

CHARLES H. CRUSE  
Plant General Manager  
Calvert Cliffs Nuclear Power Plant

Baltimore Gas and Electric Company  
Calvert Cliffs Nuclear Power Plant  
1650 Calvert Cliffs Parkway  
Lusby, Maryland 20657  
410 586-2200 Ext. 4101 Local  
410 260-4101 Baltimore



September 8, 1994

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

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant  
Unit No. 2; Docket No. 50-318; License No. DPR 69  
Licensee Event Report 94-004  
Unit 2 Reactor Trip Due to Main Generator Trip

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,

CHC/MDM/bjd

Attachment

cc: D. A. Brune, Esquire  
J. E. Silberg, Esquire  
M. J. Case, 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

9409160127 940908  
PDR ADDCK 05000318  
S 100220 PDR

IF 22  
11

## 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 INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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

FACILITY NAME (1)

Calvert Cliffs Unit 2

DOCKET NUMBER (2)

05000 318

PAGE (3)

1 OF 05

TITLE (4)

Unit 2 Reactor Trip Due to Main Generator Trip

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 NUMBERS(S)	
08	10	94	94	-- 004 --	00	09	08	94		05000 05000	
OPERATING MODE (9)		1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (Check one or more) (11)								
POWER LEVEL (10)		100	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

M. D. Milbradt, Compliance Engineer

TELEPHONE NUMBER (include Area Code)

410-260-4352

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPDs	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPDs
B	TL	EXC	W120	Y	B	TL	*	W120	Y
B	TL	CAP	W120	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

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

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-space typewritten lines) (16)

On August 10, 1994 at 2154, Calvert Cliffs Unit 2 experienced a reactor trip due to a main generator trip. The generator tripped when the exciter field breaker and generator output breakers tripped opened due to a loss of field. At the time of the event, Unit 2 was operating at 100 percent power with normal operating temperature and pressure.

The cause of the event was a drop in main generator excitation leading to the actuation of the loss of field relay. Excitation was low after the operators transferred the voltage regulator from the ON to OFF position.

Corrective actions included testing of the excitation system prior to restart; replacement of failed components; refresher training for operators; and monitoring of the system.

NRC FORM 366A (5-92)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104 EXPIRES 5/31/95	
LICENSEE EVENT REPORT (LER)				ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST; 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20565-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.	
TEXT CONTINUATION					
FACILITY NAME (1)		DOCKET NUMBER (2)		LER NUMBER (8)	
Calvert Cliffs, Unit 2		05000 3 1 8		94 - 004 - 00	
				PAGE (3) 02 OF 05	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

# I. DESCRIPTION OF EVENT

On August 10, 1994, at 2154, Calvert Cliffs Unit 2 experienced a reactor trip due to a main generator trip. The generator tripped when the exciter field breaker and generator output breakers tripped opened due to a loss of field. The loss of field occurred after problems were encountered with the main generator voltage regulator. Plant response to the event was in accordance with design. At the time of the event, Unit 2 was operating at 100 percent power with normal operating temperature and pressure.

The main generator is a Westinghouse synchronous AC, three-phase, four-pole electrical generator. The generator's excitation system supplies DC excitation to the main generator field and adjusts excitation to maintain constant generator output voltage under changing load conditions. The excitation system consists of an exciter, exciter rectifier, a permanent magnet generator, a thyristor power amplifier, a thyristor firing circuit, a base adjuster, and a voltage regulator (Figure 1). The level of excitation supplied to the main generator rotor windings is controlled by a signal from the thyristor firing circuit.

The inputs to the thyristor firing circuit are from the base adjuster and voltage regulator. The base adjuster adjusts the exciter field to maintain a constant main generator field voltage. The voltage regulator adjusts the exciter field to maintain a constant main generator output voltage. When the voltage regulator is ON, main generator excitation is supplied by a combination of outputs from both the base adjuster and voltage regulator. In addition to other protection circuits that protect the generator from abnormal operating conditions, a minimum excitation limiting (MEL) circuit provides input to the voltage regulator to ensure a minimum value of generator field voltage is maintained.

At approximately 1900 on August 10, 1994, a voltage spike occurred on the 500 KV system, originating from Calvert Cliffs. Licensed utility operators in the Control Room were not aware of the spike due to the lack of any alarms. The spike was recorded on plant and system voltage recorders. Later at around 2150, the "Main Generator Fuse/Power/Pulse" (A-12) alarm on Control Panel 1C01 was received and immediately cleared. Licensed utility operators then observed the main generator field amps, voltage regulator output, and Megavolt-Amperes Reactive spike high in the LAG direction for about 5-10 seconds. No other alarms were received at this time and again voltage spikes were recorded on local recorders. The operators proceeded to consult the Alarm Manual for guidance on responding to alarm A-12. A few minutes later, alarm A-12 flashed again and the spikes were observed again. After consulting the Alarm Manual for guidance on switching the voltage regulator from the ON to OFF position, the operators placed the regulator in the OFF position. When the regulator was placed in the OFF position, exciter field amps went to 0, an alarm indicating a loss of field was received, and the generator tripped resulting in a main turbine trip and subsequent reactor trip. After the reactor trip, operators initiated Emergency Operating Procedure (EOP)-0, "Post

NRC FORM 366A (5-92)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104 EXPIRES 5/31/95	
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 INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.	
TEXT CONTINUATION					
FACILITY NAME (1)		DOCKET NUMBER (2)		LER NUMBER (6)	
Calvert Cliffs, Unit 2		05000 3 1 8		94 - 004 - 00	
				PAGE (3)	
				03 OF 05	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Trip Immediate Actions" and proceeded to recover the plant in a normal fashion.

## II. CAUSE OF EVENT

The cause of the reactor trip was due to a main turbine trip, initiated from a trip of the main generator. The main generator tripped due to a loss of field. A loss of field relay picked up when the voltage regulator was switched from the ON to OFF position. As stated above, main generator excitation was spiking high prior to the trip. Troubleshooting determined the MEL circuit had an intermittent failure leading to the voltage spikes from the voltage regulator. When the voltage regulator was switched to the OFF position the input for the field current should have been completely generated by the base adjuster. The loss of field relay picked up when a transient, initiated by switching the voltage regulator to OFF, took the generator from a highly over-excited state (failed MEL circuit) to a much lower than normal excitation demand generated by the base adjuster. The cause for the lower than normal demand could not be determined.

Troubleshooting also determined the cause of the A-12 alarm was due to a capacitor that shorted and a resistor that opened in one of the thyristor power drawers. These degraded components combined with the voltage spikes resulted in the alarm actuation.

## III. ANALYSIS OF EVENT

This event is reportable under 10 CFR 50.73(a)(2)(iv), as a condition that resulted in an automatic Reactor Protective System actuation. The reactor tripped as designed for a loss of load trip. All protective systems performed as expected and operators performed their tasks in accordance with plant procedures. The turbine trip signal was caused by a loss of field to the main generator. There were no significant safety consequences as a result of this event.

## IV. CORRECTIVE ACTIONS

In response to this event the following actions were completed:

- A. The excitation system including the voltage regulator and base adjuster were thoroughly tested prior to the Unit's restart. The only identified problem was the MEL circuit.
- B. The voltage regulator MEL circuit board was replaced prior to restarting Unit 2.
- C. The failed capacitor and resistor in the thyristor power drawer were replaced.



LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)	PAGE (3)
Calvert Cliffs, Unit 2	05000 3 1 8	94 - 004 - 00	04 OF 05

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Although we could not positively prove either equipment malfunction or operator error was the cause for the lower than normal excitation demand, the following corrective actions are being implemented in response to this event.

- A. Preventive maintenance is scheduled to be performed on the voltage regulator circuit during the 1995 Unit 2 refueling outage. This maintenance includes extensive testing of the circuits under varying conditions. The adequacy of this maintenance is being reviewed to determine if changes should be made.
- B. To enhance operator skills and performance, the Alarm Manual for alarm A-12 was revised to provide additional guidance on transferring the voltage regulator from ON to OFF. Additionally, operators received on-shift refresher training after this event on the operation of the excitation system.
- C. To ensure the base adjuster is performing as expected, additional monitoring of key parameters such as Mega-Watts, MVARs, Boost/Buck Volts, and percent base adjust setting will be implemented for a specified period. This data will be evaluated to determine system performance.
- D. Additional investigations are being conducted to ensure the main generator excitation system is functioning properly. If any corrective actions generated from these investigations are associated with the cause of the event, they will be provided in a supplement to this LER.

V. ADDITIONAL INFORMATION

A. Affected Component Identification

Component	EIIS Funct Code	EIIS System Code
Excitation System	EXC	TL
Field Relay	RLY	TL
Main Generator	GEN	TB
Voltage Regulator	RG	TL
Capacitor	CAP	TL
Resistor	*	TL

B. Previous Similar Events

There have been no previous events at Calvert Cliffs Unit 2 involving a problem with the main generator excitation system, resulting in a Turbine/Reactor trip.

NRC FORM 366A (10-92)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104 EXPIRES 5/31/95	
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 INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.	
TEXT CONTINUATION					
FACILITY NAME (1)		DOCKET NUMBER (2)		LER NUMBER (6)	
Calvert Cliffs, Unit 2		05000 3 1 8		94 - 004 - 00	
				PAGE (3)	
				05 OF 05	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

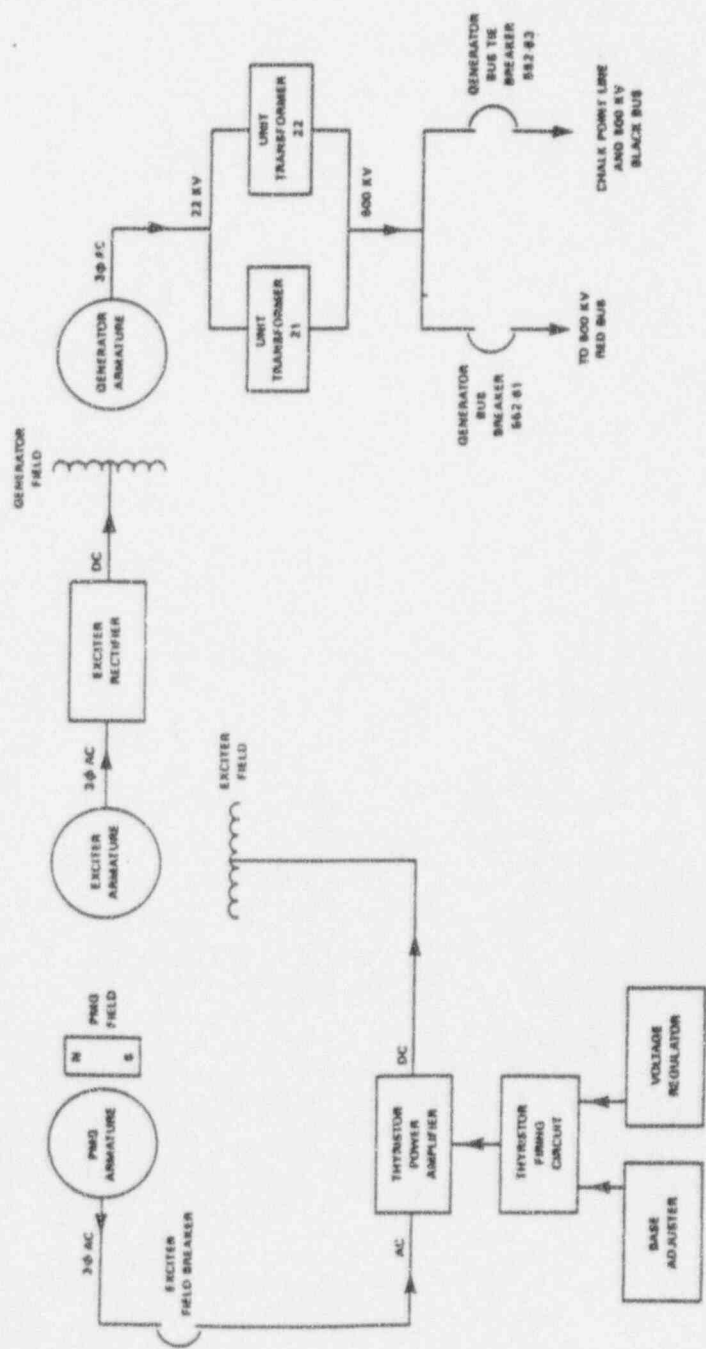


FIGURE 1  
CALVERT CLIFFS UNIT 2 -- MAIN GENERATOR