LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Diablo Canyon Unit 1	0 5 0 0 0 2 7 5 1	OF 7

TITLE (4)

Unplanned Start of Diesel Generator 1-1 Due to a 4160 V Bus H Startup Feeder Phase Potential Transformer Opened Fuse

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MON	DAY	YR	YR	SEQUENTIAL NUMBER	REVISION NUMBER	MON	DAY	YR	FACILITY NAME	DOCKET NUMBER
05	20	97	97	- 0 1 0 -	0 1	11	07	97		

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)		
5	X	10 CFR	50.73(a)(2)(iv)
POWER LEVEL (10)		OTHER	
0 0 0	(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)		

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Vickie A. Backman - Senior Regulatory Services Engineer	805	545-4289

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
B	E A	F U	G 0 8 0	N					

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED	MON	DAY	YR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[x] NO	SUBMISSION DATE (15)			

ABSTRACT (16)

On May 20, 1997, at 2131 PDT, with Unit 1 in Mode 5 (Cold Shutdown), Diesel Generator (DG) 1-1 automatically started due to an under voltage relay actuation after a fuse opened on the primary side of the 4160 V Bus H startup feeder potential transformer (PT). This event constitutes an engineered safety features actuation. A 4-hour, non-emergency report was made to the NRC in accordance with 10 CFR 50.72 (b)(2)(ii) on May 21, 1997, at 0021 PDT.

On May 20, 1997, at 2144 PDT, DG 1-1 was shut down and returned to the automatic mode of operation.

Based on available evidence, the most likely cause of failure was accumulated fuse element degradation due to current surges on the fuse over the life of the plant. The degraded fuse would have experienced higher element temperatures due to an increased resistance in the fuse element, which over time could cause the fuse to fail.

The maintenance program which monitors fuse continuity will be revised to include resistance checks of fuses. Primary side PT fuses were replaced on the vital busses for the Unit 1 startup and auxiliary transformer feeders. The fuses on the primary side of the Unit 2 startup and auxiliary power potential transformers will be checked and replaced, as necessary. Additionally, operators have reviewed the lessons learned from this event.

TEXT

I. Plant Conditions

Unit 1 was shut down in Mode 5 (Cold Shutdown) with an average plant temperature of 115°F and at atmospheric pressure. At the time of the event, switching was in progress to restore Startup Transformer 1-2.

II. Description of Problem

A. Summary

On May 20, 1997, at 2131 PDT, with Unit 1 in Mode 5, Diesel Generator (DG) (EK)(DG) 1-1 automatically started due to an under voltage relay (UV) (EA)(27) actuation after a fuse opened on the 4160 V Bus H startup feeder (EA)(BU) potential transformer (PT) (EC)(XPT). This event constitutes an engineered safety features (ESF) actuation. A 4-hour, non-emergency report was made to the NRC in accordance with 10 CFR 50.72 (b)(2)(ii) on May 21, 1997, at 0021 PDT.

B. Background

UV relay device 27HHU, is powered from the vital 4160 V Bus H through the 4200/120 V startup feeder PT and a relay sensing signal cutout knife switch. The 27HHU UV contact (relay terminals 1 and 10) picks up 2 Auxiliary Relays, 27XHHB2 and 27YHHB2. These 2 auxiliary relays provide start signals to DG 1-1.

The DG auto start feature from the bus under voltage protection scheme is enabled after energizing the startup feeder by closing the 27HHU terminal 10 knife switch in accordance with Operating Procedure (OP) OP J-2:II, "Startup Bank Return to Service."

C. Event Description

On May 20, 1997, during Unit 1 eighth refueling outage, operators were returning Startup Transformer 1-2 to service in accordance with OP J-2:II. After energizing the startup transformer from the control room, operators went to the 4160 V bus rooms to close the terminal 10 knife switch on Relay Devices 27HFU (vital Bus F), 27HGU (vital Bus G), and 27HHU (vital Bus H). The knife switches for buses F and G were closed without incident.

TEXT

Just before closing the knife switch for Bus H, the operators in the control room and at the Bus H startup breaker cubicle saw the PT B-C phase light at the Bus H drawer and the startup PT light in the control room flickering (lighting intermittently). The operators replaced bulbs at both locations, but neither of the indication lights came on. The operators concluded that the remaining knife switch for Bus H could be closed because they had just performed the same steps to energize vital Busses F and G. However, they had not recognized the lack of B-C potential indication as a precursor to bus under voltage protective relaying activation.

On May 20, 1997, at 2131 PDT, the operators closed the knife switch on Relay Device 27HHU. The relay device sensed a no voltage condition because of the opened fuse. This enabled Auxiliary Relays 27XHHB2 and 27YHHB2, which started DG 1-1.

D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

E. Dates and Approximate Times for Major Occurrences

1. May 20, 1997, 2131 PDT: Event date/discovery date. Unplanned start of DG 1-1.

2. May 20, 1997, 2144 PDT: DG 1-1 was shut down and returned to the automatic mode of operation.

3. May 21, 1997, 0021 PDT: A 4-hour, non-emergency report was made to the NRC, in accordance with 10 CFR 50.72 (b)(2)(ii).

F. Other Systems or Secondary Functions Affected

None.

G. Method of Discovery

The event was immediately apparent to the operators due to alarms and indications received in the control room.

H. Operator Actions

DG 1-1 was shut down, the knife switch on Relay Device 27HHU reopened, and the DG returned to the automatic mode of operation.

I. Safety System Responses

DG 1-1 started, but did not connect to its associated 4160 V bus because auxiliary transformer power was available.

III. Cause of the Problem

A. Immediate Cause

DG 1-1 started because UV Relay Device 27HHU actuated due to an opened fuse on the 4160 V Bus H startup feeder PT.

B. Root Cause

PG&E shipped eight PT primary side fuses to the vendor, General Electric (GE), for analysis. Since the fuse which caused the event was inadvertently discarded, fuses removed as part of the corrective action for this event were used for failure analysis. The analyzed fuses were approximately the same age (manufacture dates of 1970) and were installed in the plant for approximately the same time period as the failed fuse.

GE evaluated several different failure modes including material defect, aging, inadequate rating, overload, and transient currents.

GE found one of the eight fuses exhibited a resistance reading of approximately 2.5 times normal (6.409 ohms). The remaining fuses were found within the acceptable resistance range of 2.3 - 3.0 ohms.

Based on the application of the failed fuse and the one similar fuse exhibiting high resistance, GE concluded that the most likely cause of failure was accumulated fuse element degradation due to current surges on the fuse over the life of the plant. GE stated that if the ampere-square-time (I^2t) of the surge current is greater than 85 percent of the fuse's minimum I^2t rating for melting, damage may occur. The damage exhibited is normally a reduction in the cross sectional area of the element. The

fuse element will increase in temperature due to higher resistance and become more brittle while carrying rated current under the damaged condition. Over time, the increased operating temperature results in higher than normal resistance which increases the likelihood of element failure.

PG&E performed a comparison of a fuse removed from Unit 1 and nine fuses stored in the warehouse to determine any physical or resistance differences. PG&E determined that the fuses in the warehouse were manufactured between 1991 and 1996. All of the fuses were within the allowable acceptance criteria of 2.3 - 3.0 ohms and there were no significant differences between the new and used fuses.

C. Contributory Causes

Plant operators did not assimilate the lack of B-C potential indication as a precursor to bus under voltage protective relaying activation before closing the knife switch on Relay Device 27HHU.

IV. Analysis of the Event

Since all equipment performed as designed during the event, the inadvertent actuation of the DG ESF component did not adversely affect the health and safety of the public.

V. Corrective Actions

A. Immediate Corrective Actions

1. The fuse was replaced and tested satisfactorily.

2. Primary side PT fuses were replaced on all vital busses for the Unit 1 startup and auxiliary transformer feeds.

B. Corrective Actions to Prevent Recurrence

1. An analysis of the PT circuitry design (primary and secondary) was performed to assess the adequacy of fuse design and potential failure modes. In addition, an analysis was performed for some of the fuses removed from the primary side of the other Unit 1 vital startup and auxiliary PTs. The results of these analyses are discussed in III.B. - Root

Cause.

2. GE recommended that fuses be monitored for resistance as a method to detect degradation:

   Although the installed 0.5 amp fuse is considered adequate for its application, GE recommended a 1.0 ampere rated fuse. The 1.0 amp fuse has a higher I^2t rating and could improve the capacity to sustain the surges without adversely affecting the present design.

   PG&E evaluated the GE recommendations and is taking the following actions:

   a) The maintenance program which monitors fuse continuity will be revised to include resistance checks of the fuse.

   b) The fuses on the primary side of the Unit 2 startup and auxiliary power potential transformers will be checked and replaced, as necessary, during the next scheduled refueling outage.

   c) Based on the adequacy of the present design which utilizes 0.5 amp fuses, the isolated failure of a single fuse, and the monitoring program to identify degradation, PG&E does not believe the recommendation to change fuse design to a 1.0 amp is necessary.

3. Operators have completed the review of causes, contributing factors, corrective actions, and lessons learned from this event.

VI. Additional Information.

A. Failed Components

Fuse - Part Number: GE 9F60BBD905

TEXT

B. Previous LERs on Similar Problems

LER 1-97-009-00, dated June 6, 1997, identified an unplanned start of DG 1-1. The cause of that event was attributed to personnel error and inadequate work controls. The corrective actions focused on enhancing the clearance process, and therefore would not have prevented the event discussed in this report.

LER 1-94-011-00, dated May 10, 1994, identified an unplanned start of DG 1-2. The cause of that event was attributed to personnel error in that an operator was not aware that ac potential circuits could be inadvertently shorted together while attempting to replace an indicating light bulb. The corrective action for this event included issuing an Electrical Maintenance Bulletin and evaluating the second level under voltage sensing scheme. Neither of these actions would have prevented this event.