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November 13, 1995

PG&E Letter DCL-95-246

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Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to NRC Request for Additional Information on the Diablo Canyon Individual Plant Examination of External Events Report

Gentlemen:

Enclosed are responses to NRC questions sent to PG&E on September 6, 1995, requesting additional information on the Diablo Canyon Individual Plant Examination of External Events Report that was sent to the NRC on June 27, 1994, in PG&E Letter DCL-94-133. A conference call was held on September 19, 1995, between PG&E and NRC personnel to clarify the request for information. The enclosed responses incorporate the results of the conference call discussions.

Please let me know if you need further clarification on any of the responses.

Sincerely,

Gregory M. Rueger

cc: Steven D. Bloom
L. J. Callan
Kenneth E. Perkins
Michael D. Tschiltz
Diablo Distribution

Enclosure

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ENCLOSURE

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION ON THE DIABLO CANYON INDIVIDUAL PLANT EXAMINATION OF EXTERNAL EVENTS (IPEEE) REPORT

On June 27, 1994, PG&E submitted the IPEEE Report for Diablo Canyon Power Plant (DCPP) Units 1 and 2 in response to Generic Letter 88-20, Supplement 4. On September 6, 1995, the NRC requested additional information on the IPEEE Report. A conference call was held on September 19, 1995, between PG&E and NRC personnel to clarify the request for information. The NRC questions and PG&E responses are provided below.

I. Seismic

1. *Please provide a list of all elements of the Diablo Canyon seismic IPEEE which have changed since the LTSP, including changes in scope, changes in methods/analysis, changes in walkdown effort and findings, and any others changes that affect the seismic IPEEE procedures or results.*

   PG&E Response

   The changes to the DCPP seismic PRA since completion of the Long Term Seismic Program (LTSP) in 1991 are generally minor in nature and are summarized below.

   Changes in the DCPP seismic PRA scope include enhancement of the containment performance portions of the seismic PRA model (several specific changes that effect containment performance are identified below), and a review of the DCPP design changes since completion of the LTSP (see table below).

   The changes in methods/analyses were associated with using an updated version of the PRA software. The updated software allows seismic and non-seismic component failures to be separated into separate top events. Most of the seismic component and structural failures are modeled in seismic top events in a separate seismic event tree, which was not used in the LTSP. This is a minor change in methods, which allows easier interpretation of results, but the change does not alter the modeling assumptions. The updated software also uses Monte Carlo simulation for the uncertainty analysis rather than discrete probability arithmetic, which has no impact on the results.

   The IPEEE seismic walkdown confirmed the results of extensive design/construction and LTSP walkdowns. PRA engineers, civil engineers, and equipment qualification

engineers familiar with the LTSP were part of the walkdown team. The walkdown scope included structures and components in both units. No walkdown findings were made that changed any results from the LTSP.

There were other changes associated with assumptions made in the seismic PRA that resulted from peer review and other sources (see also response to Question 5). The changes in assumptions include the following:

- For all seismic events, it is now assumed that a very small LOCA is induced in the reactor coolant system (as explained in Section 3.1.3.7 of the IPEEE Report). This assumption requires charging pump injection to be successful to mitigate the very small LOCA.

- Seismic failure of the containment fan cooler units (CFCUs) is now assumed to lead to a containment bypass, in addition to component cooling water (CCW) failure (as explained in Section 3.1.6.2 of the IPEEE Report).

- Seismic failure of the steam generators is now assumed to fail containment (as explained in Section 3.1.6.2 of the IPEEE Report).

- The containment spray header was assigned a piping segment fragility to model the potential for header failure.

- In order to simplify the analysis while maintaining confidence in the predicted failure rates, the IPE human action failure rates were divided into two groups to model the reduced human reliability following a seismic event (as explained in Section 3.1.3.4 of the IPEEE Report). Those human actions that have a small effect on core damage were conservatively increased by a factor of 30 for all seismic levels. Human actions that have a larger effect on core damage were increased by three different multiplication factors (1, 5, and 30) depending on the seismic level. The division of the human actions into two groups is different than the LTSP approach, which applied the three multiplication factors for all human actions.

Changes to the non-seismic basis model used for the seismic PRA were made to incorporate the addition of a sixth diesel generator at DCPP, to include updated plant-specific data, and to include other minor changes to the non-seismic portion of the PRA model.

Changes in fragilities that have a minor impact on seismic risk were made to reflect updated calculations and design changes since completion of the LTSP. These changes have a minor impact on risk because the fragility is high or because other failures must occur to cause core damage. The updated fragilities are summarized as follows:

DESCRIPTION OF CHANGE	LTSP MEDIAN FRAGILITY	IPEEE MEDIAN FRAGILITY
REFUELING WATER STORAGE TANK	9.92	9.54
CONTAINMENT SPRAY PUMPS	8.65	6.00
DG CONTROL PANEL CHATTER	7.77	5.00
BLOCK WALLS	6.39	6.79

NOTE: Fragilities are given in median spectral acceleration of 3-8.5 Hz.

2. *Please provide a list of any differences between Unit 1 and Unit 2 which may affect the seismic IPEEE. Please indicate whether or not seismic walkdowns were performed on both units; was the scope of seismic IPEEE walkdowns the same for both units? What differences were noted in walkdowns in terms of unit configuration and condition?*

PG&E Response

A single model and a single set of component fragilities were used to model both DCPP Units 1 and 2. No significant differences have been identified in the plant systems or structures that would make the PRA logic model, i.e., the system fault tree or event progression, different for the two units. However, there may be small differences in fragilities between the units. The LTSP walkdowns and analyses of fragilities initially evaluated components and structures of both units, and then detailed fragility analyses were performed for the limiting component or structure of the two units. This practice of selecting the more limiting fragility accounts for all unit differences by making the seismic analysis conservative for either Diablo Canyon unit. In summary, there are some differences between the units, none are significant, and the PRA utilizes the more conservative design details so that the results bound both units.

The IPEEE walkdowns were confirmatory of seismic capability. Structures and components from both units were included in the IPEEE walkdown.

3. *The seismic initiating event frequencies reported in the third column of Table 3-5 do not match differences in exceedance frequencies reported in Table 3-2. Please explain the process that was used for deriving seismic interval frequencies.*

PG&E Response

A review of Table 3-2 (which is repeated below) and Table 3-5 does show that there are inconsistencies between the seismic initiating event values for SEIS1 to SEIS6 listed in Table 3-5, compared to the seismic exceedance frequencies reported in Table 3-2. The inconsistencies occur because the Table 3-5 values for the initiating event frequencies came from an earlier analysis (that had some values that were incorrect in the eight hazard curves listed in Table 3-1), instead of being determined by RISKMAN from the corrected full family of eight hazard curves listed in

Tables 3-1 and 3-2. The table below presents the seismic initiating event values for SEIS1 to SEIS6 and the change in core damage frequency (CDF) that result from using the corrected hazard curves in Tables 3-1 and 3-2. The corrected mean initiating event values for SEIS1 to SEIS6 determined by RISKMAN from the eight hazard curves will be used in future quantifications of seismic risk.

The uncertainty analysis correctly used the eight hazard curves.

Since the CDF results from using the new seismic initiating event values are similar, and the important seismic sequences and vulnerabilities are identical to the IPEEE Report results, the qualitative conclusions drawn from the seismic portion of the IPEEE Report remain valid.

IPEEE TABLE 3-2
MEAN SEISMIC HAZARD FREQUENCY TABLE

ACCELERATION	.200	.500	.800	1.000	1.200	1.500	2.000	2.500	3.000	4.000
EXCEEDANCE FREQUENCY	1.85E-02	7.44E-03	3.56E-03	2.19E-03	1.35E-03	6.26E-04	1.61E-04	3.73E-05	7.89E-06	2.42E-07

IPEEE TABLE 3-5 (CORRECTED)

SEISMIC INITIATING EVENT	IPEEE SUBMITTAL VALUES		RISKMAN DERIVED VALUES FROM HAZARD CURVES		CHANGE IN TOTAL CDF DUE TO INITIATING EVENT
	INITIATOR FREQUENCY	CDF	INITIATOR FREQUENCY	CDF	
SEIS1	1.41E-2	4.70E-6	1.72E-2	5.73E-6	+2.6%
SEIS2	8.00E-4	4.28E-6	8.69E-4	4.65E-6	+0.9%
SEIS3	1.47E-4	4.03E-6	1.56E-4	4.28E-6	+0.6%
SEIS4	1.17E-4	1.05E-5	1.24E-4	1.11E-5	+1.5%
SEIS5	2.82E-5	1.05E-5	2.94E-5	1.10E-5	+1.3%
SEIS6	7.43E-6	5.40E-6	7.64E-6	5.55E-6	+0.4%
TOTAL	1.52E-2	3.94E-5	1.84E-2	4.23E-5	+7.4%

NOTES:
1. SEIS1 frequency is for seismic events between 0.2 g and 1.25 g since no seismic failures are predicted below 0.2 g.
2. The IPEEE rounded up the total seismic CDF to 4.0E-5.
3. Round off is included in initiator frequency total.

A semi-logarithmic interpolation must be performed to determine the seismic initiating event frequencies for SEIS1 to SEIS3 in Table 3-5 (corrected) using the values from Table 3-2. Direct subtraction can be used to determine the SEIS4 to SEIS6 values in Table 3-5 (corrected) using the values from Table 3-2.

4. *Although the submittal says that DCPP is a rock site, it also suggests that some IPEEE components may be embedded in soil, or affected otherwise by soil. For instance, the diesel generator fuel transfer tanks are said to be underground; hence,*

transfer lines may be buried in soil. [9/19/95 NRC Clarification: Please identify all components (including interaction potential) affected by soil and explain the significance of potential soil failures to their seismic reliability.]

PG&E Response

Several IPEEE components are buried and are not supported directly by rock. The diesel fuel oil storage tanks (>10 g median fragility) were analyzed with a finite element computer program that considers the soil-structure interaction. The fuel oil transfer lines were evaluated using the results of the buried tank model. The analysis of the buried auxiliary saltwater pipelines considers that they are restrained by the concrete circulating water intake conduit that was poured on rock in an excavated trench. The 230 kV switchyard fragility is based on actual seismic performance of switchyards that have soil support (the 500 kV switchyard is not modeled because its failure alone will not cause loss of offsite power). All other IPEEE components and structures are supported by rock.

5. *What were the reviewers findings/comments related to the containment performance assessment? What peer review was made of revisions and additions to fragility calculations?*

PG&E Response

During development of the seismic analysis, there were three comments that resulted in the addition of new failure modes to the containment performance analysis.

1. As part of the analysis process, the modeling of the failure of the steam generators as a cause of containment failure was reviewed. As a result of this review, it was decided to assume that steam generator seismic failure would cause containment failure. This is further explained in the IPEEE Report, Section 3.1.6.2.

2. During the analysis process it was postulated that failure of the CFCU connection to the CCW piping may create a containment bypass, i.e., a small containment failure. This postulation was evaluated and determined to be viable. This failure was included in the model and is described in Section 3.1.6.2 of the IPEEE Report.

3. The containment spray header piping system was assigned a piping segment fragility to model the potential for header failure causing system failure. Failure of the containment spray system increases the potential for containment failure since one of two containment heat removal means has failed.

Some fragilities were changed or added as part of the IPEEE. These changes in fragilities were documented in calculations that were independently reviewed by a technically qualified peers. Additionally, the fragilities were reviewed by a number of peers inside and outside the company as part of their review of the IPEEE Report (see IPEEE Report Table 6-1).

Other comments pertaining to the containment performance assessment were editorial in nature.

Unresolved Safety Issue A-45

6. *The DCPP IPEEE submittal states that the only source of water credited for AFW function is the condensate storage tank (CST). If this is the case, why isn't the CST mentioned in Section 3.2.1 of the submittal and included in the table at the bottom of page 3-22? Please provide the seismic fragility for the CST.*

The CST was evaluated in the early phases of the LTSP fragility analysis and determined to have a median fragility of greater than 10 g spectral acceleration. Components determined to have a median fragility of greater than 10 g were generally not modeled since they have an insignificant contribution to core damage. Since the CST seismic contribution to core damage is insignificant, it was not modeled and not specifically mentioned in Section 3.2.1, nor the table at the bottom of page 3-22.

Seismic-Fire Interactions

7. *On page 4-108, the submittal states: "If one of these deluge systems were to actuate, it could result in an initiating event, but the frequency of occurrence would be small compared to the regular initiating event frequencies for these initiators." Many factors contribute to risk importance other than the initiating event frequency. Please provide an assessment of how actuation of the deluge systems during a seismic event would impact overall risk. This assessment should include the consideration of potential water damage in parallel with other seismic damage.*

PG&E Response

As mentioned in Section 4.8.1.2 of the IPEEE Report, fire water deluge systems are only used in a few select places in the plant. DCPP has deluge valves for protection of the following systems or components:

- turbine bearings
- hydrogen seal oil unit
- main feedwater pump turbines

- lubè oil reservoir
- main and startup transformers

None of these systems or components is safety-related, and only the startup transformers are modeled in the PRA. All seismic events considered in the seismic PRA are assumed to result in a demand for a reactor trip/turbine trip. There would be no additional risk impact from inadvertent actuation of any of the deluge systems, with the possible exception of the deluge system protecting the startup transformer (which is addressed below). There would be no adverse impact on safety systems in the proximity of the deluge system from deluge system spray or flooding.

Although unlikely, it is possible for inadvertent actuation of the deluge valves protecting the startup transformers to result in loss of 230 kV offsite power. Inadvertent actuation of fire water systems on the startup and main transformers was considered as part of the LTSP. It was judged that the deluge systems around the main and startup transformers have high seismic capacity relative to the switchyard, which is limiting, compared to the lower fragility of the switchgear equipment, and that they would not significantly contribute to the seismic loss of offsite power.

Additionally, the deluge system nozzles are directed at the transformers themselves; they are not directed at the insulators on the transformers. Thus, it is unlikely 230 kV offsite power would be lost even with seismically induced inadvertent discharge of the 230 kV deluge system.

8. *Concerning the second paragraph on page 4-108 of the submittal, please explain the findings of the walkdown team with respect to the three walkdown goals mentioned.*

<u>PG&E Response</u>

The three walkdown goals mentioned in Section 4.8.1.2 (page 4-108) were to:

- visually verify, where possible, the train separation for safety-related equipment with respect to wet-pipe sprinkler coverage

- verify the absence of fire water deluge system impact on safety-related equipment

- verify the presence and distribution of drains in relation to both types of fire water systems

The walkdown aided in understanding the physical layout of the fire suppression systems and the potential for equipment damage from actuation of the fire

suppression systems. The walkdown team was able to visually observe the separation of safety-related equipment with respect to wet-pipe sprinkler systems, although not every wet pipe sprinkler was examined. The walkdown team observed the deluge systems in the vicinity of safety-related systems and confirmed that they would not affect safety-related systems. Finally, the walkdown team observed the room drains in rooms where safety-related equipment is located. Examples of the observations noted during the walkdown are:

- The walkdown team noted and photographed the close proximity of the two motor-driven auxiliary feedwater pumps, which are protected by wet pipe sprinklers, but the team also noted the turbine-driven auxiliary feedwater pump was located in a separate room. It was concluded that the turbine-driven auxiliary feedwater pump would not be subject to possible failure from wet pipe sprinkler actuation.

- The physical separation of the CCW pumps, which are protected by wet pipe sprinklers, was observed. The CCW pumps are separated by walls, so actuation of one wet pipe sprinkler would not affect more than one CCW pump. It was noted that there is a heat concentrator near the sprinkler head because the ceiling is high. The room drains were observed and photographed. On the CCW pump, a label was noted that stated "gasket on this motor terminal enclosure required at all times to prevent water from entering." The requirement for a gasket provides some degree of water exclusion capability.

9. *According to the IPEEE submittal, relay panels are located in the cable spreading room. Therefore, seismically-induced electrical panel fires pose a potential risk-significant fire scenario. Were these cabinets considered as a seismically-induced fire source? If so, please provide the analysis.*

<u>PG&E Response</u>

As mentioned in Section 4.3.1 (page 4-32) and Section 4.4.2.3 (page 4-44), there are relays located in the cable spreading room of the DCPP auxiliary building at the 128 foot elevation. The potential for a seismically induced fire was not considered for these relays. The fragilities of the relays and associated racks, panels, or cabinets have a limiting failure mode fragility of greater than 10 g peak spectral acceleration. This assessment included all failure modes, including those initiated by fires within panels. The assessment was for the auxiliary relay racks and the process control and protection system located in the auxiliary building at elevation 128 feet. This median failure capacity is high enough that failure can be considered negligible. Thus, these components would not be susceptible to seismically induced fires.

10. *Mechanisms for diesel failure given seismically-induced actuation of the automatic CO_2 fire protection system have been identified. These mechanisms include diesel generator lockout due to relay chatter in the FPS controller and starvation of the diesel generator if its air intake is within the diesel generator room. Provide an analysis of the potential for diesel generator failure given seismically-induced spurious actuation of the CO_2 FPS.*

PG&E Response

The diesel generator rooms are protected by an automatic carbon dioxide fire protection system. At DCPP, no control signal is sent to the diesel generator upon carbon dioxide actuation. Thus, there is no mechanism for diesel generator lockout as a result of carbon dioxide actuation.

The impact of carbon dioxide actuation on the diesel generators has been previously evaluated. The diesel generators will have sufficient combustible air following carbon dioxide actuation because the air intake is located high in the room and the CO_2 will stratify near the floor. Seismically induced actuation of the diesel generator carbon dioxide fire protection system was evaluated by PG&E in response to ACRS questions during their review of the LTSP. PG&E told the ACRS that temperature switches that actuate the carbon dioxide system are isolated by a seismically qualified lockout rotary relay, which is not susceptible to relay chatter. Given a carbon dioxide actuation, the diesel generator would not fail provided the fire doors remain open. The roll-up fire doors, which are seismically qualified, are actuated by either a fusible link or a frangible link. The fusible link has a high seismic capacity. Therefore, door closure due to seismically induced failure of the fusible link would be very unlikely. The frangible link is actuated by thermal expansion of an electrically heated cylinder. The thermal expansion causes the link to fracture. The control circuit for the frangible link consists of bimetallic temperature switches and a solid-state actuation device. The temperature switches and the solid-state actuation device are unlikely to actuate in a seismic event due to their rugged design, although a fragility was not developed.

II. Fire

1. *The study appears to claim that, because fire boundaries will act as rated, interzonal fires will only occur if a fire door is left ajar or if a fire damper fails to close. This appears to be a case where an assumption can potentially drive the results. Such an analysis is not valid unless the assumption is adequately justified and it can be demonstrated that there are no paths through the barrier for the spread of damage. Provide such justification and demonstration for high-hazard fire areas such as the turbine building, diesel generator rooms, cable spreading rooms, switchgear rooms, and lube oil storage areas.*

PG&E Response

The Fire PRA did not claim that because fire boundaries will act as rated, interzonal fires will only occur if a fire door were left ajar or if a fire damper failed to close. The Fire PRA limited the examination of interzonal fires via doors that are left ajar, via fire dampers that fail to close, and via permanent openings (e.g., gratings and hatches), because they are the dominant propagation pathways for propagation scenarios.

In the Fire PRA, localized scenarios were postulated for each location that is susceptible to fire risk. Fire and smoke propagation pathways were identified for each location. If there was a credible propagation pathway, a propagation scenario was postulated.

The Fire PRA concluded that the dominant fire propagation scenarios (over 80 percent of the fire related CDF) are localized fires (control room fires, cable spreading room fires, or fires with the potential to disable the auxiliary feedwater or auxiliary saltwater systems). The only major propagation scenarios are those that cause loss of Buses F and G. These findings would not be significantly altered by considering the unanalyzed propagation pathways because of the conservative values used for propagation through doorways in the dominant propagation scenarios.

Although fire and smoke propagation via penetration seals, floors, walls and ceilings were not explicitly modeled, these potential propagation pathways were considered to be bounded by the pathways explicitly included in the analysis (i.e., door, stairway, or HVAC duct and damper). This assumption is valid for the Fire PRA for the following reasons:

- The fire analysis conservatively assumed that the unavailability of fire doors (door left open) and fire dampers (fire damper fails to close) is 0.1 (typically). This assumption is conservative compared to the suggested data in NUREG/CR-4840 (page 4-15, Table 4.4) for failure to close a damper (2.7E-3) or a fire barrier door (7.4E-3). Furthermore, as a result of a PLG (PLG, Inc., a consultant to PG&E) review of their proprietary fire events database, there has been no severe fire-induced damage due to fire propagation through a rated wall, ceiling, floor, and penetration seal. Therefore, doors and dampers are considered to be dominant fire propagation pathways for a given location, and the likelihood of propagation through the unanalyzed propagation paths is bounded by these dominant fire propagation pathways that have an assumed unavailability of 0.1 (doors and dampers).

- Localized fire scenarios were developed for the high-hazard areas listed in the question (turbine building, diesel generator rooms, cable spreading rooms, switchgear rooms, and lube oil storage areas). Propagation scenarios were

developed if fire propagation through the dominant credible pathways (e.g., door, damper) were deemed to be valid. In many cases, even if propagation through a rated wall, ceiling, floor, and penetration seal were to result in a previously unanalyzed fire scenario, the resultant risk impact would be bounded by the localized fire scenario.

- The FSAR Update, Appendix 9.5A (Diablo Canyon Power Plant Units 1 and 2 Fire Hazards Analysis) documents the amount of in-situ and transient combustible loadings in each fire area, fire severity, and the propagation pathways between fire areas. A review was performed for the high-hazard areas (turbine building, diesel generator rooms, cable spreading rooms, switchgear rooms, and lube oil storage areas) specified in the question. As a result of this review, no new risk significant fire propapation scenarios were identified.

- The fire walkdown team inspected the high-hazard areas (turbine building, diesel generator rooms, cable spreading rooms, switchgear rooms, and lube oil storage areas) during the Fire PRA process and did not identify any additional risk significant fire propagation pathways.

- The plant personnel and fire brigade are aware of the fire hazards associated with the listed areas. Section III of Table 4.8-1 of the IPEEE Report describes atributes of an adequate fire protection program. It is unlikely that fires will be allowed to propagate to other areas and cause further degradation of system safety without being controlled prior to the failure of the fire barriers (e.g., wall, ceiling, floor).

2. *At least two fires have occurred at DCPP on the turbine building operating floor. One occurred in 1987 due to an electro-hydraulic fuel leak. The other occurred in 1989 due to arcing in the main electrical generator exciter housing. The generic data used in the study was inconsistent with the actual occurrence of these fires over the plant's 10-year lifetime. Explain how these fires were accounted for in the study. Provide the effect on fire risk of utilizing plant-specific data for turbine building operating floor fire scenarios.*

<u>PG&E Response</u>

The EPRI Fire Events Database contained 753 fire events that occured at domestic plants between February 1965 and December 1988. Two of these fires occurred at DCPP and involved the main unit turbine. In allocating the database turbine building fire events to the calculation of fire ignition frequency in specific fire zones at DCPP, one of these fires (1/27/88) was allocated to the main unit turbine deck (Fire Zone 14-D), and the other fire (1/2/87) was allocated to the floor below the main turbine deck (14-A-119). The 1989 fire was not included in the EPRI Fire Events Database since it occurred after the cutoff date of the database, but this

event is included in the calculation below. The fire ignition frequencies resulting from the EPRI Fire Events Database were not further modified to reflect plant-specific fires.

The critical fire scenario of concern from a core damage perspective is a fire originating on the main turbine deck that propagates through the 4-kV switchgear ventilation ducts, to involve the vital 4-kV bus switchgear.

In light of foreign nuclear plant experience with severe turbine building fires, it was felt that the calculation of a "severe turbine building fire" ignition frequency might be more applicable to the specific FS8 critical fire scenario than the simple turbine deck ignition frequency combined with geometry and severity factors applied to the propagation pathway.

Analysis using the EPRI Fire Events Database determined a value of 2.19E-2 as listed in Table 4.1-3, page 4-19, of the IPEEE Report as the annual turbine deck fire ignition frequency. If we estimate the plant-specific turbine deck fire ignition frequency as 0.3 (3 Diablo Canyon fires in 10 years), the FS8 initiator frequency would be 1.46E-8 versus the 1.4E-8 resulting from the severe turbine building fire data for international plants. Application of the 0.3 estimate above would result in an increase in core damage of 6E-10 which is not significant. The inputs and resulting impact on FS8 initiator frequency of using the generic data, plant-specific data, and severe turbine building fire data are shown in the table below.

	Using EPRI Fire Event Database for Turbine Deck Fire Ignition Frequency	Using DCPP Specific Data for Turbine Deck Fire Ignition Frequency	Using International Severe Turbine Building Data for Severe Turbine Building Fire Ignition Frequency
Ignition Frequency	2.19E-2	3.0E-1	7.2E-4
Geometry Factor	5.0E-2	5.0E-2	1.0
Severity Factor	5.0E-2	5.0E-2	1.0
Propagation Factor (3 Dampers Fail to Close)	1.94E-5	1.94E-5	1.94E-5
CDF for FS8 Initiator	1.0E-9	1.46E-8	1.4E-8

3. *Human recovery actions are identified as the third most critical event in the fire scenario importance ranking lists provided on page 4-71 of the IPEEE submittal report. However, no details are provided concerning how probabilities of recovery failure were assessed. Provide a detailed description of how fire event recovery actions were assessed, including how factors such as sequence timing, elevated environmental stressors (e.g., reduced visibility, impaired communications, and impaired accessibility) were accounted for. If IPE values were assumed, were they*

adjusted to reflect reduced reliability during a fire event and, if so, how were they adjusted? If IPE values were used directly, provide a justification for not having adjusted the values.

<u>PG&E Response</u>

The Success Likelihood Index Method (SLIM) was used to quantitatively evaluate the human recovery actions. The SLIM method uses input provided by the DCPP operating crews to rate the performance shaping factors, which are used to evaluate the success likelihood of a particular task. A detailed description of the methodology was presented in the IPE Report, Section 3.3.3.

The information provided to the operator to be used as a basis for rating the performance shaping factors is listed below:

- Description of environment (such as fire in the control board, or fire in the cable spreading room) in which action is to be performed
- Actual time available to complete task
- Preceding and concurrent unrelated actions
- Preceding related actions
- Consequences of failing to perform this action
- Consequences of performing this action
- Crew training and experience for this action
- Quality of applicable procedures
- Relevant indications
- Eventual increase in available manpower outside the control room

This information includes sequence timing, environmental stressors, and other factors that may affect operator success. The human recovery actions that are identified as the third most critical event in the fire scenario importance ranking lists provided on page 4-71 of the IPEEE Report consist of the control room and cable spreading room human recovery actions only. The human action event descriptions explicitly document the conditions when the action is to be performed and the time available to perform each action. The accessibility of the control stations to be accessed by the operators and these event descriptions are then considered by the operators when assigning the rating factors for the specific actions.

The human actions for fires in areas other than the control room and cable spreading room did use IPE values. The more dominant human actions are contained in Table 4.6-5 (IPEEE Report) in Top Events RP (trip RCPs prior to seal damage), RA (cross-tie to Unit 2 auxiliary saltwater), SE (seal integrity maintained by hooking up firewater to charging pumps), and OB (bleed and feed). These are not dominant human actions and would not be adversely impacted by fires. This is because either the action is performed in the control room and is unaffected by fire, or because the fire is in an area unrelated to the human actions.

4. *A listing of significant walkdown findings is not documented in the IPEEE submittal. Provide a summary of the significant walkdown findings (if any).*

<u>PG&E Response</u>

There were no significant walkdown findings. No changes were made to the Fire PRA as a result of the walkdown. The walkdown focused on the following elements: ventilation dampers, hydrogen lines, electrical cabinets for circuitry, seismic bracing, firewater piping, and hot shutdown panel. There were a few interesting observations noted during the walkdown; these observations are summarized below:

Location	Discussion
Hydrogen bulk storage shed east of tank area at elevation 115 feet	Hydrogen piping lines could be a source of severe fires; however, these piping lines are double-walled and vented to atmosphere. This minimizes the chance of causing a severe fire in the plant. The walkdown team also verified that there is a hydrogen excess flow shut-off valve on the hydrogen supply piping on the south wall of the bulk hydrogen storage shed. Because of the excess flow check valve, hydrogen is unlikely to cause a severe fire in the plant.
Hydrogen bottle in the Chemistry Lab at elevation 85 feet	Chemistry Lab secures compressed gas bottles with only one point of support. Although adequate, in other parts of the plant two points of support are used for bottles.

Also, see the response for Seismic-Fire Interactions, Question 8.

5. *Fire propagation scenarios within the control room cabinets (where the fire originates) have utilized fire data events from outside the control room. Inclusion of these events can potentially result in optimistic risk estimates and mask the physical reality of fire propagation within the cabinet of origin. Provide justification for inclusion of non-control room cabinet fire events and an analysis of the effect on control room fire-induced core damage frequency if non-control room fire events are excluded.*

PG&E Response

A specialized severity curve, the control room panel fire severity curve f(r), was developed in the Diablo Canyon Probabilistic Risk Assessment (DCPRA). The curve was used to estimate the conditional frequency of fires initiated inside an electrical panel or a control cabinet that has the potential to propagate to a radius r feet or more. The curve was developed by PLG, Inc., a consultant to PG&E.

To develop the control room panel fire severity curve, the industry fire database was searched for fires that occurred in control rooms. Four control room panel fires were identified. The fires did not have a large damage radius; two events had a damage radius less than 1 foot. The control room severity curve was developed based on the four industry control room fire events, the extent of the damage, expert judgment, and the fact that the radiative heat flux associated with a fire decreases as $1/r^2$.

Because of the limited control room fire experience, other panel fire events in the industry fire database were examined to verify the applicability of the control room severity curves. A total of 13 additional electrical panel and relay fires (both inside and outside control room) were evaluated. Due to the similarity in equipment, functions and combustible loadings, those events that occurred in panels outside the control room were included with fires that occurred in a control room. Out of the 13 fire events, 8 events have adequate information to provide an estimate of the fire damage radius. None of the 13 fire events caused widespread damage. The damage radius estimates for the 8 events are less than 1 foot; many are substantially smaller. The 8 events are judged to be representative of the overall population of panel fires and do not invalidate the control room fire severity curve.

Furthermore, the control room is continuously manned. A fire initiated inside a control room panel would very likely be detected and controlled within a short time, and the extent of damage would be limited. Therefore, it is unlikely for a control room panel fire to cause damage at a great distance from the fire source compared to a panel fire that occurs outside the control room.

In conclusion, only the control room events were used to develop the severity curve. The other fire events were examined to further confirm the validity of the control room fire severity curve. Based on the argument above, there is no reason to believe that the control room severity curve is nonconservative.

6. *A listing of shared systems other than ASW and vital electrical power is not documented in the submittal. Provide a listing of shared systems. For each item on the list provide either the justification for screening, or an analysis of dual unit fire-induced core damage scenarios, including core damage frequency contribution.*

PG&E Response

A list of shared systems and the reason these systems were screened out for dual unit, fire-induced core damage scenarios is provided below:

SHARED SYSTEM	REASON SCREENED OUT
Control room ventilation system	There are separate fans for each Unit's control room and redundant power supply from both units for each train of the fans. One unit can satisfy the habitability requirement such that control room temperature meets the design criteria. Probability of dual unit, fire-induced core damage scenarios is extremely unlikely.
Diesel fuel oil system	Probability of fire induced loss of offsite power to both units coincident with fire induced loss of both diesel fuel oil trains is extremely unlikely.
Auxiliary boiler	A fire affecting the auxiliary boiler has no PRA impact.
Raw water reservoir	A fire affecting the raw water reservoir has no PRA impact since the raw water reservoir is not credited in the PRA.
Fire water storage tank	A fire affecting the fire water storage tank is not considered credible. Also, the fire water storage tank is not directly modeled in the PRA.
Plant air system	A fire affecting the plant air system has no PRA impact (other than causing a plant trip which is assumed anyway) since instrument air is not credited in the PRA.
Makeup water system	A fire affecting the makeup water system has no PRA impact since it is not credited in the PRA.
Chemical and volume control system	A fire affecting the common parts of the chemical and volume control system has no impact since the common parts of this system are not modeled in the PRA.
Radioactive waste treatment system	A fire affecting the radioactive waste treatment system has no PRA impact.
Turbine building lubricating oil reservoir	The only impact of fire in the turbine building lubricating oil reservoir is to cause a turbine building fire, which is evaluated.
500 kV, 230 kV	A fire affecting 500 kV and 230 kV has been evaluated and was screened out.

III. High Winds, Floods, and Others (HFOs)

1. *Provide a summary of the walkdown findings related to HFOs.*

PG&E Response

The walkdown findings for each HFO are listed in the respective section of the IPEEE Report. No changes were made to this section as a result of the walkdown. A summary of the walkdown findings is listed in the table below:

High wind	No significant findings
External flooding	No significant findings
Ship impact	No significant findings
Aircraft crash	No significant findings
Nearby Facility Accidents	No significant findings
External fires	Control burn program has been implemented at DCPP to keep brush growth down around the 230 and 500 kV lines. Goats are used to control brush growth. The results of the control burn were observed during the walkdown. It was noted that brush growth is controlled around the 500 kV and 230 kV lines.
Hazardous material	It was confirmed that the five, 1-ton, cylindrical chlorine tanks located at the intake structure were replaced by a 7,000 gallon sodium hypochlorite tank. The sodium hypochlorite does not pose a direct hazard to the control room operators. During the walkdown, the engineers noticed a new chemical, ethanolamine (ETA), which was in the testing stage, to replace the existing ammonia hydroxide. ETA has been tested in DCPP Unit 1 since August 17, 1993, to control the secondary system pH. ETA is analyzed to be less hazardous than ammonia hydroxide.