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 9

TITLE (4) IMPROPER USE OF SURGE SUPPRESSION DIODES ON THE POST-ACCIDENT SAMPLING SYSTEM 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 (8)
11	06	92	92	- 0 2 6 -	0 1	03	05	93	DIABLO CANYON UNIT 2	0 5 0 0 0 3 2 3
										0 5 0 0 0

OPERATING MODE (9)	3
POWER LEVEL (10)	0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)

X 10 CFR 50.73(a)(2)(ii)(B)

____ OTHER - _____

(Specify in Abstract below and in text, NRC Form 366A)

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER AREA CODE	TELEPHONE NUMBER
DAVID SOKOLSKY, SENIOR NUCLEAR GENERATION ENGINEER	415	973-9717

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
| | YES (if yes, complete EXPECTED SUBMISSION DATE)	|X| NO				

ABSTRACT (16)

On November 6, 1992, at 1745 PST, with Unit 1 in Mode 3 (Hot Standby) at 0 percent power and Unit 2 in Mode 1 (Power Operation) at 100 percent power, PG&E determined that surge suppression diodes used in electrical control circuitry for several solenoid valves were not adequate for operation under post-accident conditions and that diode failure could impact operability of the post-accident sampling system (PASS). Technical Specification 6.8.4.e implies that the PASS should be operable. A one-hour, non-emergency report was made to the NRC for Units 1 and 2 on November 6, 1992, at 1803 PST, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

The root cause for this event was personnel error, cognitive, in that the design engineers did not take the required steps to assure that all equipment (diodes) could function in the conditions required (high radiation and/or steam).

The diodes were removed from the affected solenoid valves. Class I solenoid valves with diodes in post-accident harsh environments are being reviewed to ensure that secondary (nonsafety-related) functions will be operable when required. Design Class II equipment needed to be operable in post-accident harsh environments will be reviewed for operability. The applicable drawing and Design Criteria Memoranda now contain guidance regarding use of components in post-accident harsh environments.

I. Plant Conditions

Units 1 and 2 have operated in all modes and at various power levels with the condition described below. At the time of discovery of the event, Unit 1 was in Mode 3 (Hot Standby) at 0 percent power and Unit 2 was in Mode 1 (Power Operation) at 100 percent power.

II. Description of Event

A. Summary:

On November 6, 1992, at 1745 PST, with Unit 1 in Mode 3 (Hot Standby) at 0 percent power and Unit 2 in Mode 1 at 100 percent power, PG&E determined that surge suppression diodes used in electrical control circuitry for several solenoid valves were not adequate for operation under post-accident conditions and that diode failure could impact operability of the post-accident sampling system (PASS) (IP). Technical Specification (TS) 6.8.4.e implies that the PASS should be operable. A one-hour, non-emergency report was made to the NRC for Units 1 and 2 on November 6, 1992, at 1803 PST, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

B. Background:

NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short Term Recommendations," was issued on July 1, 1979. NUREG-0737 "Clarification of TMI Action Plan Requirements," was issued on October 31, 1980. The NUREGs require the following:

- Capability to promptly obtain a sample under accident conditions without incurring a radiation exposure to any individual in excess of 5 rem to the whole body and 75 rem to the extremities.

- Capability to promptly quantify certain radionuclides in the sample that are indicators of the degree of core (AC) damage. Such radionuclides are noble gases (which indicate cladding (AC) failure), iodines and cesiums (which indicate high fuel temperatures), and nonvolatile isotopes (which indicate fuel melting). The combined time for sampling and analysis should be 3 hours or less from the time a decision is made to take a sample.

- Procedures shall be provided to perform boron and chloride chemical analyses assuming a highly radioactive initial sample (Regulatory Guide 1.4 source term).

On February 26 and March 13, 1981, PG&E submitted documentation of actions to be taken at Diablo Canyon Units 1 and 2 to implement items from NUREG-0578 and 0737, which included a discussion of the actions

PG&E was taking to install a PASS for each unit to meet the requirements of NUREG-0737, Item II.B.3, "Post Accident Sampling Capability." As noted in the PG&E submittals, the PASS was design Class II (i.e., nonsafety-related).

In Supplemental Safety Evaluation Report (SSER) 14, page 3-12, issued April 1981, the NRC stated that "based on our evaluation, we find that the design meets the requirements of NUREG-0578, 0737 and Regulatory Guide 8.8 and is therefore acceptable."

Further, TS 6.8.4.e, "Administrative Controls, Post Accident Sampling," requires a program for (a) training of personnel, (b) procedures for sampling and analysis, and (c) provisions for maintenance of sampling and analysis equipment, as required in Item 2 in Generic Letter 83-37, "NUREG-0737 Technical Specifications."

C. Event Description:

During implementation of the corrective actions for LER 1-92-015, "Inadequate Maintenance of Hosgri Report Commitments" (DCL-92-198, dated September 11, 1992), reactor coolant system (RCS) (AB) hot leg sample inlet valves 9351A and 9351B (IP)(SMV) were reviewed for seismic qualification. These air-operated valves are used to obtain an RCS sample during normal and post-accident operation. In addition, these valves provide the capability to obtain an RCS sample to verify boron concentration after a postulated Hosgri earthquake. While NUREG-0737 did not require seismic qualification of the PASS, a previous commitment in the Hosgri Report required that valves 9351A and 9351B be seismically qualified to ensure the capability to collect the RCS sample for boron concentration measurement after a Hosgri earthquake.

Solenoid valves SV-371 and SV-372 provide control air to the operators for valves 9351A and 9351B. When the electrical control circuitry for SV-371 and SV-372 was reviewed, surge suppression diodes across their leads were identified inside containment (NH). Although the PASS is design Class II and would not require formally documented environmental qualification (EQ) under PG&E's 10 CFR 50.49 program, the valves are required to be operable in post-accident conditions.

Because the diodes were not capable of long-term operation in a harsh environment, a review was conducted to determine which PASS sample lines are required for post-accident use. In addition to SV-371 and SV-372, solenoid valves SV-381 and SV-382 for residual heat removal (RHR) (BP) outlet sample valves 9353A and 9353B, which are located outside containment in a harsh (radiation-only) environment, were also identified as having diodes across their leads. On October 28, 1992, PG&E management was apprised that a concern existed. Design changes were issued on November 2 (Unit 1) and November 5 (Unit 2) to remove the solenoid valve diodes while investigation continued.

PG&E determined that if the diodes were subjected to a harsh environment, the solenoid valves may not be capable of operation, thus preventing operation of the associated sample valves. Therefore, the PASS might not have been able to collect post-accident RCS hot leg and RHR outlet samples, contrary to system design basis. On November 6, 1992, at 1745 PST, PG&E conservatively determined that although the PASS was design Class II, TS 6.8.4.e implies that the PASS should be operable; therefore, the PASS was considered to be outside of its system design basis. Therefore, a one-hour, non-emergency report was made to the NRC for Units 1 and 2 on November 6, 1992, at 1803 PST, in accordance with 10 CFR 50.72(b)(1)(ii)(B).

Further investigation following identification of the diode issue determined that an additional concern existed. Solenoid valve SV-327 for the outside containment isolation valve (CIV) 9356B on the RCS hot leg sample line and SV-314 for outside CIV FCV-681 on the sample return line were found to have diodes across their leads. In addition, solenoid valve SV-312 for FCV-679 (a non-PASS outside CIV) was found to be electrically tied to SV-314 for FCV-681; failure of the SV-312 diode could also affect operation of FCV-681. These diodes outside containment are exposed to a radiation environment only after initiation of RHR recirculation. While failure of the diodes would not prevent the CIVs from performing their containment isolation safety function, their failure could prevent re-opening of the valves to obtain post-accident samples (9356B), or return samples to containment (FCV-681). Design changes were issued on November 13 to remove the three solenoid valve diodes for each unit.

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

None.

E. Dates and Approximate Times for Major Occurrences:

1. February 26 and March 13, 1981: PG&E letters to the NRC committed to NUREGs 0578/0737.

2. April 1981: NRC issued SSER 14 accepting PG&E's PASS design.

3. October 28, 1992: Diodes on SV-371, 372, 381, and 382 were determined to not be adequate for post-accident conditions.

4. November 6, 1992 at 1745 PST: Event/Discovery Date: Diodes were determined to impact PASS operability.

5. November 6, 1992, at 1803 PST: One-hour, non-emergency report was made for Units 1 and 2 in accordance with 10 CFR 50.72(b)(1)(ii)(B).

F. Other Systems or Secondary Functions Affected:

None.

G. Method of Discovery:

This event was identified during a review for seismic qualification of valves 9351A and 9351B as a part of LER 1-92-015 corrective actions. Valves 9351A and 9351B are required to be seismically qualified to enable obtaining an RCS liquid sample for verification of boron concentration. While reviewing the associated solenoid valve circuitry, the diodes were noted and further investigated because of other identified concerns with diodes in a post-accident environment (see Section VI of this LER).

H. Operator Actions:

None.

I. Safety System Responses:

None.

III. Cause of the Event

A. Immediate Cause:

Use of surge suppression diodes in the PASS that were not adequate for operation under post-accident conditions.

B. Root Cause:

Personnel error, cognitive, in that the design engineers did not take the required steps to assure that all equipment (diodes) could function in the conditions required (high radiation and/or steam). Standard PG&E design practice has been to install diodes to reduce electronic noise and minimize contact pitting. However, at the time of installation of the PASS, design engineers did not recognize that diodes could fail in a harsh environment, which could result in loss of PASS liquid sampling function.

C. Contributory Cause:

The following contributory causes were identified:

1. The original PASS Design Criteria Memorandum (DCM) M-28, "Post-LOCA Sampling System," did not explicitly identify that some PASS components would be required to operate in a post-accident harsh environment.

2. The Diablo Canyon electrical design drawing that shows typical solenoid valve diode installation details did not have adequate guidance regarding use of diodes in post-accident harsh environments.

3. While the primary function of the affected design Class I containment isolation valves was adequately reviewed to assure that their safety-related isolation function could be completed, the secondary nonsafety-related PASS sampling function of these valves was not adequately reviewed.

4. PG&E design Class II PASS equipment in a post-accident harsh environment was not adequately reviewed to ensure that there was sufficient assurance that the equipment would be able to operate under post-accident conditions.

IV. Analysis of the Event

The diodes were mounted across the solenoid coils (IP)(CL) for PG&E-supplied DC solenoid valves that support the PASS operation. Seven of the valves are discussed in detail because they represent the set that are considered to be essential to the collection and return of RCS post-accident samples. Three valves, 9356B, FCV-679, and FCV-681, are outside CIVs. The remaining four valves, 9351A and B and 9353A and B, are used only for obtaining samples. Valves 9351A and 9351B are located inside containment and 9353A and 9353B are located outside containment. For post-accident conditions, the diodes are assumed to fail worst-case to complete short, which could cause the associated fuses (IP)(FU) to blow and remove the power source (IP)(JX). Failure of the diode "open" simply removes the diode from the solenoid circuit and has no affect on system operability.

Prior to their removal, the existence of the diodes would not have had any affect on the ability of the CIVs to close to isolate containment. These CIVs are located outside of containment and will be subject to a harsh (radiation-only) environment after the onset of RHR recirculation. Although diodes would be expected to survive for up to 1 hour of radiation exposure at the exposure rates postulated for their location, all of the CIVs would have already closed on the appropriate isolation signal prior to initiation of RHR recirculation. Should a valve not already be closed, diode failure (short) will cause the valve to go to its designed fail-safe closed

position.

Diode short-circuit failure could have prevented subsequent operation of the valves for PASS sampling purposes. Failure of 9351A and B and 9356B to open would have prevented collection of an RCS hot leg sample via this path. Failure of 9353A and B to open would have prevented collection of a sample from the RHR outlet. Failure of FCV-681 to open (and FCV-679 because it is electrically tied to 681) would have prevented returning the liquid samples to containment. While other methods for disposing of sample fluids may exist (e.g., the post-LOCA sample collection tank), there is no proceduralized method for use, and radiological concerns would have to be resolved before they could be used. Therefore, it is conservatively assumed that the capability to return a sample might not have been available.

The PASS is not safety-related. The liquid sampling capability is used to obtain detailed information on the condition of the reactor fuel, fuel cladding, and coolant, not directly for accident mitigation. A number of other indications of core conditions exist, including the reactor vessel level indication system, the subcooled margin monitor (JD), and incore thermocouples (JD); these systems are environmentally qualified. Sample collection is in accordance with Emergency Procedure RB-14, "Core Damage Assessment Procedure." By this procedure, a preliminary assessment of clad failure/core damage would have already been completed using available information, for example, containment area radiation monitors (IK)(MON) and containment hydrogen monitors (IK)(MON) (both are environmentally qualified). A containment air sample would have been obtained for PASS analysis (all valves in this path are qualified). RCS boron concentration may be calculated using tank [refueling water storage tank (BP)(TK), accumulator tank (BP)(ACC)] parameters.

Based on the above discussion, it is concluded that, while plant operators might not have had as accurate a picture of reactor and reactor coolant conditions as they would have with analysis of an RCS liquid sample, they would have had sufficient information to allow continuation of accident mitigation and recovery activities. Therefore, the inability to obtain RCS samples by the above paths would not have had a significant affect on the ability to mitigate and recover from any postulated accident. Thus, this event has in no way affected the health and safety of the public.

V. Corrective Actions

A. Immediate Corrective Actions:

1. Design changes were implemented to remove diodes from the seven solenoid valves on each unit.

2. Class I solenoid valves having diodes in post-accident harsh environments will be reviewed to ensure that no other secondary functions (nonsafety-related, but required to be operable in a post-

accident harsh environment) have been overlooked.

3. A review was performed that confirmed that the PASS (specifically the RCS hotleg, RHR outlet, containment air, and sample return paths) and the external hydrogen recombiners (BB)(RCB) are the only Class II systems/subsystems required to be operable in a post-accident harsh environment.

4. A review will be conducted to identify all components in the PASS and external hydrogen recombiner flow paths needed to be operable and then to assure that these components will remain operable in post-accident harsh environments.

B. Corrective Actions to Prevent Recurrence:

Substantial additional detail in current design processes and practices would be expected to preclude similar events in the future. In addition, the following actions have been taken:

1. DCM S-11, "Nuclear Steam Supply Sample System," which replaced DCM M-28 for the PASS, now states that portions of the PASS are required to operate in a post-accident harsh environment.

2. In response to previously identified diode issues (see Section VI), PG&E's new DCM T-23,"Miscellaneous Electrical Devices," now includes precautionary notes regarding the use of diodes in harsh environments. Also, the electrical design drawing has been revised to include a note regarding the use of diodes in a harsh environment.

VI. Additional Information

A. Failed Components:

None.

B. Previous LERs on Similar Problems:

LER 1-88-028-01 "Entry Into Technical Specification 3.0.3 When Two of Four Main Steam Isolation Valves Were Inoperable due to Inadequate Environmental Qualification of Electrical Connections"

The root cause of this event was personnel error, cognitive, in that the surge suppressor used within the main steam isolation valve (MSIV) (SB)(FCV) solenoid control valves electrical connections was not addressed in EQ files. The MSIVs were unique in that the solenoid valves were required to actuate to achieve their safety position rather than failing to a safety position. Corrective actions were limited to environmentally qualified Class I components outside containment

required to actuate to achieve a safety position and did not extend to any secondary actions that components might be required to take following achievement of the safety position. Therefore, the corrective actions would not have prevented the events described in this LER.

LER 2-92-005-01 "Use of Environmentally Unqualified Surge Suppression Diodes in the Auxiliary Building Ventilation System due to Personnel Error"

The root cause of this event was personnel error, in that the effects of diode failure were considered only in regards with the damper fail-safe design. This resulted in an incomplete analysis that allowed the subject diodes to be excluded from the EQ program. Corrective actions taken included a review of solenoid valve installations required to be environmentally qualified under PG&E's 10 CFR 50.49 program, addition of precautionary notes regarding the future use of surge suppression diodes, and issuing a lessons learned memorandum to design engineering. The corrective actions for LER 2-92-005 are still ongoing, and have been reassessed in conjunction with this LER.