE: 4 1 0 — 2 6 0 - 3 7 3 8

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	

SUPPLEMENTAL REPORT EXPECTED (14)

		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

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

On December 29, 1991, an inadvertent actuation of the Auxiliary Feedwater Actuation System (AFAS) occurred at Calvert Cliffs Unit 1. At the time of the event, Unit 1 was in MODE 3 (HOT STANDBY) with the Reactor Coolant System at 532 degrees Fahrenheit and 2250 psia. Preparations were underway to enter MODE 2 (STARTUP).

The cause of the event is the sensitivity of the original AFAS START logic circuit design to induced noise pulses. This sensitivity was masked by the time delay in the circuit. The modification to the logic circuit relocated the time delay and revealed the unexpected susceptibility of this circuit to noise induced pulses such as electro static discharge. The actuation is attributed to an electro static discharge on the AFAS cabinet while a licensed utility operator was shutting an adjacent AFAS sensor cabinet door.

The vendor has been requested to design and provide hardware for a corrective modification. To prevent recurrence the AFAS cabinet area is roped off and access to the area requires Shift Supervisor permission. Caution tags are in place to warn plant personnel of the potential for spurious actuation of the AFAS cabinets due to static charge. Previously established electro static discharge countermeasures were expanded for work in and around all AFAS cabinets.

I. DESCRIPTION OF EVENT

On December 29, 1991, at 10:20 a.m., an inadvertent actuation of the Auxiliary Feedwater Actuation System (AFAS) occurred at Calvert Cliffs Unit 1. The actuation occurred while a utility licensed operator was shutting an AFAS sensor cabinet door in the Cable Spreading Room of the Auxiliary Building following the resetting of alarm bistables in the sensor cabinets. The AFAS is an engineered safety feature. At the time of the event, Unit 1 was in MODE 3 (HOT STANDBY) with a Reactor Coolant System temperature of 532 degrees Fahrenheit and a pressure of 2250 psia.

The Auxiliary Feedwater (AFW) System is designed to provide feedwater to the Steam Generators (SGs) for the removal of sensible and decay heat, and to cool the RCS to 300 degrees Fahrenheit when the Main Feedwater System is inoperative. During normal operation, the AFW System is maintained in a standby mode with its components lined up for automatic start. Two AFW trains consisting of one of two selected steam driven pumps, one motor driven pump and associated flow paths are capable of automatically initiating flow to either SG.

The AFAS automatically starts the AFW pumps upon detection of low level in either SG. When the AFAS senses a low level on any two of the four (2/4) Wide Range Steam Generator Level signal channels on either SG, then after a 20 second time delay, it generates AFAS START signals to start the AFW pumps. The time delay prevents an actuation signal from being initiated unless a 2/4 low level signal exists for 20 seconds or longer. Once initiated, the auto-start signals are sealed-in by the actuation logic seal-in circuit. When the actuation logic has returned to normal pressing a local RESET push button will unseal the trip signal.

On Sunday, December 29, 1991 a plant startup was being conducted on Unit 1. At 08:10 a.m. the RCS heatup to 532 degrees Fahrenheit was completed per Operating Procedure (OP)-1, "Plant Startup From Cold Shutdown." The licensed operators proceeded to OP-2, "Plant Startup From Hot Standby to Minimum Load." While verifying readiness to enter MODE 2 (STARTUP), OP-2 required completion of the Diverse Scram System Functional Test which required the resetting of alarms on the Engineered Safety Features Actuation System (ESFAS) cabinets.

In order to complete the Diverse Scram System Functional Test, the Shift Supervisor directed the Plant Watch Supervisor (PWS), a licensed Senior Reactor Operator, to reset the ESFAS alarms locally at the ESFAS cabinets. Due to the recently completed RCS heatup, "hanging" alarms (e.g., Steam Generator High Level) existed on the AFAS sensor cabinets. The AFAS cabinets are located adjacent to the ESFAS cabinets in the Cable Spreading Room. The Shift Supervisor instructed the PWS to also clear these AFAS alarms by resetting the high level alarm bistables in the sensor cabinets.

The PWS proceeded to the Cable Spreading Room and reset the ESFAS alarms. Following verification with the Control Room on alarm status and procedural guidance, he went to the AFAS cabinets, unlocked and opened the four AFAS sensor cabinet doors and reset the alarms. The PWS, after resetting the alarm bistables in the sensor cabinets, then shut all the doors, stepped back and noticed that an AFAS START alarm had actuated in the AFAS "A" actuation logic cabinet. This cabinet door had not been opened. The PWS had been standing in front of the AFAS actuation cabinet to reset the alarm in the sensor cabinet. The PWS had not been aware of this alarm prior to this time. He immediately contacted the Control Room and verified that they had just received the AFAS "A" Actuated alarm. After confirming with the Control Room that a valid AFAS actuation condition did not exist (SG level greater than the low level setpoint), the PWS was immediately directed to RESET the AFAS alarm. He then checked that all the AFAS cabinet doors were closed and all alarms clear.

The Control Room operators acknowledged receipt of the AFAS "A" Actuated alarm on panel 1C04. AFW Pump No. 13 started and ran for approximately ten (10) seconds and then was secured by the Control Room Operators by placing the handswitch in pull-to-lock. The actuation alarm was immediately reset by the PWS which removed the AFAS "A" START signal and allowed the steam admission valve for the turbine driven pump to go shut. The Control Room operators returned the No. 13 AFW pump handswitch to AUTO and returned the AFW System to normal configuration.

Operations personnel were aware of administrative controls and concerns governing work inside, behind the locked doors, of the Unit 1 AFAS actuation logic cabinets. These controls required the use of an Electro Static Discharge pad and grounding system while working inside the logic cabinets. These controls had been implemented due to a previous electro static discharge induced AFAS "A" actuation while performing the monthly AFAS logic test Surveillance Test Procedure (STP)-O-9-1 on November 5, 1991. Since he was not in the logic cabinets the PWS did not use the grounding system and electro static discharge pad while resetting alarm bistables in the AFAS sensor cabinets. It is unclear how close the PWS came to the logic cabinet but it is suspected that a charge was induced onto the cabinet of sufficient amplitude and duration to initiate the actuation.

The Shift Supervisor immediately had the AFAS cabinet area roped off. Caution tags were hung restricting access to the area and requiring Shift Supervisor permission prior to entry. Notation on the tags warned plant personnel of potential spurious actuation of AFAS cabinets due to static charge. Troubleshooting of the AFAS cabinets the afternoon of December 29, 1991, revealed no apparent abnormalities. STP-O-9A-1, "AFAS Quarterly Refueling Test," which includes a cold start of AFW pumps, was completed satisfactorily on January 2, 1992, while employing the previously mentioned electro static discharge countermeasures. These countermeasures were expanded to include use when working in and around all AFAS cabinets. This requirement is being carried as a long-

term item on the Nuclear Operations Shift Turnover Information Sheet per Calvert Cliffs Instruction (CCI)-307E.

II. CAUSE OF EVENT

A root cause analysis investigation was initiated after the event. The cause of the event is the sensitivity of the original AFAS START logic circuit design to induced noise pulses. This sensitivity was masked by the time delay in the circuit. The modification to the logic circuit relocated the time delay and revealed the unexpected susceptibility of this circuit to noise induced pulses such as electro static discharge. The actuation is attributed to an electro static discharge on the AFAS cabinet while a licensed utility operator was shutting an adjacent AFAS sensor cabinet door.

Prior to the modification Calvert Cliffs Unit 1 and Unit 2 had experienced several spurious AFAS actuations following plant trips from high power levels. After the trip, the resulting SG level transient (shrink) would cause a momentary (lasting only a few seconds) spike low in the wide range steam generator level indication. This phenomena was known to exist and was documented in LER 318/91-004. During this time a short-lived AFAS START actuation signal would be generated and subsequently clear. The signal would cause the motor driven AFW pump breaker to close and the pump would start. Operator action was required to open the breaker. The 20 second time delay in the actuation circuit seal-in logic prevented the brief actuation signal from being sealed-in. The AFW turbine driven pump steam admission valves would start to open upon receipt of the AFAS START signal but then would shut since the START signal cleared and was not sealed-in.

In June 1991 a modification was made to the Unit 1 AFAS actuation logic circuit. The modification was designed to eliminate these spurious AFAS actuations. It relocated the 20 second time delay from the actuation circuit seal-in logic and placed it in series between the 2/4 low level logic output and the actuation signal output. The post-modification function of the time delay was to prevent an actuation (AFAS START) signal from being generated unless a 2/4 low level signal exists in either SG for 20 seconds or longer. Once the actuation signal is initiated then it is sealed-in instantaneously by the seal-in logic circuit.

Post-maintenance testing of the AFAS after installation of the modification was completed satisfactorily. Subsequent AFAS monthly logic tests (STP-O-9-1 and STP-O-9A-1) were completed successfully through October 1991. On October 1, 1991 Calvert Cliffs Unit 1 tripped from 93 percent power and no spurious AFAS actuation occurred.

In October 1991 the same AFAS modification was installed in Calvert Cliffs Unit 2 during a Maintenance Outage. Unit 2, however, experienced several spurious AFAS actuations while attempting to re-energize the logic cabinets on October 23, 1991

and during testing on October 25, 1991. An investigation of these actuations, assisted by the vendor (Vitro Corporation) during a site troubleshooting visit on October 30, 1991, revealed that electrical noise pulses were emanating within the AFAS actuation logic circuit during repeated power-up cycles of the logic cabinets. It was discovered that if the noise pulse was of sufficient magnitude and duration then it will cause a spurious actuation signal to be sealed-in. The initial design, with the time delay in the seal-in circuit, allowed sufficient time for a noise pulse to dissipate. The removal of the time delay prevented these electrical pulses from dissipating before the logic would seal-in. The modification was removed from the Unit 2 AFAS and the system restored to its previous configuration. Post-maintenance testing of the Unit 2 AFAS logic was completed satisfactorily on November 16, 1991.

On November 5, 1991 a spurious actuation of the Unit 1 AFAS occurred while licensed operators were performing STP-O-9-1. No injection occurred since the system was in a test lineup with the AFW pumps discharge valves shut. When one operator touched the face plate of the Channel "A" AFAS START logic module then an AFAS START signal was initiated and sealed-in. Investigation found that the occurrence was repeatable. The cause was traced to an electro static discharge when the operator touched the module and the voltage transient initiated the actuation. The module was replaced and an actuation by electro static discharge was not repeatable. STP-O-9-1 was performed and completed satisfactorily. Failure of the initial logic module was believed to have permitted the actuation. The original module was sent to the vendor for evaluation but the vendor was unable to reproduce the electro static discharge phenomena.

Due to operational considerations and the better performance of the Unit 1 AFAS, it was decided to leave the modification installed until the Unit 1 Spring 1992 Outage. In the interim, extra precautionary controls were implemented. Plant personnel were sensitized to the issue of static discharging causing spurious AFAS actuations while working inside the Unit 1 AFAS logic cabinets. The electro static discharge pad and grounding system were provided to be used when working in these cabinets. Instructions were provided for the proper use of the electro static discharge pad. Electro static discharge countermeasures were employed successfully on December 3, 1991 when STP-O-9-1 was completed satisfactorily without incident. On December 29, 1991 the event, as previously described, occurred.

III. ANALYSIS OF EVENT

There were no significant safety consequences as a result of this event. Auxiliary Feedwater flow to the SGs was initiated for ten (10) seconds. A negligible amount (<100 gallons) of feedwater was added to the SGs.

The actuation of the AFW system while operating at any power level is not a challenge to the plants safety analysis. The Calvert Cliffs Updated Final Safety

Analysis Report (UFSAR) defines the Excess Feedwater Heat Removal Event to be a reduction in SG feedwater temperature without a corresponding reduction in steam flow from the SG. The UFSAR describes the most limiting case to be the loss of both high pressure main feedwater heaters at hot full power (102 percent) and not an increase in feedwater flow. The analysis concludes that no safety limits are exceeded. AFW flow rate is low (approximately 600 gpm with two pumps running) in comparison with the normal feed rate to the SGs. Spurious AFAS actuations do not place the plant in any unanalyzed condition.

There were no components or systems that contributed to the event because they were inoperable at the start of the event. No plant systems or other component failures resulted from this event. AFAS actuation caused by electro static discharge onto the AFAS "A" Actuation logic cabinet is not an operability concern. Though electro static discharge may initiate a spurious AFAS actuation it will not prevent a valid AFAS actuation from occurring. AFAS circuitry that has the seal-in logic is susceptible to electro static discharge. The actuation (AFAS START) logic is the only circuit with this seal-in feature. The AFAS BLOCK signal (blocks AFW flow to a ruptured SG) circuitry is not affected. Only the AFAS START signal is required to seal-in and it is the only AFAS logic circuitry that has been affected by electro static discharge.

This event is reportable in accordance with 10 CFR 50.73(a)(2)(iv) in that it resulted in automatic actuation of an Engineered Safety Feature. This occurred as an unplanned AFAS actuation.

IV. CORRECTIVE ACTIONS

Immediate

A. Control Room operators confirmed that a valid AFAS actuation condition did not exist and secured No. 13 AFW pump. They directed the PWS to reset the AFAS alarm and then they returned the pump to AUTO and returned the AFW system to normal configuration.

B. A Root Cause Analysis was initiated to determine the cause of the actuation.

Actions to Prevent Recurrence.

A. The AFAS cabinet area is roped off. Caution tags are in place which restrict access to the area by requiring Shift Supervisor permission prior to entry. Notation on the tags warn plant personnel of "potential spurious actuation of AFAS cabinets due to static charge."

B. The previously established electro static discharge countermeasures (use of the electro static discharge pad and grounding system) were

expanded to require their use when working in and around all AFAS cabinets. The countermeasures were successfully employed during subsequent testing after the event.

C. The vendor has been requested to design and provide hardware for a corrective modification to the AFAS START logic module circuitry which would prevent electrical noise induced AFAS actuations. Bounding values chosen for the design should envelop all noise signals which could reasonably be expected to occur, including electro static discharge. The vendor is being requested to lab test the logic module modification prior to its installation. We are endeavoring to complete this design in time for installation during the Unit 1 refueling outage in March 1992 and in Unit 2 no later than its next refueling outage. In the event that the corrective modification is not complete, we will return the configuration to its pre-1991 condition until the final modification is installed.

V. ADDITIONAL INFORMATION

A. Identification of Components and Systems Referred to in this LER:

Component or System	IEEE 803A/83 Function ID	IEEE 805/84 System ID
AFW System	N/A	BA
AFW Pump	P	BA
Steam Generator	SG	N/A
Reactor Coolant System	N/A	AB
Cabinet	CAB	N/A
Channel	CHA	N/A
Feed Water Headers	HX	SJ

B. Previous Similar Events

None.