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July 8, 1992

PG&E Letter No. DCL-92-156



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

Re: Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Licensee Event Report 2-92-001-01
Conditions Outside and Deviations From the 10 CFR 50 Appendix R
Plant Design Basis Due to Personnel Error

Gentlemen:

Pursuant to 10 CFR 50.73(a)(2)(ii)(B) and Item 19 of Supplement 1 to NUREG-1022, PG&E is submitting the enclosed revision to Licensee Event Report (LER) 2-92-001-00 regarding the Unit 2 Diesel Generators (DGs) 2-1 and 2-2 field circuits being outside the design basis of the plant with respect to Appendix R criteria. The primary purpose of this revision is to report three additional Units 1 and 2 conditions that also were determined to be outside the design basis of the plant with respect to Appendix R criteria. The additional conditions are: (1) inadequate separation of steam generator and reactor coolant system circuits in containment; (2) inadequate isolation of alternate shutdown capability from the effects of a fire in the control and cable spreading rooms; and (3) inadequate isolation of emergency diesel generator control circuits from the effects of a fire in the control and cable spreading rooms. These conditions were identified as a part of PG&E's ongoing Appendix R Design Basis Documentation Enhancement Project or were referred to the Appendix R Project from other reviews now in progress.

In addition to the four reportable conditions, the Appendix R Project identified four other plant conditions that also are not in conformance with Appendix R criteria. Although PG&E does not believe that these additional four conditions are reportable, for completeness the scope of this LER has been expanded to include a discussion of these conditions as well.

These conditions did not affect the health and safety of the public.

Sincerely,

Gregory M. Rueger

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PDR ADOCK 05000275
S PDR

140000

JE 7/11

July 8, 1992

cc: Ann P. Hodgdon
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DC0-91-EN-N002
DC0-91-EN-N027
DC0-92-EN-N001
DC0-92-EN-N012

Enclosure

5811S/85K/ALN/2246

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	PAGE (3) 1 OF 33
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TITLE (4) **CONDITIONS OUTSIDE AND DEVIATIONS FROM THE 10 CFR 50 APPENDIX R PLANT DESIGN BASIS DUE TO PERSONNEL ERROR**

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 NAMES		DOCKET NUMBER (6)							
04	28	92	92	- 0 0 1	- 0 1	07	08	92	DIABLO CANYON UNIT 1		0	5	0	0	0	2	7	5
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OPERATING MODE (9) 1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)	
POWER LEVEL (10) 1 0 0	<input checked="" type="checkbox"/> 10 CFR <u>50.73(b)(2)(ii)(B)</u> <input type="checkbox"/> OTHER _____ (Specify in Abstract below and in text, NRC Form 366A)	

LICENSEE CONTACT FOR THIS LER (12)		TELEPHONE NUMBER	
RAYMOND L. THIERRY, SENIOR REGULATORY COMPLIANCE ENGINEER		AREA CODE 805	545-4004

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)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
<input type="checkbox"/> YES (if yes, complete EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO				

ABSTRACT (16)

PG&E began an Appendix R Design Basis Documentation Enhancement Project in June 1991. Four plant conditions were determined to represent conditions outside the design bases of the plant with respect to Appendix R criteria during this Project. These conditions involved: (1) inadequate diesel generator (DG) field circuit separation; (2) inadequate separation of steam generator and reactor coolant system circuits in containment; (3) inadequate isolation of alternate shutdown capability circuits in the control and cable spreading rooms; and (4) inadequate isolation of DG control circuits in the control and cable spreading rooms. One-hour, non-emergency reports were made for these conditions in accordance with 10 CFR 50.72(b)(1)(ii)(B) on February 14, June 8, June 19, and June 25, 1992, respectively.

Four other conditions that represented deviations from Appendix R criteria also were identified during this Project: (1) auxiliary saltwater pump/exhaust fan circuitry; (2) DG switch Thermo-Lag enclosures; (3) power-operated relief/auxiliary spray valve circuitry; and (4) emergency lighting. Although PG&E does not believe that these conditions are reportable, they have been included in this LER for completeness.

The root cause of the reportable events was determined to be personnel error due to a lack of attention to detail. Corrective actions include establishing fire watches, notification to operators, initiation of design changes, revision of procedures, issuance of memoranda to design personnel, and training.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

I. Plant Conditions

Units 1 and 2 have been in various Modes and at various power levels with the conditions described below.

II. Description of Event

A. Summary:

PG&E identified Conditions 1 through 4 below as a result of PG&E's currently ongoing Appendix R Design Basis Documentation Enhancement Project, or as a result of referral to the Project from other reviews now in progress, and determined that they were reportable in accordance with 10 CFR 50.72. Further, reviews that led to initiation of the Appendix R Project and investigations during the Project identified four additional conditions that were determined not to be reportable.

The conditions that were determined to be reportable are:

1. DG 2-1 and 2-2 Field Circuitry

On February 14, 1992, at approximately 1330 PST, PG&E determined that lack of 2-hour rated fire barriers for Diesel Generator (DG) 2-1 and 2-2 (EK)(DG) field circuits (ED), in conjunction with the Appendix R design basis fire for Fire Area 22-C, could potentially result in the inability of the DGs to develop and sustain rated voltage. These circuits are in separate conduits (ED)(CND) and are separated by approximately ten feet, with a minimal in situ and transient combustible loading in the fire area. However, FSAR Update, Section 9.5, states that two DGs are necessary for safe shutdown in the event of a design basis fire, and therefore the potential for disabling two of three DGs in a design basis fire represented a condition outside the design basis of the plant with respect to Appendix R criteria. A one-hour, non-emergency report was made for Unit 2 on February 14, 1992, at 1350 PST, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

2. SG and RCS Indication Circuitry

On June 8, 1992, at approximately 1610 PDT, PG&E determined that lack of adequate redundant circuit separation in Units 1 and 2 containments (NH) for steam generator (SG) level indication (AB)(LI) and reactor coolant system (RCS) temperature indication (AB)(TI), in conjunction with the Appendix R design basis fire for containment, could potentially result in degraded ability to monitor natural recirculation cooldown. These circuits are in

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (5)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE	OF
DIABLO CANYON UNIT 2	05000323	92	-001	-01	3	of 33

TEXT (17)

separate conduits and are separated by approximately 12 feet for Unit 1 and 14 feet for Unit 2. In situ and transient combustible loading is less than 10 minutes, and entry of combustible materials and ignition sources into containment is strictly controlled. However, the potential for disabling these circuits represented a condition outside the design basis of the plant with respect to Appendix R criteria. A one-hour, non-emergency report was made for Units 1 and 2 on June 8, 1992, at 16:08 PDT, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*

On June 19, 1992, at approximately 1200 PDT, PG&E determined that lack of adequate fuse (EJ)(FU) design to provide circuit separation for several 4 kV safe shutdown components required to achieve Mode 3 (Hot Standby) in Units 1 and 2, in conjunction with the Appendix R design basis fire for the control room (NA) or cable spreading rooms, could potentially result in an inability to immediately have control of these components when plant shutdown functions are transferred from the control room to the Hot Shutdown Panel (HSP) (JE)(PL).

The current 4 kV dc control circuit (EJ) design for alternate shutdown equipment provides redundant Appendix R fusing on the positive side of control room and HSP circuits and a common fuse on the negative side of the circuits. If operator actions to transfer control to the HSP are not completed prior to fire damage to the circuits, the fire could potentially blow the fuses necessary for the control room, control room/cable spreading room transfer isolation, 4 kV switchgear (EB)(SWGR), and HSP circuits and disable breaker (EB)(BKR) operation. To restore component operability, operators must either replace the fuses or manually close the individual breakers at the 4 kV switchgear.

However, MRC Letter, "Position Statement on Allowable Repairs for Alternative Shutdown and on the Appendix R Requirement for Time Required to Achieve Cold Shutdown," dated July 2, 1982, considers replacement of fuses to be a repair action, and such actions generally are not accepted by the NRC in order to achieve Mode 3. Further, while the capability exists to manually close the individual breakers (and mechanical breaker operation instructions are posted in the breaker cubical), the potential need for this action is not explicitly proceduralized and no analysis existed to show that the time required for operators to re-establish control of the components is acceptable in order to meet plant design bases. Therefore, the potential for disabling these circuits represented a condition outside the design basis of the plant with respect to Appendix R

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	4	OF 33
		92	- 0 0 1	- 0 1		

TEXT (17)

criteria. A one-hour, non-emergency report was made for Units 1 and 2 on June 19, 1992, at 1230 PDT, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

4. *DG Control Circuitry*

On June 25, 1992, at approximately 1730 PDT, PG&E determined that lack of adequate fuse design for DG control circuits in Units 1 and 2, in conjunction with the Appendix R design basis fire for the control room or cable spreading rooms, could potentially damage the DG normal and backup control circuitry. This potential damage could result in the loss of 125 V dc control power, which would result in an inability to operate the DGs from the local control panels. This Condition was identified during followup investigation for Condition 3 above.

In the event of a control room or cable spreading room Appendix R design basis fire coupled with a loss of offsite power and subsequent evacuation of the control room, the operators must have alternate capability for safe shutdown of the plant. FSAR Update, Section 9.5, states that two DGs are necessary for safe shutdown in the event of a design basis fire. Since a postulated control room or cable spreading room fire could potentially prevent start of the DGs from the local control panels, the potential for disabling these circuits represented a condition outside the design basis of the plant with respect to Appendix R criteria. A one-hour, non-emergency report was made for Units 1 and 2 on June 25, 1992, at 1808 PDT, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

The four conditions that were determined not to be reportable are:

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*
6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*
7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*
8. *Emergency lighting*

B. Background

PG&E began an Appendix R Design Basis Documentation Enhancement Project in June 1991. The Project was initiated in part to resolve some previously identified weaknesses in documentation and to provide a consistent level of supporting documentation. The Project scope included a detailed review and verification of Appendix R post-fire safe shutdown (SSD) required equipment, cable (CBL) identification, cable routing, fire area SSD analysis, SSD timeline, and emergency lighting (FH).

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	5 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

As a result of investigations leading to the Project, investigations during the Project, and other reviews now in progress, eight plant conditions have been identified to be not in conformance with Appendix R criteria. In addition to four reportable conditions, four conditions PG&E believes to be not reportable also were identified. Each of these conditions is discussed in Section II.C.

C. Event Description:

1. *DC 2-1 and 2-2 Field Circuitry*

As described in FSAR Update, Appendix 9.5A, Fire Area 22-C is a corridor outside the DG rooms in the Unit 2 turbine building (NM) at the 85 foot elevation. Fire Area 22-C contains control circuitry related to the DGs. A deviation from 10 CFR 50, Appendix R, Section III.G.2, was required for this fire area due to a lack of an area-wide fire detection system (IC). The deviation was approved in Supplemental Safety Evaluation Report (SSER) 31 on the basis of features that adequately mitigated the effects of the design basis fire and assured the capability to achieve safe shutdown. These features included an automatic wet pipe sprinkler system (KP) with remote annunciation (IC), manual fire fighting equipment (KQ) in the area, and circuit separation via 2-hour rated fire barriers for redundant safe shutdown circuits.

FSAR Update, Appendix 9.5A, states that control and backup control circuitry for the DGs in Fire Area 22-C is enclosed in 2-hour rated fire barriers to provide separation for redundant circuits. On February 13, 1992, a potential error was noted in the Fire Area 22-C post-fire SSD analysis with respect to DG 2-1 and 2-2 field circuits G05H02 and H07H02 that are routed in conduits within this fire area. The field circuits were not enclosed in rated fire barriers. The Appendix R SSD analysis did not have an evaluation of the impact to the DGs with respect to these circuits and the design basis fire for this area.

The corresponding Unit 1 fire area was reviewed and was determined to not have a condition similar to that discovered in Unit 2. A continuous fire watch was established in Fire Area 22-C as a prudent measure until the potential impact of the lack of 2-hour rated fire barriers for the field circuits could be evaluated.

On February 14, 1992, PG&E determined that a postulated design basis fire for Fire Area 22-C could potentially disable the DG 2-1 and 2-2 field circuits, which could result in the inability of the DGs to develop and sustain rated voltage. These potential circuit losses, combined with a postulated loss of offsite power, could result in the inability to energize Unit 2 vital busses G and H (EB)(BU) from their

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (7)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	6	OF 33
DIABLO CANYON UNIT 2	05000323	92	- 001	- 01	6	OF 33

TEXT (17)

respective DGs, leaving only DG 1-3 (vital bus F) in an operable status. As noted in FSAR Update, Table 9.5G-2, "Equipment Required for Safe Shutdown," Diablo Canyon is analyzed to have two out of three DGs operable following a loss of offsite power coincident with a design basis fire. Therefore, PG&E determined that the lack of proper enclosures for the field circuits represented a condition outside the design basis of the plant. On February 14, 1992, at 1350 PST, a one-hour, non-emergency report was made for Unit 2 in accordance with 10 CFR 50.72(b)(1)(ii)(B).

2. SG and RCS Indication Circuitry

As described in FSAR Update, Appendix 9.5A, the Units 1 and 2 Fire Zones 1-A and 9-A are the containment annular areas. The circuitry for SG narrow range level and RCS temperature (both T_{hot} and T_{cold}) indication pass through these annular areas. FSAR Update, Table 9.5G-2, notes that the indication required to enable performance of a natural circulation cooldown following an Appendix R design basis fire coincident with a loss of offsite power consists of SG narrow range level, SG pressure (AB)(PI), and RCS T_{hot} and T_{cold} indication for one RCS loop. This instrumentation is relied upon as the primary means of monitoring cooldown, and for these indications to be meaningful the RCS temperature indications must be on the RCS loop associated with the SG providing the cooling. Section 9.5A of the FSAR Update states: "Only one steam generator is required for safe shutdown and the circuitry is separated so that one steam generator remains available," and that the RCS temperature indication circuits "...are provided with a 1-hour fire barrier where they are within 20 feet of redundant circuitry."

On June 2, 1992, during the Appendix R Design Basis Documentation Enhancement Project, PG&E determined that not all SG and RCS circuitry was in compliance with the FSAR Update statements. For Unit 1, the SG 1-1 and 1-2 narrow range level indication circuitry was separated such that the minimum distance between these and the RCS T_{hot} and T_{cold} circuitry associated with SGs 1-3 and 1-4 was approximately 12 feet. For Unit 2, the SG 2-1 and 2-2 narrow range level indication circuitry was separated such that the minimum distance between these and the RCS T_{hot} and T_{cold} circuitry associated with SGs 2-3 and 2-4 was approximately 14 feet.

On June 8, 1992, PG&E determined that the condition identified on June 2 meant that Appendix R separation requirements for redundant circuitry had not been met, and therefore that an Appendix R design basis fire in containment potentially could disable circuitry such that SG narrow range level indication and RCS temperature indication for a given RCS loop would not be available. Although not specifically credited in the FSAR Update, natural circulation cooldown

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	7 OF 33

TEXT (17)

also could be monitored by use of indication from core exit thermocouples (IM)(TT) and SG wide range level circuitry, but PG&E determined that circuitry for this instrumentation was routed in the containment annulus and could not be postulated to withstand the design basis fire. PG&E therefore determined that lack of proper SG level and RCS temperature circuit separation represented a condition outside the design basis of the plant. On June 8, at 1638 PDT, a one-hour, non-emergency report was made for Units 1 and 2 in accordance with 10 CFR 50.72(b)(1)(ii)(B).

3. Fuse Design for Safe Shutdown Equipment Control Circuitry

As described in FSAR Update, Appendix 9.5A, the DCPD Fire Protection Program SSD analysis meets the requirements of Appendix R, Sections III.G.3 and III.L, by providing the capability to isolate SSD circuits from the effects of a fire in the control room or cable spreading rooms, and by providing an alternative location (the HSP) to perform post-fire SSD actions independent of a fire in the control room or cable spreading room. Transfer of SSD equipment control from the control room to the HSP is enabled by switches (JE)(33), which isolate all control room or cable spreading room circuit faults to allow operation using control switches at the HSP.

On June 19, 1992, PG&E identified a potential error in the Units 1 and 2 SSD analysis with respect to the fuse configuration for alternative shutdown circuitry for several components required to achieve Mode 3. Circuit analysis determined that a fire in the control or cable spreading rooms could potentially damage the 125 V dc control circuitry for breaker control of the 4 kV pumps (P) if the actions at the HSP and switchgear to transfer to local control are not completed prior to fire damage of the circuits. If operator actions to transfer control to the HSP are not completed prior to fire damage to the circuits, the fire could potentially blow the fuses common to the control room, the control room/cable spreading room transfer isolation, 4 kV switchgear, and HSP circuits and disable breaker operation. This damage could disable the ability to isolate circuits in the fire area and electrical operation of the breakers. The affected components are:

- Centrifugal Charging Pumps 1-1, 1-2, 2-1 and 2-2 (CB)(P)
- Component Cooling Water Pumps 1-1, 1-2, 1-3, 2-1, 2-2, and 2-3 (CC)(P)
- Auxiliary Saltwater (ASW) Pumps 1-1, 1-2, 2-1, and 2-2 (BI)(P)
- Auxiliary Feedwater Pumps 1-2, 1-3, 2-2, and 2-3 (BA)(P)

On June 19, 1992, at approximately 1200 PDT, PG&E determined that lack of adequate fuse design to provide circuit separation for the components described above required to achieve Mode 3, in conjunction

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (7)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	8 of 33

TEXT (17)

with the Appendix R design basis fire for the control room or cable spreading rooms, could potentially result in an inability to immediately have control of these pumps when plant shutdown functions are transferred from the control room to the HSP.

To restore operability, operators must either replace the fuse or manually close the individual component breakers at the 4 kV switchgear. However, the NRC Letter dated July 2, 1982, considers replacement of fuses to be a repair action, and such actions generally are not accepted by the NRC in order to achieve Mode 3. Also, while the capability exists to manually close the individual breakers (and mechanical breaker operation instructions are posted in the breaker cubical), the current SSD analysis did not take credit for this capability; the SSD analysis apparently assumed that the action to transfer control to the HSP would be completed prior to fire damage to the circuits. The potential need to manually close individual breakers is not proceduralized and no analysis existed to show that the time required for operators to re-establish control of the equipment was acceptable in order to meet plant design bases. Therefore, the potential for disabling these circuits represented a condition outside the design basis of the plant with respect to Appendix R criteria. A one-hour, non-emergency report was made for Units 1 and 2 on June 19, 1992, at 1230 PDT, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

4. *DG Control Circuitry*

As described in the FSAR Update, Section 9.5A, Fire Area CR-1 is the Units 1 and 2 control room complex. The FSAR Update discussion for Fire Area CR-1 notes that the requirements of Appendix R, Sections III.G.3 and III.L, are met in part by providing an alternate location to perform post-fire safe shutdown actions independent of a fire in the control room or cable spreading rooms. This alternate shutdown capability includes the ability to start the DGs at their local control panels (ED)(PL).

On June 25, 1992, as part of the followup investigation initiated following identification of Condition 3 above regarding breaker design for safe shutdown equipment control circuitry, PG&E identified a potential error in the design of the DG control circuitry. Due to the potential for a fire in the control room or cable spreading rooms, hot shorts and shorts to ground are assumed for the DG control circuits. Each DG has two redundant 125 V dc control power sources (normal and backup). Circuits associated with both the control power sources are located in the control room and cable spreading rooms. The DG remote control circuits in the control room and the local control circuits in the control panels near the DG rooms are connected to the same 20 Amp control power fuses (ED)(FU). A postulated Appendix R design basis

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3) 9 OF 33
		YEAR 92	SEQUENTIAL NUMBER - 0 0 1	REVISION NUMBER - 0 1	

TEXT (17)

fire could result in a hot short or short to ground on the positive leg of each control power source circuit in conjunction with a short to ground on a circuit connected to the negative leg of the same power source. These circuit faults could cause the 20 Amp power fuses to blow and result in loss of the ability to locally start the DGs.

On June 25, 1992, at approximately 1730 PDT, PG&E determined that lack of adequate fuse design for DG control circuits in Units 1 and 2, in conjunction with the Appendix R design basis fire for the control room or cable spreading rooms, could potentially result in an inability to operate the DGs from the local control panels. In the event of a control room or cable spreading room Appendix R design basis fire and with a loss of offsite power and subsequent evacuation of the control room, the operators must have alternate capability for safe shutdown of the plant. FSAR Update, Section 9.5, states that two DGs are necessary for safe shutdown in the event of a design basis fire. Since a postulated control room or cable spreading room fire could potentially prevent start of the DGs from the local control panels, the potential for disabling these circuits represented a condition outside the design basis of the plant with respect to Appendix R criteria. A one-hour, non-emergency report was made for Units 1 and 2 on June 25, 1992, at 1808 PDT, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

5. Auxiliary Saltwater Pump and Exhaust Fan Circuitry

As described in FSAR Update, Appendix 9.5A, Fire Zone 30-A-5 is the circulating water pump (KE)(P) room in the intake structure (MK)(NN). Conduits containing control circuits for ASW Pumps 1-1, 1-2, 2-1, and 2-2 and conduits containing the power circuits for the ASW pump exhaust fans (E-101 and 103 for Unit 1 and E-102 and 104 for Unit 2) (UA)(FAN) pass through this area. One ASW train (pump and exhaust fan) are required to be operable for safe shutdown. 3-hour fire wrap on one train of circuits per unit is provided to ensure availability of one ASW train per unit in the event of an Appendix R design basis fire.

On April 21, 1992, during the Appendix R Design Basis Documentation Enhancement Project, PG&E determined that a 3-foot long section of the circuits for ASW Pump 1-1 and ASW Pump Exhaust Fan E-103 for Unit 1, and ASW Pump 2-1 and ASW Pump Exhaust Fan E-104 for Unit 2, was not protected with a 3-hour fire wrap. This section is from the point where the circuits exit the concrete floor embedment and travel three feet up to Junction Box BJZ-114 (ED)(JBX). The junction box is protected with a 3-hour fire wrap, but the conduits entering the box are not protected.

ASW Pump 1-1 and 2-1 circuits located in Fire Zone 30-A-5 are required

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	10 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

for auto start of the pump on low ASW pressure. Fire-induced circuit damage to one train of ASW pump circuits could blow the pump's dc control circuit fuse and prevent an idle pump from automatically starting on low pressure, but will not trip a running pump. Loss of the pump's dc control power due to the blown fuse will alarm in the control room. The circuits for the alarm are not located in Fire Zone 30-A-5 and will not be affected by the fire.

ASW Pump Exhaust Fan E-103 and E-104 circuits located in Fire Zone 30-A-5 are required to supply power for the exhaust fans. Fire-induced circuit damage to one train of exhaust fan circuits could result in loss of power to the fan. The loss of an ASW fan will alarm in the control room. The circuits for the alarm are not located in Fire Zone 30-A-5 and will not be affected by the fire.

On April 28, 1992, PG&E determined that, while this condition was not in strict compliance with Appendix R, Section III.G.2, the condition did not significantly reduce the level of safety and therefore was not reportable in accordance with 10 CFR 50.72. The basis for this determination is discussed further in Section IV, "Analysis of Event."

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*

As described in the FSAR Update, Fire Areas 11-D and 22-C are corridors outside the DG rooms at the 85 foot elevation in the Units 1 and 2 turbine buildings, respectively. The DG emergency stop switches (ED)(HS) are located outside the DG rooms in these corridors. FSAR Update, Appendix 9.5A states that the DG 1-1, 1-2, and 2-1 stop switches are enclosed in 1-hour rated fire barriers. Fire Area TB-7/Zone 14-A and Fire Area TB-7/Zone 19-A are the main condenser (SG)(COND), feedwater (SJ) and condensate (SD) equipment areas in the Units 1 and 2 turbine building at the 85 foot elevation. The manual actuation switches (LW)(HS) for the DG room CO₂ fire suppression system (LW) are located in these areas. These switches likewise are to be enclosed in 1-hour rated fire barriers. However, as discussed below, anomalies were identified with the Thermo-Lag enclosures used to provide the fire barriers for these switches.

FSAR Update, Section 9.5.1, states that two DGs are required for safe shutdown in the event of a fire concurrent with a loss of offsite power. Thermo-Lag 1-hour fire barrier enclosures were provided for the DG 1-1, 1-2, and 2-1 emergency stop switches to preclude a fire in Area 11-D or 22-C from causing spurious actuations of the switches and thereby disabling more than one DG. Similarly, Thermo-Lag 1-hour fire barriers were provided for the CO₂ fire suppression system manual actuation switches to preclude a fire in Zone 14-A or 19-A from disabling more than one DG; spurious actuation of the CO₂ system manual actuation switch would result in automatic closure of a DG room

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	11 OF 33
		92	- 0 0 1	- 0 1	

TEXT (37)

roll-up door (NM)(DR), which would result in loss of cooling to the DG and thereby potentially render the DG inoperable.

On November 7, 1991, PG&E determined that vendor information for Thermo-Lag had been inappropriately applied when approving the proposed enclosure configurations, in that screws and subliming compound had been used for construction of the enclosures to hold the prefabricated Thermo-Lag panels together in lieu of steel bands or wires. This method of construction had not been tested and approved by the vendor, and therefore the enclosure configuration was potentially not adequate to provide a 1-hour fire barrier.

On November 15, 1991, PG&E determined that, while the Thermo-Lag enclosures could not be depended upon to provide a 1-hour fire barrier, the condition did not significantly reduce the level of safety and therefore was not reportable in accordance with 10 CFR 50.72. The basis for this determination is discussed further in Section IV, "Analysis of Event."

During repair activities to provide adequate fire barriers for the DG and CO₂ switches, personnel who approved the work orders to implement the design changes assumed that the compensatory measures in place for the "degraded" enclosures also would apply when the enclosures were removed. Consequently, the enclosures were removed without the proper evaluations having been performed.

Upon identification of this condition, PG&E reviewed Generic Letter (GL) 86-10, "Implementation of Fire Protection Requirements," for further Appendix R guidance regarding spurious actuation. As discussed further in Section IV, through application of the guidance in GL 86-10, PG&E determined that absence of the Thermo-Lag enclosures likewise did not reduce the level of safety and therefore the condition was not reportable in accordance with 10 CFR 50.72.

7. Power-Operated Relief and Auxiliary Spray Valve Circuitry

As described in FSAR Update, Appendix 9.5A, control circuits for power-operated relief valves (PORVs) PCV-474, PCV-455C, and PCV-456 (AB)(RV) and Auxiliary Spray Valves 8145 and 8148 (AB)(PZR)(INV) are routed in conduit through the following Units 1 and 2 Fire Areas:

- 1 Containment (Unit 1)
- 3-BB Containment Penetration Area (Unit 1)
- 3-CC Containment Penetration Area (Unit 2)
- 6-B-4 Reactor Trip Switchgear (Unit 2)
- 9 Containment (Unit 2)

The PORVs are 2-inch, pneumatically-opened, spring-closed, reverse-

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	12 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

acting globe valves. The PORVs fail closed on loss of actuating gas pressure. Instrument air (LD) is the normal actuating gas for all three PORVs. For two of the PORVs (PCV-455C and PCV-456), normal instrument air is backed up by nitrogen accumulators (LK)(ACC). Each of the two valves has its own nitrogen accumulator. The only motive power supply for PCV-474 is instrument air.

Units 1 and 2 also each have auxiliary spray for pressurizer (AB)(PZR) pressure control. The charging flow stream in the chemical and volume control system (CB) at the outlet of the regenerative heat exchanger (CB)(HX) is the source for auxiliary spray. The auxiliary spray line contains two air-operated valves installed in parallel: the auxiliary spray control valve (8145) and the auxiliary spray bypass control valve (8148). These valves are redundant, and each one has a separate nitrogen back-up supply to allow opening during loss of instrument air to the containment. Both valves fail to the closed position upon loss of actuating fluid or electrical power.

Appendix R, Section III.G, requires the capability to achieve and maintain Mode 5 (Cold Shutdown) conditions using either equipment protected from the effects of a fire or equipment that can be repaired following a fire, and describes the fire protection requirements for the necessary equipment. This equipment includes components required for a controlled RCS depressurization prior to initiation of the residual heat removal system (BP).

Following an Appendix R design basis fire and loss of offsite power, at least one of the PORVs or auxiliary spray valves is necessary for RCS depressurization to achieve and maintain Mode 5 (Cold Shutdown) since the reactor coolant pumps (RCPs) (AB)(P) and, hence, normal pressurizer spray would be unavailable. Therefore, to comply with the requirements of Appendix R, Section III.G.1.b, it must be shown that these valves will remain free from fire damage or can be repaired within 72 hours.

On January 14, 1992, during the Appendix R Design Basis Documentation Enhancement Project, PG&E identified an error in the SSD analysis for Fire Area 6-B-4. Control circuits for Auxiliary Spray Valves 8145 and 8148 and for PORVs PCV-455C and PCV-456 are routed in conduit through Fire Area 6-B-4, and do not meet Appendix R minimum separation criteria. The SSD analysis took credit for the availability of PCV-474 to achieve Mode 5 in the event of a fire in this Area since no control circuitry for PCV-474 is routed through this Area. However, the motive power supply for PCV-474, instrument air, cannot be postulated to be available following a loss of offsite power. Therefore, the post-fire ability to operate PCV-474 could not be assured.

Similar analysis and routing errors were identified in Unit 1 Fire

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	DIVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	13 OF 33

TEXT (17)

Areas 1 (containment) and 3-BB (containment penetration area) and Unit 2 Fire Areas 3-CC (containment penetration area) and 9 (containment). The control circuits for 8148 and PCV-455C are routed within the same conduit through the 100 foot elevation of Fire Area 3-CC. The control circuits for PCV-456 and 8145 are routed in separate conduits that cross either directly above or below the conduit containing 8148 and PCV-455C. Horizontal separation between the conduit containing circuits for 8148 and PCV-455C and the conduit containing circuits for PCV-456 ranges from 0 feet (where the conduits cross) to approximately 12 feet. Horizontal separation between the conduit containing circuits for 8148 and PCV-455C and the conduit containing circuits for 8145 ranges from 0 feet (where the conduits cross) to approximately 12 feet. Horizontal separation between the conduit containing circuits for 8145 and the conduit containing circuits for PCV-456 ranges from 0 feet (where the conduits cross) to approximately 9 feet.

For Fire Area 3-BB, a minimum separation of approximately 13 feet between redundant circuits exists on the 115 foot elevation of the containment penetration areas. This minimum separation occurs at the containment penetration Junction Boxes BTG 12E and BTG 19E which are provided with 1-hour fire resistive enclosures. Redundant circuits are routed in rigid conduit throughout the area.

For Fire Areas 1 and 9, the minimum separation between PORV and auxiliary spray valve circuits occurs at Containment Penetrations 12E and 19E. Penetration Termination Box BTX 12E contains circuits for auxiliary spray valve 8145 and PORV PCV-456. Penetration Termination Box BTX 19E contains circuits for Auxiliary Spray Valve 8148 and PORV PCV-455C. The minimum separation (approximately 16 feet) occurs between conduits containing circuits for 8145 and PCV-455C at BTX 12E and BTX 19E.

On January 15, 1992, PG&E determined that, while these conditions were not in strict compliance with Appendix R requirements, the conditions did not significantly reduce the level of safety and therefore were not reportable in accordance with 10 CFR 50.72. The basis for this determination is discussed further in Section IV, "Analysis of Event."

8. *Emergency Lighting*

As described in FSAR Update, Appendix 9.5D, the DCPD Fire Protection Program SSD analysis indicates that the requirements of Appendix R, Section III.J, "Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto," have been met by providing battery-operated lights (FH) in the appropriate plant locations in conjunction with credit for vital

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3) 14 of 33
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
		92	- 0 0 1	- 0 1	

TEXT (17)

ac (FG) and dc (FH) lights in certain areas. This method of compliance was described in PG&E's Appendix R submittals, which also requested deviations from the specific Appendix R, Section III.J, requirements for use of only battery-operated lights. The battery-operated light configuration and deviation requests were reviewed and approved by the NRC as documented in SSERs 23 for Unit 1 and 31 for Unit 2.

In December 1990, PG&E identified several potential errors in the Units 1 and 2 SSD analysis with respect to Emergency Procedure (EP) M-10, "Fire Protection w/ Safe Shutdown Equipment," which provides analyzed corrective actions to take following a fire in plant areas containing safe shutdown equipment; EP M-10 references Abnormal Operation Procedures (OPs) AP-8A, "Control Room Inaccessibility - Establishing Hot Standby," and AP-8B, "Control Room Inaccessibility - Hot Standby to Cold Shutdown." These potential analysis errors involved the adequacy of battery-operated lighting as follows:

- (a) EP M-10 and OPs AP-8A and AP-8B identified several plant areas that required access and/or manual actions, but these areas had no installed emergency lighting;
- (b) OPs AP-8A and AP-8B specified operator actions for several components that had not been identified in the SSD as equipment used in the event of a fire;
- (c) Time requirements for manual actions specified in the procedures had not been clearly defined in supporting analyses.

PG&E determined that while these conditions were not in strict compliance with Appendix R requirements, the conditions did not significantly reduce the level of safety and therefore were not reportable in accordance with 10 CFR 50.72. The basis for this determination is discussed further in Section IV, "Analysis of Event."

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

None.

E. Dates and Approximate Times for Major Occurrences:

1. February 13, 1992: Condition 1 identified. Review of potential impact on SSD analysis begun. Continuous fire watch posted in the area as a prudent measure.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
		92	- 0 0 1	- 0 1	15 of 33

TEXT (17)

2. February 14, 1992, at 1330 PST: Condition 1 Discovery/Event date.
3. February 14, 1992, at 1350 PST: One-hour, non-emergency report for Condition 1 made to NRC in accordance with 10 CFR 50.72(b)(1)(ii)(B).
4. June 2, 1992: Condition 2 identified. Further investigation of actual plant conditions and potential impact on SSD analysis begun.
5. June 8, 1992, at 1610 PDT: Condition 2 Discovery/Event date.
6. June 8, 1992, at 1638 PDT: One-hour, none-emergency report for Condition 2 made to NRC in accordance with 10 CFR 50.72(b)(1)(ii)(B).
7. June 19, 1992: Condition 3 identified. Investigation of potential impact on SSD analysis begun.
8. June 19, 1992, at 1200 PDT: Condition 3 Discovery/Event date.
9. June 19, 1992, at 1230 PDT: One-hour, none-emergency report for Condition 3 made to NRC in accordance with 10 CFR 50.72(b)(1)(ii)(B).
10. June 25, 1992: Condition 4 identified. Investigation of potential impact on SSD analysis begun.
11. June 25, 1992, at 1730 PDT: Condition 4 Discovery/Event date.
12. June 25, 1992, at 1808 PDT: One-hour, non-emergency report for Condition 4 made to NRC in accordance with 10 CFR 50.72(b)(1)(ii)(B).

F. Other Systems or Secondary Functions Affected:
None.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	16 of 33

TEXT (17)

G. Method of Discovery:

These conditions were identified either during investigation that led to initiation of the Appendix R Design Basis Documentation Enhancement Project and during the investigations conducted in support of the Project or referral to the Project from other reviews now in progress.

H. Operator Actions:

None.

I. Safety System Responses:

None.

III. Cause of the Event

A. Immediate Cause:

The conditions described in this LER are the result of several immediate causes. The conditions are grouped below by cause.

1. *DG 2-1 and 2-2 Field Circuitry*
2. *SG and RCS Indication Circuitry*
7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*

The immediate cause of these conditions was that the early 1980s Appendix R SSD analysis did not adequately evaluate all of the circuits with respect to the required post-fire functions of the affected components.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*
4. *DG Control Circuitry*

The immediate cause of these conditions was determined to be inadequate fuse design.

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*

The early 1980s Appendix R SSD analysis required both the conduits and the associated Junction Box BJZ-114 to be protected with a 3-hour fire wrap. However, the design change that implemented this requirement did not clearly communicate this requirement, and therefore only the junction box was protected

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	17 of 33
		92	- 0 0 1	- 0 1	

TEXT (17)

with a 3-hour fire wrap.

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*

The basis for the design of the Thermo-Lag enclosures referenced only one section of the vendor instructions instead of all applicable sections.

8. *Emergency Lighting*

(a) Manual operator actions and access/egress routes described in EP M-10 and OPs AP-8A and AP-8B were not provided with emergency lighting.

(b) A clear distinction in OPs AP-8A and AP-8B and the supporting SSD analysis was not made as to which manual operator actions required area emergency lighting. Also, a clear description of the screening criteria used in the original SSD analysis to determine which manual operator actions required area emergency lighting was not documented.

(c) No distinction was made in the SSD analysis or in EP M-10 and OPs AP-8A and AP-8B regarding time requirements for manual actions. Therefore, it was not clear which actions were to be completed within eight hours after a fire concurrent with a loss of offsite power and therefore for which emergency lighting may have been required.

B. *Root Cause:*

The conditions described in this LER are the result of several root causes. The conditions are grouped below by cause.

1. *DG 2-1 and 2-2 Field Circuitry*
2. *SG and RCS Indication Circuitry*
7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*

The root cause of these conditions was determined to be personnel error (cognitive) due to a lack of attention to detail by PG&E engineers during performance of the early 1980s Appendix R SSD analysis. The rationale for this as applied to each condition follows:

For Condition 1, the corresponding Unit 1 DG field circuits are contained in the room with their respective DGs, and are not

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	18 OF 33

TEXT (17)

routed into the corresponding Unit 1 corridor. For reasons that could not be determined, the Unit 2 DG 2-1 and DG 2-2 field circuits are routed out of their respective rooms, into the Fire Area 22-C corridor, and then back into their respective rooms. Investigation indicates that the early 1980s SSD analysis most likely assumed that DG circuits having both endpoints within the DG room did not exit that room.

For Condition 2, separation of the SG narrow range level and RCS temperature indication circuitry in containment was provided. However, the SSD analysis failed to superimpose the availability of the subject SG and RCS indications for various fire locations inside containment and therefore did not ensure sufficient available indication for a given RCS loop in the event of a fire.

For Condition 7, the SSD analysis did not properly assess the effects of a concurrent fire and loss of offsite power on the air supply to PCV-474. The SSD analysis also did not adequately assess the post-fire availability of components required for RCS depressurization following a design basis fire in containment or the containment penetration areas.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*
4. *DG Control Circuitry*

Investigation indicates that the root cause for the inadequate fuse design was an assumption made during system design that transfer of equipment control (to the HSP for Condition 3 and to the DG local control panels for Condition 4) was completed prior to damage of the circuits by the fire.

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*

A review of the design change initiated to implement Appendix R requirements for wrapping of circuits in the plant indicates that the requirement to wrap the subject ASW circuits was inadequately communicated by Nuclear Engineering and Construction Services (NECS) Engineering in the design change to personnel implementing the requirement. While the junction box associated with the subject circuits was wrapped, a 3-foot long section of the circuits was not protected with a 3-hour fire wrap.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (5)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	19 of 33

TEXT (17)

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*

A review of the design changes initiated to implement Appendix R requirements for installation of the Thermo-Lag enclosures indicates that the design changes were ambiguous and did not provide adequate guidance for proper construction and installation of the enclosures.

8. *Emergency Lighting*

- a. Requirements for access/egress routes and manual actions and the emergency lighting requirements have not been clearly defined and documented in the SSD analysis or in plant procedures.
- b. There was no process that ensured that EP M-10 and OPs AP-8A and AP-8B were updated to be current with respect to the SSD analysis in the FSAR Update.

C. *Contributing Causes:*

1. *DG 2-1 and 2-2 Field Circuitry*

The original Appendix R SSD analysis performed in the early 1980s did not use as rigorous criteria as is currently required by procedure. Also, the Nuclear Engineering Manual Procedure (NEMP) 3.3, "Design Calculations," requirements for incorporation of material such as the SSD analysis results into design calculations were not as strict in the early 1980s as they have been since revision to NEMP 3.3 in 1986.

2. *SG and RCS Indication Circuitry*

None.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*

4. *DG Control Circuitry*

IE Information Notice 85-09, "Isolation Transfer Switches and Post-Fire Shutdown Capability," suggested that licensees review isolation transfer switches installed outside the control room for potential deficiencies in electrical design regarding lack of redundant fusing. PG&E's original review of the Notice incorrectly concluded that proper circuit isolation was provided at DCPD and therefore that no action for the Notice was

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	20 of 33

TEXT (17)

required. Though no documentation could be found, interviews with involved personnel indicate that this conclusion was based on a assumption that multiple circuit faults would not occur prior to transfer of equipment control. However, current PG&E safe shutdown methodology conservatively assumes that multiple circuit faults occurring prior to equipment transfer could result in blowing of control fuses and loss of control of equipment from a remote control station.

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*
None.

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*
None.

7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*
None.

8. *Emergency Lighting*
None.

IV. Analysis of the Event

The following analyses for the first four conditions provide evaluations for impact to the health and safety of the public. The remainder of the analyses provide the rationale used to determine safety significance and reportability.

1. *DG 2-1 and 2-2 Field Circuitry*

A postulated design basis fire for Fire Area 22-C could potentially disable the DG 2-1 and DG 2-2 field circuits, which could result in the inability of the DGs to develop and sustain rated voltage. These potential circuit losses, combined with a postulated loss of offsite power, could result in the inability to energize the Unit 2 vital busses G and H from their respective DGs. However, the minimum distance between the generator field circuits in the corridor is approximately 10 feet, and the circuits are in separate conduits. Additionally, the normal in situ and transient combustible loading is minimal, with a fire severity of less than ten

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE	OF
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	21	of 33

TEXT (17)

minutes. Hourly fire patrols are provided in this area to monitor transient combustibles. Therefore, it is likely that even with a fire in the corridor, at least one of these two DGs would have been available if required. Therefore, this condition did not adversely affect the health and safety of the public.

2. *SG and RCS Indication Circuitry*

A postulated design basis fire for either Fire Zone 1-A or 9-A could potentially disable SG narrow range level and RCS temperature indication circuitry such that both these indications would not be available on a single RCS loop. These potential circuit losses, combined with a postulated loss of offsite power, could result in an inability to properly monitor natural circulation cooldown.

However, the combustible loadings in the containment annular areas where the subject SG and RCS circuitry is routed are less than 10 minutes, and the most significant contributor to these loadings is non-Class 1E cable insulation (EC)(ISL). The major combustible loading in containment, the RCPs, is not considered to be a concern for the annular areas because each RCP has automatic wet pipe sprinkler protection, smoke detection (IC), shield walls, and a lube oil collection system (AB)(LL). Also, containment is a high radiation area, and materials (including potential combustibles and ignition sources) brought into containment are strictly controlled. The subject SG and RCS circuits are inside rigid metal conduits, such that an electrically induced fire in one conduit should not impact any adjacent conduits. Lastly, the annular areas have automatic smoke detection that alarms in the control room, and manual fire suppression, hose reels, and extinguishers are readily available for fire brigade use. Therefore, this condition did not adversely affect the health and safety of the public.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*

A postulated design basis fire in either the control room or the cable spreading rooms could potentially disable circuitry for control of components from the HSP, which then could impede the ability to achieve Mode 3. However,

- The cable spreading room is provided with smoke and heat detection (IC), and smoke detectors also are provided in the control panels in the control room for the components of concern.
- The cable spreading room is provided with a total-flooding CO₂ suppression system that can be actuated by the heat detectors, or that can be manually actuated by plant personnel during periods when the CO₂ system automatic actuation is disabled.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	- 0 0 1	- 0 1	22 of 33

TEXT (17)

- The control and cable spreading rooms are supplied with portable fire extinguishers, and fire hose stations are available.
- The control room is continuously manned, and the cable spreading rooms have been provided with an hourly roving fire watch since the beginning of commercial operation.
- Redundant cabling is separated, sized, and protected to preclude a cable fault-initiated fire. The possibility of a non-electrical fault-initiated fire is very remote due to lack of fixed ignition sources and administrative control on transport of temporary ignition sources into the control room or cable spreading rooms.

Therefore, in the event of a design basis fire in the either the control room or cable spreading rooms, the ability to achieve Mode 3 was not adversely impaired. Therefore, this condition did not adversely affect the health and safety of the public.

4. *DG Control Circuitry*

A postulated design basis fire in either the control room or the cable spreading rooms could potentially disable the DG control circuitry, which then could impede the ability to achieve safe shutdown. However,

- The cable spreading room is provided with smoke and heat detection, and smoke detectors also are provided in the control panels in the control room.
- The cable spreading room is provided with a total-flooding CO₂ suppression system that can be actuated by the heat detectors, or that can be manually actuated by plant personnel during periods when the CO₂ system automatic actuation is disabled.
- The control and cable spreading rooms are supplied with portable fire extinguishers, and fire hose stations are available.
- The control room is continuously manned, and the cable spreading rooms have been provided with an hourly roving fire watch since the beginning of commercial operation.
- Redundant cabling is separated, sized, and protected to preclude a cable fault-initiated fire. The possibility of a non-electrical fault-initiated fire is very remote due to lack of fixed ignition sources and administrative control on transport of temporary ignition sources into the control room or cable spreading rooms.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	23 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

Therefore, in the event of a design basis fire in the either the control room or cable spreading rooms, the ability to achieve safe shutdown was not adversely impaired. Therefore, this condition did not adversely affect the health and safety of the public.

5. *Auxiliary Salt-water Pump and Exhaust Fan Circuitry*

As noted in Section II.C.5., PG&E determined that this condition was not reportable in accordance with 10 CFR 50.72. The basis for this determination was that PG&E believed there was adequate assurance that it was unlikely that a fire would damage both trains of ASW (pumps and pump exhaust fans) and, therefore, at least one ASW train would be available in the event of a fire because:

- Fire Zone 30-A-5 contains in situ combustible loading equivalent to a fire duration of 14 minutes, with an additional allowable transient combustible loading of 5 minutes. The majority of the in situ combustible loading consists of the cable insulation and lube oil for the circulation water pumps, which are located in a concrete housing. The entrance to the concrete housing is the only significant opening from the enclosure to the room containing the ASW circuits and is "sunk" into the concrete floor from which the circuits emerge. Therefore, the housing would serve to contain any oil spill since it is unlikely that the lube oil would travel out through the entrance, up the short approximately 2-foot flight of stairs, and then out into the room.
- There is a high pressure, heat-activated CO₂ flooding fire suppression system in the concrete housing for the circulating water pumps. Also, there are smoke detectors at the entrance of the ASW pump vault. Although these do not constitute area-wide detection, they do annunciate in the control room. Fire extinguishers and hose reels are available in this fire zone for use by the fire brigade.
- There is no intervening combustible material between the redundant ASW circuits.
- Assuming a fire damaged one ASW train, the fire would have to propagate along a torturous path to damage the other train. This path involves traveling around three, 3-hour rated walls and alongside another 3-hour rated wall. Propagation of a fire along this path is considered even less likely based on the lack of intervening combustibles between the redundant circuits.

Therefore, given the remote probability a fire disabling both ASW circuits of Unit 1 or of Unit 2, this condition did not significantly reduce the level of safety. Since the condition of the plant was not seriously degraded, this condition therefore was determined not to be reportable in

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCS. NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
DIABLO CANYON UNIT 2	0 5 6 0 0 3 2 3	92	- 0 0 1	- 0 1	24 OF 33

TEXT (17)

accordance with 10 CFR 50.72, and the condition did not adversely affect the health and safety of the public.

6. DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures

As noted in Section II.C.6., PG&E determined that this condition was not reportable in accordance with 10 CFR 50.72. Prior to removal of the Thermo-Lag enclosures, this determination was based on the following points that PG&E believes give adequate assurance that a fire would not disable more than one DG:

- While the ability of the enclosures to provide a 1-hour fire barrier was indeterminate, the enclosures still could have functioned as radiant energy shields.
- The DG emergency stop switches are spaced approximately 20 feet apart, and also are separated by DG room roll-up doors and normal access doors. Section III.G.2.b of Appendix R states that physical separation of 20 feet or more measured horizontally, in conjunction with no intervening combustible or fire hazards, fire detectors, and an automatic fire suppression system, is also a means of fire protection for safe shutdown equipment. Although the DG corridor is not provided with fire detectors, the corridor is provided with automatic suppression and the switches were separated and provided with the Thermo-Lag enclosures.

Although the physical separation point can not be used for the CO₂ manual actuation switches since they are separated by less than three feet, and the Unit 2 switches additionally are mounted vertically, all three switches in Unit 1 and two of the three switches in Unit 2 were located in their own Thermo-Lag enclosure.

- The normal in situ and transient combustible loading for the DG corridors is minimal, with a fire severity of less than ten minutes. Transient combustibles are kept to a minimum and controlled in accordance with AP C-13, "Fire Loss Prevention." Also, the corridors are high traffic areas, and it is highly unlikely that there would be sufficient transient combustibles stored such that a fire could affect more than one switch.

The normal in situ and transient combustible loading for the areas in which the CO₂ manual actuation switches are located is approximately 13 minutes; the transient portion of this loading is approximately three minutes, and storage of transient combustibles near the switches is unlikely given their location (along a narrow access path for Unit 1, and near structural supports for Unit 2). The area in the immediate vicinity of the Unit 1 switches is essentially void of combustibles. The area in the immediate vicinity of the Unit 2

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	25 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

switches also is void with the exception of potential leakage of lube oil from the nearby condensate booster pumps (SD)(P). However, the turbine building floor near the Unit 2 lube oil reservoirs (LL)(RVR) slopes away from the switches, and therefore it is unlikely that a fire involving the lube oil would disable the switches.

- Hourly roving fire watches have been in effect for the subject areas since beginning of commercial operation, which is consistent with Technical Specification requirements for surveillance of impairment to penetrations in fire area boundaries. These areas also are high traffic areas.
- The subject areas have automatic, area-wide wet pipe sprinkler systems, and manual hose stations and portable fire extinguishers. If the sprinkler system is activated, a water flow alarm is received in the control room. Upon receipt of a water flow alarm, an operator is sent to the area of indication; if a fire is found, the fire alarm is sounded and the fire brigade is summoned.

Following this original determination, the Thermo-Lag enclosures were mistakenly removed and the following basis was developed regarding reportability:

- GL 36-10 states that a single spurious actuation should be postulated in the event of fire in a given fire area. The failure mode for the subject switches in the event of a fire is a hot short, and is considered to be a spurious actuation. Therefore, a fire in the vicinity of the unprotected DG or CO₂ switches would result in only one spurious actuation and, therefore, disable no more than one of the three DGs. Therefore, even with no Thermo-Lag enclosures, the plant design basis may be considered to have been met.

Since the level of plant safety was not reduced and the condition of the plant was not seriously degraded, this condition was determined not to be reportable in accordance with 10 CFR 50.72 and this condition did not adversely affect the health and safety of the public.

7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*

As noted in Section II.C.7., PG&E determined that this condition was not reportable in accordance with 10 CFR 50.72. This determination was based on the following points that PG&E believes give adequate assurance that the ability to transition to Mode 5 was not significantly affected:

- The likelihood of spurious opening of a PORV or auxiliary spray valve is unaffected by the lack of circuit separation due to design features and existing procedural guidance. The lack of circuit separation only impacts the ability to operate the PORVs or auxiliary spray valves

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)				PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	-	REVISION NUMBER		
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	92	-	0 0 1	-	0 1	26 of 33

TEXT (17)

during a controlled RCS depressurization in the transition from Mode 3 to Mode 5.

- To be in accordance with Item 1.b of Appendix R, Section III.G., it must be shown that the valves will remain free from fire damage or can be repaired within 72 hours in order to enable transition to Mode 5.

The ability to cycle Auxiliary Spray Valves 8145 or 8148 can be established through the use of a temporary air jumper arrangement. Abnormal Operating Procedure (OP) AP-8B, "Control Room Inaccessibility - Hot Standby to Cold Shutdown," Appendix D, describes how to use air jumpers to enable closure of Valves 8146 and 8147 to isolate diversion paths for auxiliary spray flow (these are fail-open valves that must be closed to establish the proper lineup for auxiliary spray initiation). With minor modifications, this same jumper arrangement can also allow the cycling of Valves 8145 or 8148, which are located close to 8146 and 8147, to provide auxiliary spray if the control circuits for the PORVs and the auxiliary spray valves were damaged during a fire. The charging valves should be closed using the jumpers (or control room switch, if available) and an air jumper should be used to open and close valve 8145 or 8148.

Though actions to restore auxiliary spray valve or PORV operability were not proceduralized at the time of discovery of the condition, PG&E believes that operators had sufficient capability to determine the cause of the postulated valve inoperability and determine the actions necessary to regain valve operability in order to achieve Mode 5.

- For Areas 3-BB and 3-CC, transient combustible loading is minimal and in situ loading consists primarily of cable. Smoke detection is provided for the cable trays (FA), and these Areas have been provided with hourly fire watches during periods when safe shutdown equipment has been required to be available. Cables associated with the PORVs and auxiliary spray valves are routed in rigid metal conduits. Additionally, a wet pipe sprinkler system is provided.

For Area 6-B-4, transient combustible loading is minimal and in situ loading consists primarily of cable. The redundant PORV and auxiliary spray cables are routed through separate junction boxes and rigid metal conduits. The Area is provided with smoke detection, and has been provided with an hourly fire watch since the beginning of commercial operation.

For Areas 1 and 9, the major combustible loading, the RCPs, is considered not to be a concern for the annular areas because each RCP has automatic wet-pipe sprinkler protection, smoke detection, shield walls, and a lube oil collection system. Also, containment is a high radiation area, and materials (including potential combustibles)

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) D'ABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3) 27 OF 33
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
		92	- 0 0 1	- 0 1	

TEXT (17)

brought into containment are strictly controlled. The subject circuits are inside rigid metal conduits, such that an electrically induced fire in one conduit should not impact any adjacent conduits. Lastly, the annular areas have automatic smoke detection that alarms in the control room, and manual fire suppression, hose reels, and extinguishers are readily available for fire brigade use.

Therefore, given the remote possibility a fire disabling the circuits, and given the 72-hour time frame available to operators to implement the above repairs in conjunction with procedures and equipment available for operation of the adjacent auxiliary spray valves, this condition did not significantly reduce the level of safety. Since the condition of the plant was not seriously degraded, this condition was determined not to be reportable in accordance with 10 CFR 50.72, and the condition did not adversely affect the health and safety of the public.

8. *Emergency Lighting*

As noted in Section II.C.8., PG&E determined that this condition was not reportable in accordance with 10 CFR 50.72. This determination was based on the following points that PG&E believes give adequate assurance that the ability to perform safe shutdown functions was not significantly impaired:

- Most of the actions in the procedures that were identified not to have adequate emergency lighting were actions for which the SSD analysis had not taken credit. Therefore, these actions were not considered essential to achieve safe shutdown and there was no requirement for these actions to have emergency lighting.
- Although emergency lighting may not be available for some post-fire manual actions, the ability to achieve safe shutdown in the event of a fire and concurrent loss of offsite power would still be available due to sound operational practices and alternative means of ensuring operator access and egress. Operators would use flashlights, if required, to perform required manual actions. Steps in procedures required to place the plant in a safe condition would not be bypassed by operators due to a lack of emergency lighting.
- Flashlights have always been available for operator use.
- Hourly roving fire watches have been in effect for the subject areas since the beginning of commercial operation.

Therefore, since only a limited number of required manual actions in EP M-10 and OPs AP-8A and AP-8B did not have adequate emergency lighting, and given that flashlights were available and operators therefore had the ability to complete the actions satisfactorily, this condition did not significantly reduce the level of safety. Since the condition of the plant was not

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3) 28 OF 33
		YEAR	INCIDENTAL NUMBER	REVISION NUMBER	
		92	- 0 0 1	- 0 1	

TEXT (17)

seriously degraded, this condition was determined not to be reportable in accordance with 10 CFR 50.72, and the condition did not adversely affect the health and safety of the public.

V. Corrective Actions

A. Immediate Corrective Actions:

1. *DG 2-1 and 2-2 Field Circuitry*

- a. A continuous fire watch was posted in Fire Area 22-C.
- b. The corresponding Unit 1 fire area was reviewed and was determined not to have a condition similar to that discovered in Unit 2.

2. *SG and RCS Indication Circuitry*

All plant operators were advised regarding the strategy for performing a natural circulation cooldown in the event of loss of SG narrow range level and RCS temperature indication postulated during an Appendix R design basis fire in containment coincident with a loss of offsite power. This strategy involves maintaining the auxiliary feedwater flow (for which indication is not damaged by a containment fire) to all SGs and maintaining the main steam flow (SB) (for which control room control likewise is not damaged by a containment fire) from all the SGs matched as closely as possible. This would allow the level indication on one of the SGs to be used as a relative indication of the level in the SGs with temperature indication but without level indication.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*

4. *DG Control Circuitry*

A continuous fire watch was posted in the Units 1 and 2 cable spreading rooms. The control room is continuously manned by operators, and a Shift Order was issued to identify that the Unit 1 Control Operator would provide the continuous fire watch function for the control room area.

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*

Transient combustibles present at the time of discovery were removed from the fire zone, smoke detectors were determined to

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	29 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

be operable, and an hourly fire watch was posted.

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*

Hourly fire watch tour routes were reviewed to ensure that affected fire areas were being appropriately covered.

7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*

a. Hourly fire watches were verified to be in place for affected areas outside containment.

b. Information was sent to all shift supervisors and shift foremen that described the use of air jumpers to enable remote control of auxiliary spray in the event that control of the auxiliary spray valves and PORVS is not available from the control room.

c. EP M-10 and OPs AP-8A and AP-8B were revised to incorporate the potential need to effect the repair.

8. *Emergency Lighting*

a. A Shift Order was issued to describe the problem.

b. An on-the-spot change was issued to OPs AP-8A and AP-8B to inform operators of the potential need to use flashlights in areas where emergency lighting might not be adequate. Similar guidance was added to EP M-10.

c. The action to perform a quarterly inventory of the HSP equipment locker in accordance with OP AP-8A was revised to include inventory of flashlights.

B. Corrective Actions to Prevent Recurrence:

1. *DG 2-1 and 2-2 Field Circuitry*

a. A design change will be implemented to provide adequate fire barriers to provide circuit separation and obviate the need for a continuous fire watch.

b. A memorandum was issued to NECS electrical and mechanical fire protection personnel regarding this condition and the importance of attention to detail with respect to Appendix

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	30 OF 33
		92	- 0 0 1	- 0 1	

TEXT (17)

R assumptions and implementation.

- c. Since 1986, Appendix R calculations have been performed in accordance with NEMP 3.3, which requires that these calculations be prepared checked, approved, and documented in a thorough and consistent manner.
- d. A review of all DG circuits that could potentially disable a DG due to fire-induced circuit failure was performed. No further unprotected circuits with this capability were identified. There is a possibility that this type of condition could exist elsewhere in the plant; however, the Appendix R Design Basis Documentation Enhancement Project under which this condition was identified is substantially complete and to date no other similar condition has been identified.

2. *SG and RCS Indication Circuitry*

- a. A design change will be implemented to provide adequate Appendix R instrumentation separation.
- b. A memorandum was issued to NECS electrical and mechanical fire protection personnel regarding this condition and the importance of attention to detail with respect to Appendix R assumptions and implementation.
- c. Since 1986, Appendix R calculations have been performed in accordance with NEMP 3.3, which requires that these calculations be prepared checked, approved, and documented in a thorough and consistent manner.
- d. No further unprotected circuits with this capability were identified. There is a possibility that this type of condition could exist elsewhere in the plant; however, the Appendix R Design Basis Documentation Enhancement Project under which this condition was identified is substantially complete and to date no other similar condition has been identified.

3. *Fuse Design for Safe Shutdown Equipment Control Circuitry*

- a. A design change will be implemented to provide adequate fuse isolation.
- b. A memorandum will be issued to NECS electrical and mechanical fire protection personnel regarding this

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1) DIABLO CANYON UNIT 2	DOCKET NUMBER (2) 0 5 0 0 0 3 2 3	LER NUMBER (6)			PAGE (3) 31 OF 33
		YEAR	DECADANTIAL NUMBER	REVISION NUMBER	
		92	- 0 0 1	- 0 1	

TEXT (47)

condition and the importance of attention to detail with respect to Appendix R assumptions and implementation for fuses.

- c. NECS electrical and mechanical fire protection personnel will be trained on Appendix R fuse requirements for design changes as part of the training for E3.6 DC, "Diablo Canyon Power Plant Design Changes."
- d. Procedure EE-2, "Electrical Engineering Procedure For the Review of Electrical DCNs For Impact on 10 CFR Appendix R Electrical Analysis," will be revised to include details of the level of circuit analysis to be performed for Appendix R safe shutdown components.
- e. No further fuses with this capability were identified. There is a possibility that this type of condition could exist elsewhere in the plant; however, to date no other similar condition has been identified.
- f. A review of circuit design for all safe shutdown components credited for operation from remote stations will be performed as a part of the Appendix R Project.

4 *DG Control Circuitry*

- a. A design change will be implemented to provide adequate fuse separation.
- b. A memorandum will be issued to NECS electrical and mechanical fire protection personnel regarding this condition and the importance of attention to detail with respect to Appendix R assumptions and implementation for fuses.
- c. NECS electrical and mechanical fire protection personnel will be trained on Appendix R fuse requirements for design changes as part of the training for E3.6 DL.
- d. Procedure EE-2 will be revised to include details of the level of circuit analysis to be performed for Appendix R safe shutdown components.
- e. No further fuses with this capability were identified. There is a possibility that this type of condition could exist elsewhere in the plant; however, to date no other similar condition has been identified.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	POCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	32 of 33
		92	- 0 0 1	- 0 1	

TEXT (17)

f. A review of circuit design for all safe shutdown components credited for operation from remote station will be performed as a part of the Appendix R Project.

5. *Auxiliary Saltwater Pump and Exhaust Fan Circuitry*

a. A design change will be implemented to provide 3-hour fire wrap for the subject circuits.

b. A memorandum will be issued to NECS electrical and mechanical fire protection personnel regarding this condition and the importance of attention to detail with respect to implementation of Appendix R commitments in design changes.

c. A review of previous Appendix R modifications will be performed to verify that Appendix R commitments were properly implemented.

6. *DG Emergency Stop and CO₂ Switch Circuitry Thermo-Lag Enclosures*

a. The subject DG emergency stop and CO₂ switch enclosures will be replaced with adequate fire retardant enclosures.

b. Procedures for evaluation of non-tested Thermo-Lag configurations are now in place which specify requirements for detailed review and documentation of such configurations.

7. *Power-Operated Relief and Auxiliary Spray Valve Circuitry*

a. A memorandum was issued to NECS electrical and mechanical fire protection personnel regarding this condition and the importance of attention to detail with respect to Appendix R assumptions and implementation.

b. Since 1986, Appendix R calculations have been performed in accordance with NEMP 3.3, which requires that these calculations be prepared, checked, approved, and documented in a thorough and consistent manner.

c. No further SSD analysis assumption errors involving air-operated valve circuits were identified. There is a possibility that this type of assumption has been made elsewhere in the SSD analysis; however, the Appendix R Design Basis Documentation Enhancement Project under which

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	33 of 33
		92	- 0 0 1	- 0 1	

TEXT (17)

this condition was identified is substantially complete and to date no other similar condition has been identified.

8. *Emergency Lighting*

- a. A design change will be implemented to install emergency lighting in areas determined to be deficient.
- b. EP M-10 and OPs AP-8A and AP-8B were cross-checked against the SSD analysis. Permanent emergency lighting will be provided in areas identified not to have adequate lighting where SSD actions are required.
- c. A detailed emergency lighting review has been initiated that will specifically identify manual operator actions which credit emergency lighting and subsequently verify adequacy of lighting of plant areas and access/egress routes for those actions.
- d. NECS review of revisions to OPs AP-8A and AP-8B and Operations Department review of revisions to NECS Calculation M-680 (Appendix R SSD Equipment List) are now required as noted in these documents.

VI. Additional Information

A. Failed Components:

None.

B. Previous LERs on Similar Problems:

None.