Pacific Gas and Electric Company®

Barry S. Allen
Vice President, Nuclear Services

Diablo Canyon Power Plant
Mail Code 104/6
P. O. Box 56
Avila Beach, CA 93424

805.545.4888
Internal: 691.4888
Fax: 805.545.6445

February 25, 2015

PG&E Letter DCL-15-032

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

10 CFR 50.90

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 - National Fire Protection Association Standard 805

References:

1. PG&E Letter DCL-13-065, "License Amendment Request 13-03, License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)," dated June 26, 2013
2. NRC Letter, "Diablo Canyon Power Plant, Units 1 and 2 - Request for Additional Information Re: License Amendment Request to Adopt National Fire Protection Association Standard 805 (TAC Nos. MF2333 and MF2334)," dated July 31, 2014
3. NRC Email from S. Lingam, Project Manager (NRR/DORL/LPL4-1), "Diablo Canyon, Units 1 and 2 - Requests for Additional Information (RAIs) for Fire Protection (NFPA-805) License Amendment Request (LAR) (TAC Nos. MF2333 and MF2334)," dated February 4, 2015

Dear Commissioners and Staff:

In Reference 1, Pacific Gas and Electric Company (PG&E) submitted a license amendment request to adopt National Fire Protection Association Standard 805.

In Reference 2, the NRC provided a request for additional information (RAI) regarding Reference 1. Initial RAI questions were discussed in draft form in a teleconference on July 8, 2014, and during an audit performed at Diablo Canyon Power Plant during the week of July 14, 2014. Follow-on RAI questions were discussed in draft form in teleconferences on January 21, 2015, and on February 4, 2015. Enclosed are PG&E's responses to these RAI questions.

Three new regulatory commitments are included in this letter. The commitments are additions to Table S-3 from Reference 1.

This letter includes no revisions to existing regulatory commitments.

If you have any questions or require additional information, please contact Mr. Philippe Soenen at 805-545-6984.

I state under penalty of perjury that the foregoing is true and correct.

Executed on February 25, 2015.

Sincerely,

Barry S. Allen

Barry S. Allen
Vice President, Nuclear Services

mjrm/4557/50037411-15
Enclosure
cc: Diablo Distribution
cc/enc: Marc L. Dapas, NRC Region IV
Thomas R. Hipschman, NRC Senior Resident Inspector
Siva P. Lingam, NRR Project Manager
Gonzalo L. Perez, Branch Chief, California Dept of Public Health

**Response to NRC Request for Additional Information –
National Fire Protection Association Standard 805**

References:

1. PG&E Letter DCL-13-065, "License Amendment Request 13-03, License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)," dated June 26, 2013

2. NRC Email from S. Lingam, Project Manager (NRR/DORL/LPL4-1), "Diablo Canyon, Units 1 and 2 - Requests for Additional Information (RAIs) for Fire Protection (NFPA-805) License Amendment Request (LAR) (TAC Nos. MF2333 and MF2334)," dated February 4, 2015

Attachment 1 of this enclosure includes a list of acronyms used in this response for convenience.

On February 4, 2015, the NRC provided RAIs (Reference 2) regarding LAR 13-03 (Reference 1), herein referred to as "LAR" or "the LAR." PG&E's responses to the NRC questions are provided below.

<u>PRA RAI 01.f.01</u>

The response to PRA RAI 01.f (in a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635)) states that given the unacceptable operating experience with the Westinghouse reactor coolant pump (RCP) Shutdown Seals (SDS), Pacific Gas and Electric Company (PG&E, the licensee) has decided to install redesigned Westinghouse RCP Generation III SDS (GEN III) instead and explains that:

> "Modeling of the RCP GEN III SDS applicable to the FPRA model as well as other hazard PRA models will be based on guidance in PWROG-14001-P, Revision 1, 'PRA Model for the Generation III Westinghouse Shutdown Seal.' PWROG-14001-P, Revision 1 has been submitted to NRC (Reference PWROG OG-14-211 dated July 3, 2014) but has not yet been approved. The post-transition FPRA model will be verified to reflect the as-approved version of PWROG-14001-P before it is used as a basis in self-approval of post transition changes. This report provides the basis for the GEN III SDS credit in the PRA model in the response to PRA RAI 3."

The U.S. Nuclear Regulatory Commission (NRC) is accepting models of SDS failure based on the best available information at the time of transition when accompanied by assurance that accepted models will be used when available. Provide a Table S-3 implementation item stating that PG&E will use NRC accepted SDS failure models as these become available to confirm, as a minimum, that the transition change-in-risk estimates will not exceed the Regulatory Guide (RG) 1.205 acceptance guidelines. The implementation item should also clarify that self-approved changes that rely on the SDS failure model will not be undertaken before acceptable models have been developed.

PG&E Response:

PG&E is making the following regulatory commitment to be added as a new item to Attachment S, Table S-3 of the LAR:

> PG&E will use NRC accepted SDS failure models as these become available to confirm, as a minimum, that the transition change-in-risk estimates will not exceed the RG 1.205 acceptance guidelines. The DCPP NFPA 805 Change Evaluation process will include provisions to ensure that self-approved changes that rely on the SDS failure model will not be undertaken before acceptable models have been developed.

PRA RAI 01.g.01 (Electrical Distribution Panel Fire Scenarios)

The response to PRA RAI 01.g (in a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635)) states that guidance in Section 6.5.6 of NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities: Summary and Overview," September 2005 (ADAMS Accession No. ML052580075), and Section 8.2 of NUREG/CR-6850, Supplement 1 (specifically FAQ 08-0042, "Fire Propagation from Electrical Cabinets") was used to screen "[w]ell-sealed electrical cabinets that have robustly secured doors (and/or access panels) and that house only circuits below 440 V." However, the response also states: "[n]o cabinets that are PRA components were screened," and that "a fire scenario [was] still created if the cabinet was a PRA component or had terminating PRA cables." Therefore, it appears that even though well sealed and secured electrical cabinets below 440 V that are PRA components or have terminating PRA cables could have been screened, they were, nonetheless, included in the Fire PRA as sources for non-propagating fire scenarios. It is not clear whether this departure in applying NUREG/CR-6850 guidance constitutes conservative or non-conservative treatment. If these unscreened cabinets were included in the fire ignition Bin 15 count, then they would have the effect of reducing the per-cabinet fire frequency (i.e., diluting the count). Clarify whether your approach of including well sealed and secured cabinets that are PRA components or have terminating PRA cables conservatively or non-conservatively estimates the risk results (i.e., core damage frequency (CDF), large early release frequency (LERF), ΔCDF, and ΔLERF). If the risk results are underestimated, then replace this approach with an acceptable approach in the integrated analysis provided in response to PRA RAI 03.

PG&E Response:

Some electrical cabinets from both Units 1 and 2 were screened based on guidance in FAQ 08-0042 as well-sealed and robustly secured cabinets that house only circuits below 440 V. These cabinets were however included in the original fire ignition source counting for fire ignition source Bin 15. The inclusion of these electrical cabinets in the fire ignition Bin 15 count results in a reduction of the per-cabinet fire frequency (i.e., diluting the count). This approach could potentially produce non-conservative estimates of the fire risk.

The per-cabinet fire frequency was updated based on the corrected total electrical cabinet (Bin 15) population and guidance provided in Chapter 6 of NUREG/CR-6850.

The change (i.e., increase) in the per-cabinet fire frequency will be reflected in the frequencies of the electrical cabinet fire scenarios. As these cabinets are excluded from the ignition source counting, any detailed fire scenarios previously developed from these ignition sources will be removed from the base FPRA model.

The base FPRA model and the integrated analysis provided in response to PRA RAI-3 will incorporate the change in the per-cabinet fire frequency and the removal of detailed fire scenarios associated with the electrical cabinets screened from the fire frequency counting.

PRA RAI 05.01

The response to PRA RAI 05 (in a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635)) does not identify current or updated controls for Fire Compartment 6-A-3 that will preclude or limit combustible quantities of transient material that could generate heat release rates (HRRs) above the reduced HRRs assumed in the fire modeling. The response explains there are no pumps or oil in this fire compartment, but acknowledges that there is normal access to Fire Compartment 6-A-3. It is not clear what limits quantities of transient combustibles in this area, which may or may not be similar to materials for which testing results are presented in Table G-7 of NUREG/CR-6850. Describe the controls that justify limiting the 98% HRR modeled for this fire compartment to 142 kW.

PG&E Response:

In fire compartment 6-A-3, there are two transient fire scenarios postulated along the north wall of the charger/inverter room where the 75th percentile HRR (i.e., 142 kW) was used. These scenarios are both based on transient fires that are within 5 feet of the wall.

Therefore, DCPP will implement additional administrative controls in 6-A-3 that will limit combustible transient material within the fire compartment by creating a "No Combustible Storage" area within 5 feet of the north wall of the compartment.

This "No Combustible Storage" area will be identified and controlled within DCPP administrative guidelines, and will have localized visual warning similar to other "No Combustible Storage" areas at DCPP (e.g., floor areas are painted red, and/or are labeled as no storage areas).

LAR Attachment S, Table S-3, describes the Implementation Items that will be completed prior to the implementation of the new NFPA 805 Fire Protection Program.

PG&E is making the following regulatory commitment:

> A new implementation item will be added to Table S-3 to apply the administrative controls that will limit the combustible materials in 6-A-3.

Table S-3 – Implementation items			
Item	Unit	Description	LAR Section/Source
S-3.27	1	PG&E will create a "No Combustible Storage" area within 5 feet of the north wall of Fire Compartment 6-A-3. This will include the addition of localized visual warnings in accordance with OM8.ID4 and the addition of Fire Compartment 6-A-3 to Section 5.5.4 of OM8.ID4.	PRA RAI 5

<u>PRA RAI 11.01</u>

The response to PRA RAI 11 (in a letter dated October 29, 2014 (ADAMS Accession No. ML14302A805)) states that the method used for apportioning the generic junction box fire frequency to each physical analysis unit (PAU) is consistent with the method described in Section 3.2 of FAQ 13-0006, "Modeling Junction Box Scenarios in a Fire PRA," and derives that the junction box frequency for a PAU is related to the cable load of a PAU to the total plant cable load. The derivation relies upon FAQ 13-0006, in particular, the response explains per FAQ 13-0006 that "the number of junction boxes in a specific PAU can be assumed to be proportional to the ratio of the number of junction boxes to conduits in a representative, comparable PAU and the cable loading associated with the location. The proportionality constant can be developed by determining the count in a relatively simple PAU (e.g., a PAU where the junction boxes could be counted during a walkdown) and applying the value consistently throughout the plant." It appears that a proportionality constant (PC) was derived for application to all PAUs. However, the response does not identify from which PAU the PC was derived and why the PC from that PAU can be considered to be representative for the rest of the plant. Please identify from which PAU the PC was derived and why the PC from that PAU can be considered to be representative for the rest of the plant. If you are unable to justify your selected PC, then apply acceptable methods to determine the risk from junction box fires, and update the response to PRA RAI 03.

PG&E Response:

Junction Box Fire Frequency

The method PG&E used for apportioning the generic junction box fire frequency to an individual PAU is:

$$\lambda_{PAU,\,JB} = \lambda_{JB} \;\; X \;\; \frac{\text{Cable Load In a PAU}}{\text{Cable Load in the Plant}}$$

This is the method prescribed in Section 6.5.6 of NUREG/CR-6850 to apportion the frequency for junction box fires (Bin 18). This methodology is supported by FAQ 13-0006 (makes reference to this method on pages 1 of 9 and 5 of 9, shown respectively below):

> "The frequency can be apportioned based on ratio of cable in the area to total cable in the plant. Therefore, ignition source-weighting factor of the cables may be used in this bin, as well."

> "Chapter 6 of NUREG/CR-6850 describes a process for apportioning the generic junction box fire ignition frequency based on the amount of cable (e.g., cable loading, number of cables, cable lengths, etc.) in the different PAUs within the scope of the Fire PRA. This process remains a valid approach and the clarifications and recommendations presented in this FAQ are alternative methods."

PG&E's previous response to PRA RAI 11 provided calculations for mathematical comparison of the two junction box fire frequency methods (i.e., Chapter 6 of NUREG/CR-6850 versus FAQ 13-0006). As explained above, PG&E apportioned the frequency of junction box fires based on the NUREG/CR-6850 methodology, which is identified as a valid approach in FAQ 13-0006. Therefore, the selection of a representative PC for a PAU was not used in apportioning the generic junction box fire frequency.

As discussed in FAQ 13-0006, NUREG/CR 6850 provides no guidance on how to represent the risk of junction box fire scenarios. As such, PG&E used the screening/analysis method from FAQ 13-0006. The discussion below adds clarification to the response to PRA RAI 11 originally provided in PG&E Letter DCL-14-098, "Ninety-Day Response to NRC Request for Additional Information – National Fire Protection Association Standard 805," dated October 29, 2014:

Junction Box Fire Impacts in a PAU

Two different approaches of modeling junction box fire impacts are considered depending on the level of fire modeling performed in the associated PAU (i.e., single whole room burnup scenario or detailed fire modeling and scenario development).

Approach 1 (PAUs represented by a single full compartment burnup scenario):

Where no detailed fire modeling is performed for a PAU, fires in the PAU are modeled by a single fire scenario. This type of scenario is where all the PRA targets in the PAU are assumed to be failed by fire at the time of fire ignition. Its CCDP is calculated assuming all the PRA targets mapped to the PAU are failed by fire. Its ignition frequency is the sum of the contribution from each of the ignition sources assigned to the PAU, including junction box frequency apportioned to the PAU. The CDF contribution of junction boxes is calculated based on the whole room burn CCDP and the junction box fire frequency of the PAU apportioned based on the discussion above. This method bounds any CDF estimate based on the first screening analysis described in Section 3.2 of FPRA FAQ 13-0006 for any route points in the PAU. Therefore the treatment of junction box fires in PAUs where its fire impacts are represented by a single whole room burnup scenario is conservative and consistent with FPRA FAQ 13-0006.

Approach 2 (PAUs performing detailed fire modeling and scenario development):

Where detailed fire modeling and scenario development is performed for a PAU, at least one fire scenario representing junction box fires in the PAU is included. The junction box fire frequency for the PAU is estimated by apportioning the generic frequency to the PAU based on the cable load as discussed above. At DCPP, the impact of junction box fires (i.e., a set of fire damaged PRA SSCs) for the PAU is conservatively selected by mapping the target set to a surrogate impact such as a cable tray or a fire scenario in the same PAU that contains a significant number of risk PRA SSCs.

A comparison analysis was performed to demonstrate, via a sampling method, that the DCPP approach of using the surrogate impact (i.e., CCDP) for junction box fires bounds the impacts of fire damage to an individual junction box and conduits/cables terminated at the junction box.

The comparison analysis involves:

1. The selection of a sample population of PAUs representing various types

of plant configurations (e.g., electrical room, mechanical room, room sizes, buildings, etc.). Fourteen PAUs (7 from Unit 1 and 7 from Unit 2) out of 59 PAUs are selected for the comparison analysis. The process and basis for the selection of 14 sampled PAUs is described below.

a. As shown in Table 1 below, 59 PAUs were binned to 15 groups. The grouping was performed such that the PAUs within a group house similar type of equipment (e.g., AC versus DC, 230 kV versus 4 kV versus 480 V, Power Distribution cabinets versus Control Cabinets, Switchgear Room versus Cable Spreading Room) and locations (e.g., Turbine Building versus Auxiliary Building, inside versus outside).

b. With such similar characteristics among the PAUs in a group, any PAU can be selected as a representative of the group for the analysis. Groups 14 and 15 are screened from further comparison analysis (that is, no representative PAU is selected for these groups). Refer to Table 1 for the basis for the screening of these groups.

2. Each PAU selected for a group as shown in Table 1 was walked down to sample junction boxes. At least one junction box from each quadrant of the PAU was identified if possible. In order to ensure a conservative bias (i.e., a higher CCDP of sampled junction boxes) in the comparison analysis, junction boxes terminated with multiple conduits and carrying safety-related/vital cables are favored over those with lesser number of conduits or carrying non-vital cables.

3. For each sampled junction box, conduits terminated at the junction box were identified and mapped to PRA SSCs.

4. For each selected PAU, the CCDPs of sampled junction box scenarios were determined and compared to the CCDP of the as-modeled junction box scenarios (e.g., surrogate fire scenario or cable tray).

5. Table 2 below shows for each PAU the number of sampled junction boxes, the CCDP of the surrogate fire scenario or cable tray, and the range of the CCDPs of sampled junction boxes calculated based on the fire impact information obtained in Step 3 above. Using PAU 5B4 as an example, Table 3 illustrates the fire impacts of the fire scenario (Z5B4TS2F1) modeled as the surrogate for the junction box fire in PAU 5B4, eight (8) junction boxes sampled for the analysis, their fire impacts, and corresponding estimated CCDPs.

Table 1 – Description and Basis of Grouping and Screening

Group	Represented by	PAU Unit 1	PAU Unit 2	PAU Description, Basis of Grouping and Screening
1	6A1	6A1	6B1	Group 1 includes the PAUs housing vital 125 VDC equipment. Each PAU houses a bank of batteries, battery chargers, inverters, DC distribution panel, and other electrical cabinets supporting one of three vital 125 VDC power divisions (buses). The spatial arrangement, number and types of electrical equipment housed in any one of the PAUs is similar to the others as well as the cable loading. Unit 1 PAU 6A1 is selected to represent Group 1.
		6A2	6B2	
		6A3	6B3	
2	5A1 and 5B3	5A1	5B1	Group 2 includes the PAUs housing vital 480 VAC MCCs in the Auxiliary Building. Each PAU houses mostly MCCs, a load transformer and electrical cabinets supporting one of three vital 480 VC power divisions (buses). The spatial arrangement, number and types of electrical cabinets housed in any one of the PAUs is similar to the others as well as the cable loading. Unit 1 PAU 5A1 and PAU 5B3 from Unit 2 are selected to represent Group 2.
		5A2	5B2	
		5A3	5B3	
3	24A	13A	24A	Group 3 includes the PAUs housing vital 4 kV SWGRs in the Turbine Building. Each PAU houses 4 kV Aux, Startup Power, and Emergency Diesel Feeder breakers and ECCS load SWGRs supporting one of three vital 4 kV power divisions (buses). The spatial arrangement, number and types of electrical cabinets housed in any one of the PAUs is similar to the others. All PAUs in Group 3 contain a limited number of junction boxes. Unit 2 PAU 24A is selected to represent Group 3.
		13B	24B	
		13C	24C	

Group	Represented by	PAU		PAU Description, Basis of Grouping and Screening
		Unit 1	Unit 2	
4	12A	12A	23A	Group 4 includes the PAUs housing mostly cable raceways associated with vital 4 kV SWGRs located directly above in separate fire zones in the Turbine Building. Each PAU houses cable raceways supporting one of three vital 4 kV power divisions (buses). The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in any one of the PAUs is similar to the others. All PAUs in Group 4 contain a limited number of junction boxes. Unit 1 PAU 12A is selected to represent Group 4.
		12B	23B	
		12C	23C	
5	20-85	10-85	20-85	Group 5 includes the PAUs housing cable raceways for 12 kV, non-vital 4 kV SWGRs, and interconnecting bus duct works in the Turbine Building. Unit 1 PAU 10-85 contains additional circuit breakers and duct works associated with the 230 kV Aux and Start Power. Besides additional 230 kV circuit breakers in Unit 1 PAU, the number and types of electrical cabinets as well as cable loading housed in any one of the PAUs is similar to the others. In Unit 1 PAU 10-85, there is no additional cable conduit or junction box associated with the 230 kV SWGRs. Both PAUs in Group 5 contain a limited number of junction boxes. PAU 20-85 is selected to represent Group 5.
6	10-76	10-76	20-76	Group 6 includes the PAUs housing mostly cable raceways associated with 230 kV circuit breakers, 12 kV SWGRs, non-vital 4 kV SWGRs, and protection and control relay panels located directly above in a separate fire zone (e.g., PAU 10-85 for Unit 1) in the Turbine Building. The amount of raceways and conduits housed in Unit 1 PAU 10-76 is similar to Unit 2 PAU 20-76. Unit 2 PAU 10-76 is selected to represent Group 6.
7	5B4	5A4	5B4	Group 7 includes the PAUs housing non-vital 480 V SWGRs and MCCs, interconnecting bus duct works, and pressurizer heater control cabinets, Hot Shutdown Panel and other non-vital electrical cabinets in the Auxiliary Building. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 5A4 is similar to Unit 2 PAU 5B4. Unit 2 PAU 5B4 is selected to represent Group 7.

Group	Represented by	PAU		PAU Description, Basis of Grouping and Screening
		Unit 1	Unit 2	
8	6B4	6A4	6B4	Group 8 includes the PAUs housing MCR annunciator cabinets, rod control cabinets, reactor trip breakers, MG motor sets, and non-vital electrical cabinets in the Auxiliary Building. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 6A4 is similar to Unit 2 PAU 6B4. Unit 2 PAU 6B4 is selected to represent Group 8.
9	6B5	6A5	6B5	Group 9 includes the PAUs housing plant process computer power cabinets and other electrical cabinets in the Auxiliary Building. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 6A5 is similar to Unit 2 PAU 6B5. PAU 6B5 is selected to represent Group 9.
10	7A	7A	7B	Group 10 includes the PAUs housing plant process monitoring and control cabinets, and conduits and raceways carrying inputs and output from and to such cabinets in the Auxiliary Building. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 7A is similar to Unit 2 PAU 7B. Unit 1 PAU 7A is selected to represent Group 10.
11	12E	12E	23E	Group 11 includes the PAUs housing ISO Phase bus ducts, potential transformer, Main Generator Manual Disconnect, and associated electrical cabinets in the Turbine Building. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 12E is similar to Unit 2 PAU 23E. Unit 1 PAU 12E is selected to represent Group 11.
12	19A	14A	19A	Group 12 includes the PAUs housing the Balance-Of-Plant (BOP) equipment, Main Turbine Generators, and mostly non-vital conduits and raceways and electrical cabinets. The spatial arrangement, number and types of electrical cabinets as well as cable loading housed in Unit 1 PAU 14A is similar to Unit 2 PAU 19A. Unit 2 PAU 19A is selected to represent Group 12.

Group	Represented by	PAU		PAU Description, Basis of Grouping and Screening
		Unit 1	Unit 2	
13	3BB100	3BB85	3CC85	Group 13 includes the Auxiliary Building PAUs. PAUs 3BB and 3CC at different elevations in the Containment Penetration areas house Main Steam leads, Main Feedwater leads, Auxiliary Feedwater leads, CCW piping, conduits and raceways supporting the equipment located in the Containment. PAUs 3C and 3X house Primary System SSCs supporting normal plant operation and a limited number of conduits and raceways impacting PRA SSCs. Unit 1 PAUs 3BB85, 3BB100, 3BB115, 3C, and 3X are similar to Unit 2 PAUs 3CC85, 3CC100, 3CC115, 3C, and 3X, respectively (that is, 3BB85 is similar to 3CC85, etc.) in their spatial arrangement, number and types of electrical cabinets as well as cable loading. Unit 1 PAU 3BB100 is selected to represent or bound Group 13 from the comparison analysis perspective because in 3BB Elevation 100 foot (PAU 3BB100) more number of conduits and raceways are routed through, as well as their higher risk importance as compared to the other Auxiliary Building PAUs.
		3BB100	3CC100	
		3BB115	3CC115	
		3C	3C	
		3X	3X	
14	Screened	8G	8H	This is the SSPS rooms located next to the MCR, housing electrical cabinets which process plant parameters and actuate ESF equipment and trip reactor breakers when demanded. These PAUs are screened from the comparison analysis because of no visible junction boxes.

Group	Represented by	PAU		PAU Description, Basis of Grouping and Screening
		Unit 1	Unit 2	
		13D	24D	PAUs 13D and 24D house the Main Generator Exciter control cabinets, associated conduits and raceways, and three conduits which impact the emergency diesel generators (EDGs) availability. There are a limited number of junction boxes in these PAUs. A walkdown of PAUs 13D and 24D verified that a junction box fire from these PAUs does not impact any PRA targets (i.e., EDG conduits), or PRA conduits are terminated in any of the junction boxes in these PAUs. Current approach of modeling junction box fires in PAU 13D and 24D using a surrogate impact of damaging a EDG is conservative. Therefore PAUs 13D and 24D are not included in the comparison analysis.
		4A	4B	PAUs 4A and 4B house the RCA Access control, Rad Protection/Chemistry offices, and Chemistry Lab and Counting areas in the Auxiliary Building. In the base FPRA, the fire impacts (i.e., CCDPs) of junction box fires in these PAUs are conservatively represented by the CCDPs of the whole room burnup scenarios of these PAUs. Therefore PAUs 4A and 4B are not included in the comparison analysis. PAU 4B(U1) is the same as PAU 4B but introduced as a separate PAU in order to capture risk impacts of an Unit 2 fire on Unit 1 risk.
		4B(U1)		
15	Screened	28	29	Outside Areas. Used the highest CCDP scenario from each PAU in this group to represent the CCDP of junction box fire in that PAU. Therefore the approach used for this group is bounding. This group is screened from the sensitivity analysis.
		34	34	

Table 2 – Comparison of CCDPs between modeled surrogate and sampled junction boxes in PAUs representing each group identified in Table 1

Group	Selected PAU	No. of Sampled Junction Boxes (Note 1)	CCDP of Modeled Surrogate	CCDP Range of Sampled Junction Boxes (Note 2)
1	6A1	7	1.28E-02	1.46E-05 to 3.33E-03
2	5A1	7	5.81E-04	1.46E-05 to 2.16E-04
	5B3	4	9.52E-04	1.46E-05 to 4.96E-04
3	24A	1	1.53E-03	1.46E-05
4	12A	2	1.06E-02	1.46E-05
5	20-85	6	7.08E-05	1.46E-05
6	10-76	8	7.76E-05	1.46E-05 to 7.76E-05
7	5B4	8	5.19E-05	1.46E-05 to 5.19E-05
8	6B4	8	1.35E-03	1.46E-05 to 1.35E-03
9	6B5	7	1.35E-02	1.46E-05 to 8.90E-04
10	7A	10	2.36E-03	1.46E-05 to 1.64E-05
11	12E	12	2.05E-02	1.46E-05 to 2.05E-02
12	19A	13	3.23E-04	1.46E-05 to 7.05E-05
13	3BB100	14	7.07E-03	1.46E-05 to 4.62E-05
14	Screened	NA	NA	NA
15	Screened	NA	NA	NA

Note 1: There is only 1 junction box installed in PAU 24A and 2 in PAU 12A.
Note 2: CCDP value of 1.46E-05 represents an uncomplicated reactor trip scenario (reactor trip with no other PRA SSC out of service or fire damaged).

Table 3 – List of sampled junction boxes for PAU 5B4 and corresponding CCDPs

		Sampled Junction Boxes							
PRA SSCs Impacted (Y)	Bin 18	BJH303	BJH304	BJH74	BJH301	BJH310	BJH263	BJH306	BJH261
AFW-2-FT-50-AV				Y					
AFW-2-FT-77-AV				Y					
AFW-2-LCV-110-DT	Y				Y	Y			
AFW-2-LCV-111-DT	Y				Y	Y			
AFW-2-PT-433-AV				Y					
CVCS-2-81450DC/DT					Y				
EP-2-IY23-AV	Y								
RCS-2-NISNE52-AV							Y		Y
RCS-2-PHPG2-OP	Y		Y					Y	
RCS-2-PHPG3-OP	Y				Y	Y			
RCS-2-PHPG4-OFF	Y								
EP-2-TRY21-AV	Y								
EP-2-TRY23-AV	Y								
EP-2-TRY24-AV	Y								
CCDP	5.2E-05	1.5E-05	1.5E-05	2.5E-05	5.2E-05	2.1E-05	1.5E-05	1.5E-05	1.5E-05

The impact of junction box fires in each PAU is modeled using a surrogate scenario. The surrogate scenario is selected for each PAU with a higher risk impact than that of individual junction box fires in the same PAU to ensure conservative modeling of the junction box fires. This conservative modeling demonstrates, as shown in Table 2, that the CCDP of the modeled surrogate bounds those of the junction boxes. The lower CCDP limit of 1.5E-05 for a junction box fire typically represents the CCDP of a reactor trip sequence with a no PRA or limited PRA SSCs impacted. The impacts of some of the sampled junction box fires are similar to those of the surrogate but still bounded by the impact of the surrogate.

The results of this comparison analysis show that the CCDP of the surrogate impacts modeled for junction box fires in each sampled PAU bounds the CCDPs of the sampled individual junction boxes in the PAU, confirming that the DCPP approach of modeling the impacts of junction box fires is conservative compared to the method described in FPRA FAQ 13-0006 and is an appropriate level of refinement for the FPRA.

PRA RAI 15.01

NRC staff notes that based on the response to PRA RAI 15 (in a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635)) the most dominant scenario for the compliant plant model for both units (by a wide margin) is the whole-room burn-up scenario for the Cable Spreading Room (CSR), representing most of the risk reduction credit realized in the “risk offset” values presented in Tables W-4 and W-5 of the license amendment request. Whole-room burn-up modeling implies that this fire area was conservatively modeled. If this fire area was conservatively modeled, then it appears that this scenario contributes to overestimation of the compliant plant risk and therefore underestimation of the change-in-risk estimates.

In light of potential conservatism in the compliant plant modeling, demonstrate that the net change-in-risk (i.e., total risk decrease associated with non-VFDR [variance from deterministic requirements] risk reduction modifications and total risk increase associated with unresolved VFDRs) associated with the integrated analysis presented in response to PRA RAI 03 meet RG 1.174 CDF and LERF risk guidelines.

PG&E Response:

The fire modeling of the CSR including its whole-room burn-up scenario is not conservative. This scenario did not contribute to overestimation of the compliant plant risk and therefore did not result in underestimation of the change-in-risk estimates. The details are discussed below.

Detailed fire modeling was performed for all ignition sources in the DCPP CSRs. The methodologies used meet the NUREG/CR-6850 guidelines and applicable FAQs for fire growth, propagation, and suppression analysis. No special treatments on fire modeling or unapproved methods were introduced in the development of fire scenarios in the DCPP CSRs including the development of the whole-room burn-up scenario. The description of fire scenario development for the Unit 1 CSR is provided below in more details.

Because the Unit 1 and Unit 2 CSRs are similar in size, type and number of ignition sources, secondary combustibles and fire protection features, the discussion below for the Unit 1 CSR is also applicable to the Unit 2 CSR.

Detailed fire modeling was completed for 42 ignition sources in the Unit 1 CSR, including multi-section electrical cabinets.

Multiple fire damage states were analyzed for each ignition source. In most cases, 2 and sometimes 3 HRR points were analyzed:

- The HRR severity factor for a fire that was not capable of damaging targets beyond the ignition source
- The 75^{th} percentile HRR fire scenario
- The 98^{th} percentile HRR fire scenario

For each fire damage state, FPRA equipment targets within the ZOI of a fire ignition source were determined. In addition, multiple HGL temperatures were analyzed for temperature sensitive electronics, as well as thermoset and thermoplastic cable damage criteria.

In all, a total of 131 detailed fire scenarios (i.e., ignition source-damage state combinations) were developed for the Unit 1 CSR. The sum of the 131 fire scenario frequencies in the Unit 1 CSR is approximately 2.4E-03/yr.

Due to the design and configuration of the CSR, nearly all fixed ignition sources and some postulated transient fires are located below cable trays and capable of propagating to secondary combustibles. For any fire scenario capable of propagation to secondary combustibles, credit was taken for the installed automatic CO_2 suppression system and manual suppression of fire. Failure of both automatic CO_2 and manual suppression would lead to the generation of HGL in the CSR – the impact of which is equivalent to "whole-room burn-up."

A total of 54 out of the 131 detailed fire scenarios were mapped to the single whole-room burn-up scenario, Scenario ID Z7ATS17F2 for Unit 1 CSR. The frequency of this whole-room burn-up scenario was approximately 1.6E-05/yr, which is less than one (1) percent of the total frequency of the 131 detailed CSR fire scenarios.

As noted above, DCPP followed the guidance in NUREG/CR-6850 and approved FAQs in performing the detailed fire modeling for the CSR. Considering the significant amount of secondary combustibles in the fire area, limited spatial configuration between ignition sources and intervening combustibles, and failure probabilities of the automatic CO_2 system and manual suppression actions, it is reasonable and realistic to postulate the whole-room burn-up scenario. No specific modeling uncertainties or associated assumptions were introduced in the compliant plant CSR modeling, which could have led to a "conservative" whole-room burn-up scenario. The modeling of the CSR whole-room burn-up scenario did not result in underestimation of the change-in-risk estimates of the CSR. Therefore the "risk-offset" credits presented in Tables W-4 and W-5 of the LAR are not over-estimated or inflated.

No change to the compliant plant model, the PRA RAI-03 aggregate model, or variant plant model is necessary as part of the response to this RAI. However the risk-off set values in Tables W-4 and W-5 of the LAR, which were based on the RCP seal modeling of an older version of the Westinghouse SDS, will be updated to reflect DCPP's plan to install the Westinghouse GEN III RCP SDS.

Accordingly the net change-in-risk (i.e., total risk decrease associated with non-VFDR risk reduction modifications and total risk increase associated with unresolved VFDRs) will be updated as part of the aggregate analysis in response to PRA RAI 3 to ensure alignment with RG 1.174 CDF and LERF risk guidelines.

<u>Fire Modeling (FM) RAI 01.c.01</u>

In a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635), the licensee responded to FM RAI 01.c and stated that a mass-weighted average heat release rate per unit area (HRRPUA) was used in the fire propagation calculations for trays with a mixture of thermoplastic and thermoset cables, as recommended in NUREG/CR-7010, "Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE)."

The response indicates that the same approach (mass-weighted average) was used to determine the flame spread rate for trays with mixed cables. However, NUREG/CR-7010 recommends that for trays with mixed cables the flame spread rate for the predominant material be applied (see page 153).

Provide technical justification for using a mass-weighted flame spread rate for trays with more than 50% thermoplastic cable.

PG&E Response:

The fire modeling analysis will be updated to follow the guidance provided in NUREG/CR-7010 for the flame spread rate for trays with mixed cables. Trays with 50 percent or more thermoplastic cable will assume the thermoplastic cable flame spread rate. The thermoplastic cable tray grouping tables, and any associated fire growth analysis, in the detailed fire modeling will be updated as shown below:

Thermoplastic Cable Tray Grouping			
%TP Group	**TP %**	**HRR per Unit Area [kW/ft^2]**	**Fire Spread Rate [in/min]**
0	TP=0%	14	0.71
1	TP<5%	15	0.78
2	5%≤TP≤10%	15	0.85
3	10%≤TP<25%	17	1.06
4	25%≤TP<50%	19	1.42
5	50%≤TP<75%	21	2.13
6	75%≤TP≤100%	24	2.13

Any fire scenarios in the detailed fire modeling analysis that need to be updated will be reflected in the updated fire risk results that will be provided to the NRC after the Fire PRA is updated and additional quantification is performed in the response to PRA RAI-03

FM RAI 01.g.01

In a letter dated November 26, 2014 (ADAMS Accession No. ML14330A635), the licensee responded to FM RAI 01.g and described the procedure that was used to model high energy arcing fault (HEAF)-initiated fires. The response provides details regarding the HRR of HEAF fires, duration and growth, damage conditions, etc. However, the propagation of HEAF-initiated fires in secondary combustibles, such as cable trays is not discussed.

Explain how HEAF-initiated fire propagation in secondary combustibles was modeled.

PG&E Response:

Fire propagation to secondary combustibles in HEAF fire scenarios are modeled as follows:

The first overhead cable tray within the ZOI of the HEAF was assumed to be damaged and ignited at time zero. For horizontal cable trays, the horizontal cable tray flame spread rates and the HRRPUA for cable trays were determined using the method recommended by NUREG/CR-7010, Volume 1, Section 9.2.2 as discussed in FM RAI-01.c. The total area of exposed cable trays and combustibles within the ZOI of the HEAF scenario are assumed ignited at time zero. Any remaining trays in a stack ignite consistent with or more conservative than the timing rules in Section R.4.2.2 of NUREG/CR-6850 and NUREG/CR-7010.

Fire propagation to adjacent cabinet sections was assumed to occur at 10 minutes in accordance with NUREG/CR-6850, Appendix S. The worst case cable configuration (i.e., cables are in contact with the panel sides) was used which utilized a 10-minute spread time in accordance with NUREG/CR-6850, Appendix S.

Non-cable secondary combustibles were evaluated in the response to FM RAI-01.b, and it was determined that there were no non-cable secondary combustibles in the ZOI of a HEAF.

FM RAI 02.b.01

In a letter dated October 29, 2014 (ADAMS Accession No. ML14302A804), the licensee responded to FM RAI 02.b stating that cable tray covers were assumed not to impact cable damage thresholds, but were credited with delaying damage and ignition in accordance with NUREG/CR-6850, Appendix Q.2.2. Furthermore, the response stated that bottom covers with small and infrequent gaps or holes may have been credited to delay ignition.

(i) Appendix Q.2.2 of NUREG/CR-6850 notes that cable tray fire barrier tests performed by Sandia National Laboratories showed that barriers seem to substantially delay cable damage for qualified cable, but not for nonqualified cable. Explain how the barriers were credited for trays with a mixture of qualified and nonqualified cables.

(ii) Provide details on the length of the assumed ignition delay for covered trays with small and infrequent gaps or holes and the technical basis.

PG&E Response:

(i) Fire propagation in cable trays containing thermoplastic cables has been evaluated using the experimental results in NUREG/CR-0381. Based on these test results, it can be concluded that there is a delay in fire propagation to cable trays containing thermoplastic cables with solid bottom covers. The worst time to electrical short in any of the tested thermoplastic configurations with a solid bottom was 4 minutes, and the worst time to ignition among these configurations was found to be

10 minutes. Therefore, a 4-minute delay to both damage and ignition for thermoplastic cable trays with tray covers was assumed. This is consistent with the NUREG/CR-6850 conservative treatment that ignition/damage occur at similar thresholds.

The DCPP FPRA assumes that a tray containing less than 5 percent thermoplastic cable would not have a significant impact on the credited delay to damage/ignition. Therefore, where bottom covers were credited to delay damage to trays with less than 5 percent thermoplastic cable, the thermoset delay to damage was credited. Where bottom covers were credited to delay damage to trays having more than 5 percent thermoplastic cable, the thermoplastic delay to damage was credited.

(ii) The ignition delay for covered trays with small and infrequent gaps was credited in the same manner as covered trays with no gaps. A 20-minute delay to ignition was given for trays with less than 5 percent thermoplastic cables and a 4-minute delay was credited for any tray with 5 percent or greater thermoplastic cables. No credit is given to delay damage to covered trays with small and infrequent gaps, only credit to delay ignition.

Small and infrequent gaps were considered to be holes of one inch or less, spaced three or more feet apart and were examined by DCPP fire modeling/PRA analysts via plant walkdowns.

Due to the infrequent nature of the gaps, there is a very low probability that the gaps would be located such that they would be directly exposed to the hot gases and radiant heat from a fire.

These gaps will be monitored as part of the DCPP NFPA 805 Monitoring Program. LAR Attachment S, Table S-3, describes the Implementation Items that will be completed prior to the implementation of the new NFPA 805 Fire Protection Program.

PG&E is making the following regulatory commitment:

> A new implementation item will be added to Table S-3 to commit to monitoring small and infrequent gaps in credited cable tray covers.

Table S-3 – Implementation items			
Item	Unit	Description	LAR Section/Source
S-3.28	1, 2	PG&E will monitor small and infrequent gaps in credited cable tray covers to ensure they do not exceed one inch wide, spaced three or more feet apart as part of the DCPP NFPA 805 monitoring program.	FM RAI 02.b

Acronym List

BOP	Balance –Of-Plant
CCDP	Conditional Core Damage Probability
CDF	Core Damage Frequency
CSR	Cable Spreading Room
DC	Direct Current
DCPP	Diablo Canyon Power Plant
ECCS	Emergency Core Cooling System
FPRA	Fire Probabilistic Risk Assessment
HEAF	High Energy Arcing Fault
HGL	Hot Gas Layer
HRR	Heat Release Rate
HRRPUA	Heat Release Rates Per Unit Area
ISO	Isolated
LAR	License Amendment Request
LERF	Large Early Release Frequency
MCR	Main Control Room
MG	Motor Generated
NRC	Nuclear Regulatory Commission
PAU	Physical Analysis Unit
PC	Proportionally Constant
PG&E	Pacific Gas and Electric Company
PRA	Probabilistic Risk Assessment
RAI	Request for Additional Information
RCP	Reactor Coolant Pump
SDS	Shutdown Seals
SSC	Structure, System, or Component
SSPS	Solid State Protection System
SWGR	Switchgear
VFDR	Variance From Deterministic Requirements
ZOI	Zone of Influence