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PG&E Letter DCL-10-150

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20852

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to NRC Letter dated November 24, 2010, Request for Additional Information for the Applicant's Environmental Report - Operating License Renewal Stage

Dear Commissioners and Staff:

By letter dated November 23, 2009, Pacific Gas and Electric Company (PG&E) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for the renewal of Facility Operating Licenses DPR-80 and DPR-82, for Diablo Canyon Power Plant (DCPP) Units 1 and 2, respectively. The application included the license renewal application (LRA), and Applicant's Environmental Report – Operating License Renewal Stage.

By letter dated November 24, 2010, the NRC staff requested additional information needed to continue their review of the DCPP LRA. PG&E's response to the request for additional information is included in Enclosure 1.

PG&E makes no regulatory commitments (as defined in NEI 99-04) in this letter.

If you have any questions regarding this response, please contact Mr. Terence L. Grebel, License Renewal Project Manager, at (805) 545-4160.

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

Executed on Decmeber 6, 2010.

Sincerely,

for

James R. Becker

tlg/50361766
Enclosure
cc: Diablo Distribution
cc/enc: Elmo E. Collins, NRC Region IV Regional Administrator
Michael S. Peck, NRC Senior Resident Inspector
Andrew L. Stuyvenberg, NRC Environmental Project Manager, License Renewal
Alan B. Wang, NRC Project Manager, Office of Nuclear Reactor Regulation

PG&E Response to NRC Letter dated November 24, 2010
Request for Additional Information for the Applicant's
Environmental Report – Operating License Renewal Stage

1. RAI 1.e

The response to this RAI states that SBO due to LOOP initiating events accounts for 6% of the CDF. What is the contribution from consequential LOOPs for other initiating events?

PG&E Response to RAI 1.e

Consequential loss of offsite power (LOOP) is modeled in the Diablo Canyon Power Plant DC01B model. The consequential LOOP contribution to core damage frequency (CDF) for non-LOOP internal initiating events is 1.09E-07/yr. This represents approximately 1.3% of the total internal event CDF.

2. RAI 1.f

a. Confirm that the modeling of Unit 2 systems in the Unit 1 PRA takes into account the operational and maintenance status of Unit 2.

b. The response to this RAI does not include mention of a two unit LOOP. This would impact the availability of the Unit 2 EDGs. Discuss this and any other two unit initiating events

PG&E Response to RAI 1.f

a) The DC01B model is an average maintenance model and takes into consideration the operational and maintenance status of Unit 2. Unit 2 specific equipment includes modeling of maintenance unavailability as well as plant (refueling) outage unavailability, as appropriate.

b) For the DC01B model a loss of offsite power (LOOP) is assumed to affect the entire site, including both units. The Diablo model has several LOOP initiators including those caused by severe weather, grid related, switchyard related and plant centered. All of these are modeled as affecting equipment from both units.

Other initiators that would affect both units include loss of Auxiliary Salt Water, which was discussed in the original RAI response to 1.f, and external event initiators.

3. RAI 1.g

The response to this RAI ("Some important component variables that increased in failure rate include the emergency diesel generator …") implies that there are other important component failure rates that have increased. If this is true identify other important variables that have increased and their potential impact on the SAMA analysis.

PG&E Response to RAI 1.g

The only other important component that increased in frequency is the reactor trip breaker shunt trip coil failure frequency. However, the reactor trip breaker undervoltage (UV) trip coil decreased approximately the same amount as the shunt trip coil increased. Since both are required to fail to cause an anticipated transient without scram (ATWS), there would be no net effect to the severe accident mitigation alternative (SAMA) analysis.

4. RAI 1.i)

The response to this RAI indicates that the DC00 stage 1 model reviewed in the PWROG peer review is different than the DC00 model described in Section F.2.1.6 of the ER. Identify the most significant changes made to the prior model to obtain the DC00 stage 1 model and the most significant changes made in the DC00 stage 1 model to obtain the DC00 model. Also provide the internal events, fire and seismic contributions to the total CDF.

PG&E Response to RAI 1.i

In June 2000, Diablo Canyon Power Plant completed the update to the previous model DCPRA-1997 to support the RI-ISI submittal. The updated model was named as DC00 (stage 1 model). The significant changes made to DCPRA-1997 model included (1) change to the frequencies of Medium loss of coolant accident (LOCA) and Large LOCA base on a review NUREG/CR-5740, (2) development of a simplified large early relief frequency (LERF) model based on input results and insights from the original model, and (3) revision in the modeling of impact on the auxiliary saltwater (ASW) system for loss of direct current (DC) Buses F and G initiating events.

The results of DC00 (stage 1) model are provided below.

Contributor	Mean Core Damage Frequency (per year)	Mean Large Early Release Frequency (per year)
Internal Events	1.41E-05	5.54E-07
Seismic Events	3.36E-05	1.25E-06
Fire Events	1.50E-05	6.42E-09
Total	6.26E-05	1.81E-06

Excluding the Cable Spreading Room and Control Room fires, the total core damage frequency (CDF) was reduced to 5.26E-05 per year.

While preparing the RI-ISI submittal, a few additional changes were made to DC00 (stage 1) model to take credit for the reactor coolant system (RCS) depressurization following loss of charging in the seismic probabilistic risk assessment (PRA) model. As a result the base CDF has slightly reduced to 5.05E-05 per year (PRA Calculation File PRA00-05, Rev 0, Attachment F). The name of the Base model used for the RI-ISI was DC004ISI.

The model reviewed in the pressurized water reactor owners group (PWROG) peer review was DC00 (stage 1).

The DC00 (stage 1) model was updated in March 2001 and renamed it as DCC0. The update included changes made to the model since June 2000. The detailed changes, including the list of the significant changes were listed in F.2.1.7 of the environmental report (ER).

Please note that the next major updated base model after DC00 (stage 1) was DCC0 (not DC00).

The results of DCC0 model are provided below (also in F.2.1.7 of the ER).

Contributor	**Mean Core Damage Frequency (per year)**	**Mean Large Early Release Frequency (per year)**
Internal Events	1.04E-05	4.94E-07
Seismic Events	3.12E-05	1.28E-06
Fire Events	1.33E-05	6.31E-09
Total	5.38E-05	1.78E-06

5. RAI 1.k)

The response to this RAI states "Given that the PRA impact of each of the open items is small, their resolution is not expected to change the conclusions of the SAMA analysis." Further it is stated that the exercise in re-evaluating the SAMAs using the 95th percentile "…more than bounds the impact of PRA open items found in Addendum 1." While the evaluation of the open items in Addendum 1 concludes for most of the items that the impact of the PRA is insignificant or that the results are conservative. This is not the stated conclusion for all the items. For some items, the acceptability of the current model is stated to be that a SAMA has been identified that addresses the stated impact of the model deficiency. While this may partially justify the adequacy of the model for the SAMA identification process, it does not justify the adequacy of the model for the cost-benefit analysis. Further, the assessment at the 95th percentile is intended to provide insights associated with the uncertainty in input parameters not in the best estimate model. Provide further justification for those open items for which the conclusion of no impact on the SAMA identification process described in Addendum 1 is not necessarily applicable to the SAMA cost benefit analysis. In the response, specifically address SAMAs 727 (p. F-277), 289 (p. F-309), 419 (p. F-315), 420 (p. F-315), and 431 (p. F-317),

PG&E Response to RAI 1.k

It is recognized that parametric uncertainty does not technically account for the issues raised in a large majority of the peer review comments, such as model completeness. The citation of the 95th percentile sensitivity analysis was only intended to demonstrate that the impact of addressing the open peer review comments would be bounded by the results of that sensitivity study; i.e., no new SAMAs would be identified as cost beneficial that were not already identified as cost beneficial when the 95th percentile PRA results were used. Estimating the impact of how the use of the 95th percentile PRA results could impact the model after incorporation of the unresolved peer review comments is beyond the scope of the analysis.

In order to directly disposition each of the entries in Addendum 1, it has been reproduced in this response with additional information and/or clarifications in the "Importance to SAMA" column.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	34	Internal flooding - NRC IN 98-31, SER 3-98, A0468801	AR A0468801 was written to document PG&E'S evaluation of an event at WNP-2, where a fire system water hammer led to flooding of emergency core cooling system (ECCS) pump rooms. The evaluation was not complete by the time the 1997 PRA internal flood update was performed. This PG&E evaluation should be reviewed as part of the 1999/2000 PRA update to see if any assumptions or new insights need to be added to the PRA internal flooding analysis.	This will be considered in the updating of the Internal Flooding PRA.	None. No direct impact on current model anticipated. • No expected change in core damage frequency (CDF) or Level 2 results. • No expected change in the SAMA cost benefit analysis.
D	A	35	Human actions for internal flooding in intake structure	The loss of auxiliary saltwater (ASW) due to internal flooding initiating event was created in F.4 revision 1, and uses two human actions in basic events FLHE1 and FLHE2. These basic events represent failure to isolate an ASW pipe rupture (0.1 used) and piping leaks/expansion joint failure, which uses the human action ZHESV2 as a reasonable representation of the value. As part of the next human actions update, consideration should be given to developing the human actions for basic events FLHE1 and FLHE2.	The human error probabilities (HEPs) were re-quantified in the human reliability analysis (HRA) calculator as part of G.2 rev 4. They will be incorporated in the next update of the internal flooding analysis.	None. Current model is conservative and no impact on SAMA application. Flooding is a minor contributor to CDF (<1%) and further reduction of the contributors due to replacing screening HEPs with the results of detailed calcs will reduce it further. This will have no significant impact on CDF, large early relief frequency (LERF), or the SAMA cost benefit analysis.
D	A	56	Expansion joints	Need to add expansion join failures to various system models and maybe some of the system initiators. Expansion joints were added in the intake flooding initiator in winter of 1999. Expansion joints appear in various modeled systems. There is the ASW system (CALC. D.2.6), and the CCWHE (CALC. D.2.7), and there maybe more.	Expansion joints were included as a contributors to the unavailability of ASW and component cooling water (CCW) systems. Need to consider expansion in the circulating water system in the updating of Internal Flooding analysis.	Inclusion of the expansion joint failures to the flooding model will have an minimal impact on the PRA: • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	309	ST - 3 - Flooding Treats Doors Deterministically "C"	The flooding analysis treats failure of doors deterministically, not probabilistically. In a PRA, a probabilistic assessment of failure of flood barriers should be included. That is, the probabilities that various flood barriers may fail should be included in the overall assessment of flooding-induced core damage scenarios.	Consider the effects of failure of flood barriers when Internal Flooding analysis is updated.	The incremental impact of the additional failure mechanisms is not likely to be large unless a new propagation pathway is identified. Insignificant impact on flooding risk is expected and no impact on SAMA application. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
D	A	602	ASME SRs IF-B1b, IF-C5, IF-C5a	Table F.4-2 [B3] includes a screening process. However the general screening criteria used are not well defined and justified and in some cases include judgmental credit for isolation of sources before damage/ propagation can occur and /or drainage capacity. The containment is screened out on the basis that it is designed for loss-of-coolant accident (LOCA) and high energy line breaks in containment (section F.4.3). **Recommendation for improvement to meet PRA Standard** Recommend defining a set of qualitative and quantitative screening criteria consistent with the ASME standard and indicating for each specific flood area which particular criteria is applicable.	Screening criteria from the ASME PRA Standard will be adopted in the update of Internal Flooding analysis.	Flooding events are not significant contributors to CDF and revision of the screening rules and applying them to the containment area will not introduce new, important flooding scenarios. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	603	ASME SRs IF-C1, IF-C3b	Table F.4-2 identifies the flood propagation paths from the source area to an adjacent area (but no further) Section F.4.3.2 provides a general discussion Section F.4.3.2 provides a good general description for each building (turbine, intake, auxiliary and fuel handling) of the flood propagation pathways to their ultimate point of accumulation. Did not see any reference to analysis of structural failures in the analysis although this probably because the potential for significant flood accumulation in most cases is minimal given the plant design. The only evidence of random barrier element failures being considered is in respect of the ASW room drain check valves. **Recommendation for improvement to meet PRA Standard** In flood area information sheets (see IF-A4) document potential propagation paths thru cable penetrations as well as doors and heating, ventilating, and air conditioning (HVAC) ducts. Review flood analysis to identify cases where flood accumulation may occur (or has not been ruled out) and determine if consequences of barrier element challenges (e.g. doors or penetration seals) may result in a plant impact which has not been addressed in the current flood analysis. If so perform engineering analysis to determine if the barrier element will withstand the loading Performing the above will satisfy the Cat II requirements. In order to satisfy Cat III requirements the random failure of any barrier elements identified as being challenged and with significant consequences of failure will need to be addressed. (See Westinghouse F&O type C) For area which may be susceptible to high energy line breaks determine if barriers and barrier elements will be challenged by over pressure and determine consequences of failure.	Only areas where significant accumulation leading to structural failure of barrier elements are the safety injection (SI) Pump room and Charging Pump Room. In these cases one can assume that barrier failures may lead to damage in adjacent areas where appropriate.	Those flooding events are not significant contributors to CDF. In these rooms, the most likely failure barriers are the doors leading to the hallway. Because significant openings exist between the floor/platform elevations in the Aux Building, the flood should accumulate in the basement (i.e., 54' Elev) of the Aux Building, where no risk significant equipment is present. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	604	ASME SRs IF-C2a, IF-C6	Automatic or operator responses to terminate floods are summarized in the discussion of flood location and scenario evaluations provided in section F.4.3.2 Table F4 Scenarios 45, 46, 53, 54 appears to credit manual action for isolation in order to screen (although it is not clear whether the consequences of non isolation are significant). No discussion of flood indication, timing or means of isolation is provided. **Recommendation for improvement to meet PRA Standard** Where such features form part of the argument for screening or evaluating flood scenarios this information should be provided. Specifically recommend evaluating the reliability of actions credited in the scenarios 45, 46, 53, 54, 69, 83 and 84.	Consequences of non isolation in a timely manner were found to be potentially significant for service cooling water (SCW), CCW, refueling water storage tank (RWST) supply floods and auxiliary feedwater (AFW) pump room floods in terms of controlling the potential for flood propagation or gross system impact. A screening analysis is proposed which does not credit isolation, except in the case of the SCW where the flooding rate relative to the volume required to cause damage was judged to be such that the time available would be many hours.	The manual and power operator valves that are potentially available to isolate a system breach were listed in the flooding analysis calculation (PRA Calc F.4) as part of a complete systems description; however, inclusion of the valves on that list does not imply that they (or manual operator actions) were credited in screening flood scenarios. The problem or gap description in Record #604 is not correct and no response to this record is necessary. • No change in CDF or Level 2 results. • No change in the SAMA cost benefit analysis.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	605	ASME SR IF-C3	Equipment susceptibility to various types of flood hazard are identified in table F.2-12 of the original Diablo Canyon Power Plant (DCPP) flood PRA. In summary this table indicates that all electrical components except cables are assumed to be susceptible to flood accumulation and spray. High energy jet impingement may cause damage to all electrical components including cables. No reference to junction box qualification/damage is given and the treatment needs to be checked. It is not clear that high energy line break effects have been considered in the Revision 1 update. **Recommendation for improvement to meet PRA Standard** Need to include potential damage to junction boxes treatment due to spray and submergence.	Impact of high/moderate energy line breaks (high energy line break (HELB)/moderate energy line break (MELB)) need to be considered for Capability Category II. An update of the Internal Flooding Analyses should evaluate and document the impact of HELB/MELB.	Impact on conclusions of the current application will be negligible. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
D	A	606	ASME SR IF-C3c	The results of engineering calculations of maximum flood heights reported in DCM T-20 (see table F.4.4) are used in the study. For example a maximum flood height of 3" is cited as the reason for lack of flood propagation from the AFW TDP pump room to the AFW MDP pump rooms. When this reference was reviewed the calculation referred to was not apparent. **Recommendation for improvement to meet PRA Standard** Need to identify location of flooding calculations relied upon in the analysis and review underlying basis to ensure consistency with PRA requirements (e.g. no restrictions on maximum crack size or assumptions about isolation within specific time)	An update of the Internal Flooding Analysis should determine the applicability of design calculations cited in the existing Internal Flooding study.	Documentation issue. No impact on SAMA application.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
D	A	607	ASME SR IF-C4	Flood scenario development is generally accomplished in section F4.5.1. However it is not clear the analysis has recognized the consequences of flood isolation on system availability That is isolation of an AFW system flood may require the condensate storage tank (CST) source to all pumps to be isolated depending upon (the break location). Isolation of a CCW flood may require partial isolation of the CCW system **Recommendation for improvement to meet PRA Standard** Screening analyses proposed which does address impact of isolation of flood source. Further detailed analyses may be needed if this conservative analysis shows high risk contribution.	The affected Internal Events analysis is conservative.	As discussed in Record #604, the flood analysis does not take credit for manual actions as means of mitigating the consequences of a flooding. The current Internal Flood PRA model is conservative since a guaranteed failure of the system is assumed if a system breach/rupture occurs. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
D	A	608	ASME SR IF-C5a	It appears that DCPP analysis (Table F.4-2 item 23) credits isolation of a large turbine building flood prior to propagation to the diesel generator (DG) corridor or the fuel oil pump room vaults via drains, and the 12kV room due to the automatic condenser mitigating features. This qualitative argument is used to screen out all propagation scenarios from the turbine building. **Recommendation for improvement to meet PRA Standard** Further examination of the reliability of the isolation system, the timing available for operator action, the integrity and reliability of the doors and drain check valves which protect the emergency diesel generator (EDG) rooms, the fuel oil pump vaults and the 12kv switchgear (SWGR) room as well as any drainage paths to the outside, is warranted in order to screen this scenario (Although extremely unlikely this scenario could lead to a loss of the EDGs and loss of offsite power).	An update of the Internal Flooding Analysis will re-examine the Turbine Building flood scenario(s).	It is unlikely this scenario could lead to a failure of EDGs even with a loss of the automatic detection and isolation system because of the significant openings to the outside at the 85' TB elevation. It is not likely to accumulate to the level which could challenge the barriers between the turbine building and EDG rooms/corridor. • Expected to have no significant impact on CDF or Level 2 results. • Expected to have no significant impact on the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	320	Missing human action to line up SUT21 after failure of SUT11	The fault tree for top event OG takes credit for the Unit 2 transformer after the failure of SUT11. However, when this was put into the model, a human error probability (HEP) was not added for this. Probably because at first it was just being added to the model for planned maintenance on SUT11, but was expanded to failure of SUT11.	Including HEP for switching to Unit 2 SUT on loss of SUT11 has a very small impact on the unavailability of power from the 230kV offsite grid.	• No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	394	hard coded conditional HEP in top event MU	Originally, in the model there was one HEP for the operators to makeup to the RWST in the general transient tree. During the HEP dependency study it was noticed that the HEP was used even if the operators had failed to swap over to recirculation cooling. As a work around for this, a conditional probability of 0.1 was used. A new HEP needs to be developed for this situation that is more realistic.	A new conditional prob of 0.5 was used in sensitivity study.	If the failure probability of the RWST makeup action is too low, the SAMA analysis could be impacted. However, a SAMA was identified to automate swap to recirc mode (SAMA 2), which would preclude the need to refill the RWST, if successful. Even if it assumed that the benefit of SAMA 2 is directly proportional to the RWST makeup HEP, a multiplier of 5 on the SAMA 2 averted cost risk (to account for the difference in proposed HEPs) would still not yield a cost beneficial result. The result of multiplying the 95th percentile averted cost-risk (from RAI 3c) by a factor of 5 is still far below the $6.5 million implementation cost: 5 * $192,451 = $962,255. This issue will not change the SAMA identification process or the conclusions of the cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	407	HEP ZHEBC1 has procedure steps different from execution procedure.	During the H.3 Rev. 2 procedure review, it was noticed that HEP ZHEBC1 execution steps differed from the current revision of J-9:II (Rev.14). Steps have been deleted and added to the procedure since the HEP analysis. For Calc Files G.1 and G.2 update, this should be reviewed.	The operator action (HEP of ZHEBC1) is a very small contributor to the unavailability of the long term DC power supply.	No impact on the conclusion of the SAMA evaluation since the change will have a very small impact on CDF and the Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	411	ZHEAW2 needs updating	ZHEAW2 needs to be updated by including new procedure steps from OP D-1:V. The current PEXE in ZHEAW2 does not include opening MU-284. 284 is now a normally closed valve and must be opened prior to supplying AFW with RWR.	This has a very slight impact (small increase) on HEP.	Insignificant impact on the SAMA analysis due to the very small impact on the unavailability the AFW system and CDF/Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	429	Include Manipulation Time in HRA calculator Timing Analyses	Currently, G.2 Rev. 5 is inconsistent in its description of timing (i.e. the scenario description form indicates a TSW that is different than the time window form.). In addition, the time window does not indicate a manipulation time whereas the scenario description indicates a manipulation time. For the determination of low dependence, medium dependence etc. this is not a concern since the available time window remains the same. However, with the addition of a dependency module in the HRA calculator, the inclusion of a manipulation time in the time window form may become important. Action: Include manipulation time in time window form for the HRA calculator and adjust TSW accordingly.	Include manipulation time in time window TW. HRA issue.	This is being addressed in the HRA gap closure project. Inclusion of manipulation time in the HRA calculator will not impact the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	430	HRA assumption for control staffing has changed	During interviews with operations personnel for the fire HRA, the control room staffing arrangement was brought up. Since the HRA update, the makeup of operators and Senior Reactor Operators (SROs) in the control room has changed. The position of Shift Engineer is now called the Work Control Shift Foreman (WCSFM) and that person now sits in the 119' turbine building area. Also, the two Senior Control Operators (SCOs) (one for each unit) are also located outside of the control room. These relocated OPS personnel can and will still respond to an accident situation. This may effect the assumptions in the HRA concerning cognitive and execution recoveries. During the next HRA update, investigate whether any of the DCPP HEPs will be affected by this staffing change.	Investigate impact of CR staffing change on HRA. HRA issue.	Despite ex-control room locations for operations personnel, they will be available during an accident to assist control room staff with diagnosis and performance of credited actions. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	448	ZHEPR3 assumed time window of 1 hour	HFE ZHEPR3, Operators fail to close power operated relief valve (PORV) Block Valve within 1 hr. The time window for this HFE was changed from 4 minutes in G.2 Rev.3 (ZHEPR2 - isolate PORV after reactor trip, prior to SI) to 1 hour in revision 5. The basis for the 1 hour criteria is not clearly spelled out anywhere in the PRA documentation.	Determine basis for 1 hour time window for ZHEPR3.	Documentation issue. No impact on SAMA analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	704	ASME SR HR-G2:(2)	There are also other actions that were assumed to have negligible HEPs for the cognitive contribution and were not evaluated for cognitive errors (there are a total of 15 actions which have zero values in Table 1 for the human cognitive response probability; e.g. ZHEOR1 for steam generator tube rupture (SGTR) cooldown and depressurization). This review does not accept the assertion that these actions can be assigned zero cognitive error probabilities.	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	The gap closure process may result in a change in HEP values. However, previous sensitivities performed on this set of HEPs as part of ECCS allowable outage time (AOT) license amendment request (LAR) show that the impact on CDF is small. Given the small impact on CDF, it is projected the there will also be a small impact on the Level 2 results and that they will not impact the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	707	ASME SR HR-G3:(1)	Due to the short time window available for cognitive diagnosis and decision-making (excluding cue time, any other delay time, and manipulation time), some actions may be significantly influenced by the PSF for "Time" (e.g., ZHERE5, ZHEPR1, ZHEOE1, ZHERF2, of the 10 sampled are of this type) These actions were evaluated using the CBDT approach only. For actions evaluated using the CBDT, the PSF for “Time” is accounted for only in the assignment of the level of dependency for recovery. For the evaluation of the initial errors, however, the PSF for “Time” (which may contribute to the occurrence of error due to the time pressure) is not accounted for in the CBDT tree branches.	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	The gap closure process may result in a change in HEP values. However, previous sensitivities performed on this set of HEPs as part of ECCS AOT LAR show that the impact on CDF is small. Given the small impact on CDF, it is projected the there will also be a small impact on the Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	709	ASME SR HR-G3:(2)	Section 5.3 on Page 19 states that “single” procedure should be selected for PCE but this seems inconsistent with EPRI guidance. (see actions ZHEPR1, ZHERF2,).	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	The impact to the HEP as a result of a change in PCE to "multiple" procedures results in a small increase in HEP value. This will have only a small impact on CDF. Given the small impact on CDF, it is projected the there will also be a small impact on the Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	712	ASME SR HR-G3:(2)	Regarding Assumption 7 in Section 4.1 on Page 4, not all procedures use the Response Not Obtained (RNO) format so it is unclear if the THERP tables used are correctly adjusted for all actions. For example, Step 3.h in Appendix B of Procedure OP AP-11 was treated in the analysis of the execution error for ZHECC1 (CCW heat load reduction) as if the procedure is in a columnar or “Response/Response Not Obtained” format, while this procedure is not written in this format. Another example is the annunciator response procedure used for the analysis of ZHECV1 (Control room ventilation recovery).	Actions important to risk typically involve procedures that are in a RNO format (All emergency operating procedures (EOPs) except for some appendices). ZHECC1 and ZHECV1 use Swain's table 20-7 which is used for narrative style procedures not RNO procedures.	Does not impact the SAMA analysis or any other application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	713	ASME SR HR-G3:(2)	For Modeling Convention 6 in Section 4.3.4 on Page 13, the reviewers do not believe that NUREG/CR-1278 intended that the first 10 steps of a long list can be assumed to be from a short list. (e.g., in the analysis of ZHERF2).	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	The use of a long list assumptions increases the HEP by slightly more than a factor of 2. However, previous sensitivities performed on a set of HEPs (including ZHERF2) as part of ECCS AOT LAR show that the impact on CDF is small. Given the small impact on CDF, it is projected the there will also be a small impact on the Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	727	ASME SR HR-G7:(2)	The dependence analysis documentation suggests that there was a general assumption that if actions are directed by procedures with different numbers they can be considered independent. This is questionable. Other factors, such as time required, increased stress, availability of resources, and common instrumentation, can lead to dependencies between actions. Such dependencies governed by time are noted in the HRA methodology write-up.	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	Important sequences that contain multiple operator actions were reviewed in the DCPP HRA dependency analysis. The only identified combinations that were screened for this reason involved seismically induced failures of the CST (AW) and subsequent failures to either initiate feed and bleed (OB) or cold leg recirculation following successful feed and bleed (RF). While the dependency analysis is pending, the dependency assessments are not expected to change significantly for the relevant sequences: • The independence of swap to recirculation mode will be established based on the vast difference in timing and also on cue type/instrumentation (low RWST level vs steam generator level).

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
						Continued from above • The timing for aligning an alternate AFW suction source and initiation of Bleed and Feed is similar, but they are based on different alarms/cues using different instrumentation (low CST level/AFW pump trouble vs. low SG level). In addition, the actions address different functions (secondary side heat removal vs. primary side heat removal, involve different systems AFW/saltwater (SW) vs SI/chemical and volume control system (CVCS)) and of course, different procedures. The expected dependence level would be "low" or "independent" for these actions. This issue did not prevent identifying HFEs important to the SAMA analysis or the development of SAMAs. In addition, the margin in the cost benefit results for the relevant SAMA (SAMA 14) is large enough that the potential changes to the assumed level of dependence would not change the conclusions of the analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	728	ASME SR HR-G7:(2)	In some sequences, the presence of an intervening successful action (i.e. in the same sequence) can be used to dismiss actions failed in the same sequence as being only weakly dependent. Successful actions were not considered in the dependence review.	Not crediting successful intervening actions is conservative. Disposition of this issue will not adversely affect the results of this application.	Addressing this issue would potentially reduce importance of impacted HEPs. Impact of this would be minor since only HEPs with modeled dependency would be affected, and then only slightly. The reduction of dependence levels could result in a reduction in CDF, Level 2 results, and in some averted cost-risk values. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
F	A	731	ASME SR HR-G7:(2)	For one selected sequence involving ZHEOE1, the analysis asserts that the action quantification analysis itself (using CBDT) adequately considers dependence with preceding actions in the sequence. This is not correct. Another example of a need to carefully evaluate the dependence on preceding actions in specific sequences is ZHEMU3.	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	An increase in the dependency between ZHEOE1/ZHEMU3 and preceding HFE failures would increase the importance of these sequences. This corresponding increase in CDF would be small since the current sequence contributions are low and would not be increased significantly by incorporation of dependence. The minor impact on CDF and Level 2 results would have no significant impact on the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
F	A	732	ASME SR HR-H2:(1)	For the analysis of recovery actions (e.g., in the case of ZHECT1), it is unclear if credit can be taken, when the procedural guidance referenced is not sufficiently detailed to determine the operator's execution steps. Failure mechanism PCF may better be evaluated as item (g) 6E-2, rather than (a) negligible.	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	Proceduralized RNO directs investigation of differential/overcurrent relay issues. Given skill of craft, this direction is sufficiently detailed given cue (blue lights on CR panels). No change in CDF or Level 2 results expected; therefore, this issue would not impact the SAMA analysis.
F	A	733	ASME SR HR-H2:(1)	The action contained in recovery split fraction RE6A is mentioned in the dependency analysis but is not included in summary Table 1	DCPP HEPs are being reviewed as part of the internal PRA gap closure process.	Documentation issue. Dependency is modeled. No impact on SAMA analysis.
G	A	808	ASME SR LE-F2	LE-C10 is met at Capability Category I. The Level 2 re-peer reviewers noted a lack of evaluation of impact of key sources of uncertainty on the Level 2 LERF model. The re-peer report discusses a number of potential sources of uncertainty and impacts. For most PRA applications, it is not likely that such issues will affect LERF insights.	A formal evaluation of uncertainties in the LERF model has not been performed.	Not significant. Given the conservative nature of the approach used, formal consideration of uncertainties in the LERF modeling has no significant impact on the SAMA analysis.
G	A	811	ASME SR LE-G4	LE-G4 is not met. Basis is the Level 2 re-peer reviewer's assessment. Consideration should be given to developing the recommended evaluation of Key Assumptions and Key Sources of Uncertainty for the LERF model.	A formal evaluation of uncertainties in the LERF model has not been performed.	Not significant. Given the conservative nature of the approach used, formal consideration of uncertainties in the LERF modeling has no significant impact on the SAMA analysis.
G	A	812	ASME SR LE-G5	An assessment of limitations of the LERF model that might impact applications has not been developed.	A formal assessment of the limitation of the LERF model and the evaluation of uncertainties in the LERF model has not been performed.	Not applicable. The SAMA analysis uses an expanded Level 2 model.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
H	A	176	Seismic trip and PORV challenge	In revision 2 of calculation file F.6, the assumption that there was a PORV challenge on every seismic initiating event was removed. This was because in most cases, the plant had already tripped from the seismic event (via seismic trip) and did not experience a load rejection when 500 kV was lost. The first item is that this assumes the seismic trip works successfully all the time. To be more correct, the seismic trip should be added to the model and than the effect of the seismic trip can be evaluated probabilistically. Second item is the seismic trip has a setpoint of about 0.3 G'S which is about 2/3'S the way through the first seismic initiator (which goes to 0.53). This would imply that below 0.35 there should be a PORV challenge, if 500 kV was lost (which is not yet modeled). To better model this SEIS1 initiator should be changed to 0.4, and the details of the 500 kV and seismic trip should be modeled. Note RISKMAN is limited to only six acceleration levels, so this would require re-adjusting the exist boundary between SEIS1 and SEIS2. Also note this corresponds to the double design earthquake (DDE) earthquake, which was the safe shutdown earthquake prior to the HOSGRI upgrades which put the SSE to 0.75 G'S. 12/19/02 EGD Also note we do not model a PORV challenge on seismically induced LOSP, which should be adequate for SEIS 2 through 6 due to seismic trip, but maybe a noticeable contributor in SEIS1.	Modeling PORV challenge due to seismic induced LOSP has insignificant impact on the seismic induced CDF/LERF.	None. Insignificant impact on CDF, Level 2 results, and SAMA analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
H	A	265	Address anchorage of relay panels in cable spreading rooms	NRC letter dated 12/4/97 informed DCPP that the intent of GL 88-20, supplement 4, had been met. The attachment to the NRC report was a consultant's report entitled, "Technical Evaluation Report on the Submittal-Only review of the Diablo Canyon Power Plant (Units 1 and 2) Individual Plant Examination Of External Events," dated September, 1997. On page 28 of the consultant's report, they state in (B)(1) "..it is unclear if the licensee performed an analysis of the anchorage of relay panels within the cable spreading room." the concern is whether this equipment is a seismic induced hazard. Please address this issue and reference documentation.	To confirm that an analysis had been performed of the anchorage of relay panels within the cable spreading room.	This is a documentation issue and no impact on the SAMA analysis.
H	A	271	Address potential for d/g lockout from cardox	NRC letter dated 12/4/97 informed DCPP that the intent of GL 88-20, supplement 4, had been met. The attachment to the NRC report was a consultant's report entitled, "Technical Evaluation Report On The Submittal-Only Review Of The Diablo Canyon Power Plant (Units 1 and 2) individual plant examination of external events," dated September, 1997. Page 28 of the consultant's report, under (B)(2), they state "..it is unclear if the analysis considered the potential for diesel generator (lockout or starvation) failure caused by seismically induced activation of the co-located CO2 system. Also, it is unclear if the licensee analyzed the potential for icing or freezing or relays within the cable spreading room given seismically induced activation of the CO2 system, or the potential for the weight of the CO2 suppressant, which condenses on the cable trays, to fail safety-related cabling because of structural failure. Please address these three issues and reference documentation.	Address Seismic-induced loss of CO2 and its impact.	The electrical power reliability, including the EDGs, has been addressed in the SAMA. The risk contribution due to a failure of EDGs from a seismically failed CO2 system is expected to be minor. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
H	A	450	Split fraction event tree rules for seismic RCP seal modeling	The backstop split fraction SEX is seen in sequence 124 (DC01 ECCS AOT application) and others. This is a result of the lack of a rule that looks for no CCW flow with AS=S but with no support for CCP 1-1. The complementary rule exists (with no support for CCP 1-2). The result of this discrepancy is to give slightly more conservative results since a guaranteed failure is used in this particular instance rather than a calculated split fraction. Update SE event tree logic with provision for no CCP 1-1 support.	Need to add SF and rule for the scenarios with No CCW and no support for CCP 1-1.	Current results are conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.
J	A	1	Self assessment - initiating events -- expand ISLOCA calc discussion	More discussion should be added to ISLOCA calculation files C.4.7 and E.10 to justify the exclusion of tests or procedures contributing to the ISLOCA frequency.	Review related test procedure to determine if they contribute to ISLOCA.	This is a documentation issue and no impact on the SAMA analysis.
J	A	8	Self assessment - thermal/hydraulic analysis -- review FSAR success criteria for realism	In the future, success criteria based on the FSAR should be reviewed (i.e., number of accumulators that must inject for a large LOCA) to see if the success criteria can be made more realistic and less conservative. 12/19/02 EGD During the beaver valley peer certification, I learned that MAAP could not be used for the accumulators because it does not do a good job during the LOCA blow down phase when the accumulators are used.	To review applicability of FSAR success criteria to PRA to reduce conservatism.	Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	11	Self assessment - data analysis -- compare random comp data with current data	Compare the random component failure data with a more current database or data used in other PRA'S (such as the data available in the Westinghouse Owners Group (WOG) PSA comparison database) to ensure that the probability values are reasonable. Note that the original database used as the basis for the DCPP PRA model is 1988 vintage. Even though most of the data has been updated using plant specific information, a general review of the probability values is prudent.	Compare component failure rate used with other industry sources (e.g., WOG Comparison database). Use the most appropriate one. Results not expected to change significantly since they were updated with plant specific experience.	Not significant since risk results are not expected to change significantly. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	43	CRVS alignment with both trains OOS	In CALC file D.2.4, there is a maintenance alignment that has both trains of control room ventilation out of service, thus disabling HVAC to the solid state protection system (SSPS) room. Is this allowed by Tech Specs (remembering that CRVS has a support function for SSPS)? Should it be left in top event CV. It does not appear in initiator LOCV. Need to check the new ITS and ECGS.	Need to consider the validity of two CRVS trains out of service configuration. Note that operator would open door to SSPS room as compensatory measure.	Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	48	Inconsistent number of "cold shutdowns"	In CALC file E.5, they assume one cold shutdown per year in addition to a refueling every 1.5 years. The number of non-refueling cold shutdown is not consistent with DCPP operating history. Additionally, it uses variable ZDCNCS of 0.842 for the number of cold shutdowns to model demands, but CALC file E.2 uses this same variable to model demands in AFW which are actually hot shutdowns, of which there are more in DCPP history. CALC file E.2 also has a local variable @NRF of one refueling shutdown per year, while other CALC files use one refueling every 18 months (which is no longer true). We should probably setup some global variables that all the system calcs could reference for consistency basis. This appears in two system CALC file. In both cases the cold shutdowns are added to the number of refueling shutdowns. However, in H.1.5 we gather the number of cold shutdowns including refueling outages. Maybe the easiest way is to just gather the data differently (i.e. only gather as non-refueling cold shutdowns). Also note there is another action note because the number of cold shutdowns in E.2 appears to actually be used as number of hot shutdowns.	ZDCNCS is to be updated in the next data analysis update.	Given that a very small impact on risk results is expected, this issue has no impact on the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	52	C.9 quantification notes, LLOCA and accumulators	During the review of C.9 results, it was noticed for the LLOCA sequences that the accumulator failure was quite noticeable. DCPP uses 3/3 success criteria, but other plants seem to be using 2/3 or maybe 1/3. It should be investigated if the DCPP success criteria from the late 1980's is still appropriate, or should it be relaxed. Also note accumulators are taken credit in the time to core uncovery in the electric power recovery model.	Not implemented. To review success criteria of accumulators for LLOCA in future update.	Current results are conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	54	C.9 quantification notes and CV vs SSPS	While reviewing the results of the C.9 quantification, it was noticed that there was a dependency between SSPS and its souce of HVAC. The question that comes to mind is what part of SSPS is needed in a MLOCA after the first phases of the accident? It takes 90 minutes for the SSPS room to heat up (see section A for DCPRA). I checked the LLOCA and it was the same way. But when I checked the general transient tree, the CV dependency was not there. I would expect this to be the other way around, i.e. GENTRAN needs CV and the faster acting scenarios do not.	Investigate validity of dependency of SSPS on CRVS. (see Item #80)	Current results are conservative. Even with conservative results, this dependency was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.
J	A	59	MLOCA recirc success criteria	While performing an evaluation of the risk significance of the "void" issue, the existing DC1997 model did not have the details needed. Hence a separate calculation had to be performed. Basically, the success criteria used in the PRA model has 2 out of 4 of the centrifugal charging pumps (CCP'S) and/or safety injection pumps (SIP'S) needed for a medium LOCA. In a more detailed thermal hydraulic calculation, it was noticed that the criteria could be relaxed to 1 out of 4 pumps in recirculation phase. PRA calculation 99-01 has further details.	Revise CH/SI success criteria to 1/4 from 2/4 for MLOCA in future update. (See PRA 99-01)	Current results are conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.
J	A	68	Gather other plants' data on relief valves	During the review of the BOP model, it was noticed that we do not collect plant data for relief valves. We have been using the same failure rate since the LTSP for ZTVR2O and ZTVR2T. We should be gathering some plant data on these. Probably need more than just one type of relief valve (i.e., the relief valves on saltwater systems are subject to more failures than clean systems). Note we do gather specific data on the pressurizer PORV'S.	Consider developing plant specific data for relief valves.	No impact on the SAMA analysis as contribution of relief valves to CDF/Level 2 results is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	76	Battery charger unavailability in H.1.5 & D.2.1.2	The unavailability of battery chargers in the PRA appears to be less than actual plant practice. The average unavailability in the model is 37 hours per year which is noticeably less than the duration of the one planned yearly maintenance outage window (MOW) of three to four days. Prior to the current model, battery chargers did not have a maintenance alignment in the PRA. In the DC1997 model, the direct current (DC) train alignments were changed from the bus to the battery chargers, utilizing the existing database variables of ZMBCHF and ZMBCHD. These variables appear to represent data collected over the normal range of the PRA. The duration of 69.9 hours seems reasonable but the frequency is 6.06E-5 which is significantly less than the yearly MOW frequency. The battery chargers used to be done in the outage. They were moved to on-line maintenance in the early to mid 1990's. The frequency in the PRA database is probably affected by the time when battery charger maintenance was not done on-line. Also in the 1997 update (for 1/1/95 to 9/30/96) there was no observed out of service times, which does not sound correct for yearly MOWs. Finally, it needs to be checked to see if this data is just for the primary chargers (11, 12 and 132) or also for the backup chargers. The low unavailability was noticed by Tom Leserman when he was establishing an unavailability criteria for the battery chargers for the maintenance rule. In 2000 the battery chargers MOW went from single shift to double shift since they are risk significant in the maintenance rule.	The battery charger maintenance unavailability is about twice that is being used in the current model. The impact on the DC Power unavailability due to this increase in maintenance unavailability is insignificant due to the availability of backup charger. Need to update Battery Charger maintenance unavailability in future update.	Impact on DC Power unavailability is insignificant. Also, the identified SAMA #3 is associated with the DC power supply. Therefore, there is no impact on the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	80	CRVS modeling, how is the split fraction logic done	When Tom Leserman was looking at control room ventilation, it was unclear how CRVS failure affected the SSPS since the CRVS is after SSPS in the MECHSP tree. On closer examination, it was noticed that some of the equipment that used SSPS actuation looked at both SSPS and top event OS (and some CV directly). It appears that OS0 gets selected if SA and SB are successful, but maybe also should have CV=S also. We checked the CCDP and it was almost 1.0 (but then again that was also true of the LTSP). the whole methodology of how CV failure affects the model needs to be checked out. At best all we may need to do is document what is there so we can better understand it. But when you look at AE'S 24, 25, 34 AND 50, it appears that something probably needs updating in the model. I Ran a sensitivity run with CV=S "ANDED" on the OS0 split fraction and the increase in CDF was only 1E-8. In C.13 two new maintenance cases were generated for the two trains of CRVS, and the results were similar. But the RAW for each of the trains for the other alignments (including the no maintenance alignment) were still off by an order of magnitude. Tom Leserman thinks that this maybe due to the dominance of the two trains maintenance alignment (MAINT3) which fails the system and has all its risk passed back to the assumed running train. The reason for SSPS is the 90 minute heatup of the SSPS room with no action to provide alternate cooling. This could probably be looked at and updated, since the adjacent computer room appears to have excess cooling. Also the old Tech Specs has CRVS for equipment cooling (but doesn't say which equipment) and operator safety. The NE ITS DCPP. For the SSPS room heatup, PLG-0637 SEC A.4.2.1 says 90 minutes, CALC file D.1 table D.1-1 footnote #43 quotes 8 hours.	Only dependency of SSPS on CRVS need to be investigated. (See Items #54 and #111)	Current modeling of dependency of SSPS on CRVS is conservative. Even with conservative results, this dependency was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	82	Moving FCV-495/496 from ASW CALC to CCW CALC	When doing the ASW PRA system evaluation (D.2.6 REV 7), it was determined that the failure (transfer close) of FCV-495/496 would be better modeled in the CCW CALC file (D.2.7) where the heat exchangers are located. the reason for this was that the ASW system did not know which heat exchanger was in service, so it was assumed that if either FCV-495 or FCV-496 closed that would fail the ASW system because it could not be determined if there was a flow path to the inservice heat exchanger. The rate of the FCV-495 and FCV-496 transferring closed is small and could be more realistically modeled with the CCW heat exchangers in top event CC. In the ASW system the current model says that ASW is failed if either FCV-495 or FCV-496 has closed, and that is not realistic. Failure of FCV-495, FCV-496 have been taken out of the AS top event but has not been added to the CCW system.	Model FCV-495/496 in CCWS. Note that these valves have been removed from the ASW model. Contribution of FCV to CCWS unavailability not significant.	Not significant since impact on CCWS unavailability is insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	88	No common cause between instrument inverters D.2.1.7	There is no common cause failures modeled between any of the four vital instrument inverters. It is suggested that common cause failure between the four inverters be developed. this is not expected to be a major effect on the model, since the inverters are reliable and contribute little to core damage. However, the common cause failure of the inverters will probably be a noticeable effect on the worth of the individual inverter components.	Consider CCF of inverters. No industry data on CCF of inverters is currently available (See NUREG/CR-6268)	Pending availability of data. Based on the reliability of the components, the impact will be small: • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	105	Electric power recovery, separate offsite and DEG	When looking at the plant trip of 5/15/00, it was noticed that electric power recovery in the model could not be applied to reflect the plant conditions during that trip. Electric power recovery has both off-site and diesel generator recovery built into the split fraction. The plant at that time could not recover off-site power due to in plant equipment failures, but could recover the diesel generators. To model this in the future, additional recovery factors should be developed in calculation file G.4, so diesel only recovery is available for top event RE.	Recovery of DG only is modeled for the significant LOSP scenarios.	Current model includes the recovery of DG only for LOSP scenarios. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	111	MLOCA and CRVS lead to core damage	During the review of sequences for CALC C.9, it was noticed that an MLOCA and failure of CRVS (top event CV) Leads to core damage. The split fraction logic has failing all the ECCS equipment on failure of CRVS and operator failure (which operator failure is guaranteed under INIT=MLOCA). The actions are needed fast, but the CRVS will not fail that fast. This should be looked at more closely, since the CRVS will not fail the SSPS until a substantial time delay, and the automatic SSPS actions needed to combat a MLOCA are needed during the initial part of the transient. See sequence #58 in C.9 REV 7.	Review the dependency of SSPS on CRVS for MLOCA scenarios.	Current modeling of dependency of SSPS on CRVS is conservative. Even with conservative results, this dependency was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.
J	A	121	Unfavorable exposure time (UET) and ATWT	On the longer cycles, the effect of ATWT becomes more pronounced with the UET. On initial investigation the DCPP model does not take this into account.	Investigate the effect of longer fuel cycle on the impact of ATWT scenarios. Effect is expected not to be significant.	Not significant since contribution from ATWT events on CDF/LERF is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	143	All Main Steam Isolation Valves (AMSIV) & IMSIV PORV challenges in D.1 & E.3	The present model has the PORV'S as being challenged by AMSIV and IMSIV by water if the operators do not terminate safety injection in time (note present DC00 model has the operator action set to 1.0). This challenge is correct, but there is also a challenge by steam initially. When all the MSIV'S go shut, there is a pressure rise which lifts the PORV'S then there is a high pressure reactor trip. This happens seconds into the transient. This initial challenge is not in the model. Presently the model probably overstates the effect of PORV challenges since it assumes there is a water challenge each time. When an updated operator action is put back in, the model will probably understate the effect of the PORV'S since it does not account for the initial steam challenge. Also note the closure of one MSIV will lead to a steam line isolation due to rapid steam pressure change, which in turn shuts the rest of the MSIV'S.	Need to investigate if there are other conditions that would challenge the PORVs. In particular, steam relief if operator is successful in terminating the high pressure injection.	From PORV importance point of view, which is a concern to SAMA, the assumption of water challenge to PORV is more severe and conservative. Therefore the impact of this model conservatism should not affect the SAMA selection. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	146	add anticipated transient without scram (ATWS) mitigation system actuation circuitry (AMSAC) CC to H.1.4	In CALC file D.2.8 rev.0, AMSAC, investigate the common cause failure rates for the components in reliability block LP. The failure rates in rev. 0 are modified relay failure rates. Future rev. may need new failure rates developed for any common cause combination of three trip logic modules. for further information, see documentation in CALC file section D.2.8.1.3. 01/30/02 EGD The WOG SSPS WCAPS may have some failure rates that are more appropriate to use.	Use WOG SSPS failure rates in future updates. New data source is expected to have a small impact on the system reliability.	Not significant since impact on AMSAC unavailability is insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	148	Add AMSAC maintenance unavailability to H.1.2	AMSAC added to model DCC0 with CALC file D.2.8 rev. 0. Current revision contains estimated maintenance unavailability. H.1.2 needs to be updated to include the AMSAC information.	Include AMSAC maintenance data to H.1.2 in data analysis update. Updated data is expected to have a small impact on the system reliability.	Not significant since impact on AMSAC unavailability is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	160	RTB testing frequency in D.2.3	The testing frequency in the calculation file is each train every 30 days, where as Tech Specs is every 60 days. The frequency should be changed to the Tech Spec 60 days.	Revise test freq. to once per 60 days. Current RTB unavailability result is conservative.	The current RTB unavailability is conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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J	A	161	AMSAC UPS vs actuation maintenance unavailability	Presently AMSAC has one number for maintenance unavailability. But it was noticed that there are times when the UPS in cleared but AMSAC is still used. We should probably split these out into two different unavailabilities when we start collecting the actual plant data.	To develop AMSAC specific data. Updated data is expected to have a small impact on the system reliability.	Not significant since impact on AMSAC unavailability is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	166	Need PORVs blocked maintenance alignment	PORVs need a maintenance alignment for when they are blocked and thus not available for reactor coolant system (RCS) pressure relief (very important in ATWT), But are available for feed and bleed. This will simplify special risk assessments when a PORV is blocked. We should also try to obtain the historical data for the amount of time a PORV has been blocked and put it into the data collection.	Maintenance alignments for blocked PORV have been modeled in top event PO (ATWT response). Need to include actual plant data for such configurations in data update. Updated data is not expected to have a significant impact on PORV unavailability.	Not significant since impact on AMSAC unavailability is not significant and ATWT scenarios contribution to CDF/LERF is also not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	168	Multiple inverters cleared at the same time	The model does not prevent clearing multiple inverters at the same time, since each is in an independent top event. They should be changed so that only one inverter can be in maintenance at a time by using an intermediate top event. This is also the same kind of arrangement that will be needed to implement common cause failure of inverters.	Conservative for clearing for multiple inverters. Need to know if there are common cause failure data for inverters. No industry data on CCF of inverters is currently available (See NUREG/CR-6268)	Resolution pending availability of data, but the current result is conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	169	Split out loss of 500 kV from turbine trip	Need to split out the contribution of loss of 500 kV from the existing turbine trip initiator into a new initiator to be able to model the different plant impact. For some (but not all) loss of 500 kV will prevent from using the 500 kV backfeed since there may not be 500 kV available immediately. This was noticed when examining the plant response to the may 2000 fire event.	To separate loss of 500kV from Turbine Trip IE. When conservatively assume no credit for 500kV backfeed for Turbine Trip initiating event, the increase in CDF/LERF is less than 0.3% of the total plant CDF/LERF value.	Not significant since impact on CDF/LERF is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	171	AMSAC needs some new failure rates	When revision 0 of the AMSAC calculation file was done, some failure rates were not available so some surrogate failure rates were used. See section D.2.8.1.2 for details. Need to find and/or develop more applicable failure rates for these components. one source maybe the recent work done by the WOG on SSPS.	Consider failure data for AMSAC - based on WOG data, in next data update. Updated data is expected to have a small impact on the system unavailability.	Not significant since impact on AMSAC unavailability is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	172	Common cause INSTR channels for SSPS not modeled	While drafting the AMSAC calculation file (D.2.8), it was noticed that common cause of instrument channels for SSPS was not modeled. Need to model the common cause failure of instrument channels for both AMSAC and SSPS. It Is expected that this would not be significant for AMSAC since many single channel failures will disable AMSAC. However SSPS needs two instrument channels to fail Before failing an input function and thus the common cause failure might be more noticeable. Also include PRA CALC D.2.8 for AMSAC	Model common cause failure of Instr. Channels for SSPS. Expected to have very small impact on the unavailability of SSPS.	Not significant since impact on SSPS unavailability is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	173	SSPS input channel unavailability	Presently DCPP does not model input channel unavailability for SSPS or AMSAC. This can come from Eagle 21 testing or channel calibration. In the past DCPP only did channel calibration in the outage. Most are done online. prior to Eagle 21, when a channel was tested it was placed in a trip condition There by reducing the chance of another channel failure disabling a trip. Now the tested channels are not placed into trip which reduces the chance of a plant trip, but increases the chance that another channel could fail thus disabling that input function. Also include AMSAC D.2.8	Instr. channel test now disables the channel for SSPS and AMSAC. Need to include test contribution. Expected to have very small impact on the unavailability of SSPS.	Not significant since impact on SSPS unavailability is not significant • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	181	Bistable failure rates	The failure rates for bistables in the DCPP database is different by a factor of 200 from what Westinghouse uses in their SSPS risk analysis.	Consider using WOG failure rate for bistables.	Not significant since scenarios associated with or resulting from spurious actuation of bistables/SSPS have been analyzed and should not lead to a severe accident. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	188	Implement updated SSPS failure rates	A0460719-32 was to investigate why SSPS split fractions went up noticeably when, DCPP implemented the slave relay testing from quarterly to 18 months, even though the Westinghouse study cited there was no real increase. Some items were done in the DCC0 update, to reduce the risk of SSPS, but they did not address the basic problem, they just lessened the affects on other equipment. The DCPP SSPS model has many simplifying assumptions, to fit into the RISKMAN software from the early 90's. A review of DCPP split fractions to South Texas split fractions show a noticeable difference, some even over an order of magnitude. below are some of the items to look at to improve the model: 1-The failure rates used by DCPP are dated and from the late 70's early 80's. In many cases they are not directly for SSPS components but similar. Westinghouse has done several studies over the last several years that have more appropriate failure rates for SSPS components. examples are WCAP-15376-P, 15377-NP, 14117, 14334-NP, 14333-P. There is also a Westinghouse letter from GR Andre to Raymond Thierry which describes some of the differences. 2-South Texas Project has a lot more detail in their model. They generally, model at a lot lower level, where as DCPP Models more at the functional level. 3-DCPP models that if one slave relay fails, then the whole function fails.	Use WOG SSPS component failure rates in future update. Current results are conservative.	The current SSPS unavailability is conservative, but even using the conservative values, SAMAs related to SSPS failures were not cost beneficial. Updating the component failure rate data will not change the conclusions for these SAMAs or any of the other SAMAs.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	230	Model cross tying during SLOCA for RHR pumps	When the vital bus cross-tying was added to the model, it was not credited for LOCA (even SLOCA), because the time to crosstie outside the control room may not be adequate for some of the components used for the injection phase of the accident. However, there are some components that are used for high pressure recirculation, and there would be hours to crosstie the vital bus prior to needing that equipment (e.g., the RHRPs). We should look at the possibility of adding the crosstie capability for some components used later in accident mitigation. Instead of using the existing crosstie top events, it might be easier to implement with separate top events in the late tree.	Consider the cross-tying of buses for equipment needed for longer term mitigating actions. Current results are conservative.	The value of cross-tying the vital buses is insignificant, especially for the non-electrical transient scenarios given that it is only required in cases of a loss of offsite power and one or two emergency diesels. Improving its reliability should not significantly change the risk contribution from most of initiating events. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	231	Modify loss of 500 kV failure rate	While reviewing the maintenance configuration for clearing startup power on-line, it was noticed that the loss of 500 kV failure rate as originally developed in PRA97-017 is too high for how it is being used in top event OGA. In top event OGA, it is used as a failure rate for loss of 500 kV to the plant. But in PRA97-017, the data was gathered as a 500 kV event that caused a plant trip, regardless if 500 kV was lost or not (i.e., a system disturbance). In fact, only one of the seven instances were a loss of 500 kV. In a second, the 500 was declared inoperable but was still available. The present number can be used as a generator trip. A lower number would be more applicable for loss of 500 kV, or maybe use the present number as a momentary loss and followed by another number to reflect the amount of time 500 kV was "instantly recovered".	Update loss of 500kV switchyard (ZT500K) failure frequency base on recent data in next data analysis update. Current 500kV switchyard unavailability is conservative.	Current 500kV switchyard unavailability is conservative. Since the power related SAMAs (e.g., 3, 4, and 5) were determined to be not cost beneficial, further reducing the 500kV switchyard failure rate will not change the conclusions for those SAMAs, nor will it change the conclusion for any other SAMA.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	234	Accumulators used to mitigate seal LOCA	While researching information to respond to the NRC ASP preliminary evaluation of the may 2000 12 kV fire event, it was noticed that DCPP's time to core uncovery due to seal LOCA in station blackout (SBO) was about three times longer than Westinghouse analysis (5 vs 15 hours). This was researched by NOs in CHRONS 148151, 111456 and 147169. The transient analysis group re-reviewed this and the major difference was Westinghouse only de-pressurized to 600 psig, whereas the PG&E MAAP Runs went to about 300 psig. Thus, PG&E had the accumulators as another source of water before uncovery. This is not documented in any PRA calculation files. The modeling does not have any dependency between the accumulators and seal LOCA recovery in STADIC. The present DCPP model (DCC0 of 2001) only uses accumulators to mitigate a LLOCA. The dependency between accumulators and seal LOCA NEEDS to be added to the model. The present importance calculations will understate the importance of accumulators.	Investigate the requirement of accumulator for seal LOCA. There is only a small difference between the probability of non-recovery of offsite power at 5 hours and that at 15 hours. This will have a small impact on the electric power recovery results if accumulators are not considered in the evaluation.	Impact on electric power recovery results is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	243	Contributors to failure of top event OG are missing	While developing PRA01-09 calculation file, it was noted that a couple of contributors to failure of top event OG (in particular, contributors to basic event OG-BK1A) may not have been included in the base model. These contributors include failure of the crosstie breaker to close, failure of unit 1 SUT breaker to open, and HEP for performing the required actions. Evaluate this potential error.	Include additional contributors to top event OG via basic event OG-BK1A. Operator actions required for transfer of power from Unit 2 12kV Startup bus. (See Item #320). This model revision has a very small impact on the unavailability of power from the 230kV offsite grid.	Very small impact on the unavailability of power from the 230kV offsite grid and on the CDF/Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	254	ZHEAW4 not needed for runout of AFW pumps	Previous AE'S have asked about putting the MDAFW pump runout protection into the model to avoid the issue of runout for the pumps. When conducting the operator interviews for ZHEAW4, the scenario of the operators controlling the AFW flow to the turbine driven AFW pump, their answer was that is was not needed. The turbine driven AFW pumps does not have the runout protection control on the LCV's, because it is not subjected to run conditions due to piping configurations. This needs to be investigated and if true incorporated into the PRA Model. Section 4.3.10.2 of DCM S-3B rev 3 does provide some discussion of secondary system pipe ruptures.	Consider modeling of TDAFWP runout protection Result of current model is slightly conservative.	Failure of AFW due to pump runout was not an issue for SAMA. Given that the current results are slightly conservative, changes to reduce risk further will not impact the SAMA analysis. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	260	Loss of power to LCV-8 controller may drain CST	During operator interviews for HEPs in December 2001, one of the operators stated that if you lost power to the controller for LCV-8 (condensate makeup valve from the CST to the main condenser), it would drain the CST rather fast. (it Sounded as if he was speaking from experience.) Abnormal procedure AP-26, "Loss Of Offsite Power," revision 6, directs the operator to check this valve closed in Step 1.C. LCV-8 is an air operated valve that fails closed on loss of instrument air. It is controlled in the control room by 1-02-I-C-HC-1, whose power supply is 52-PV1529 (nonvital instrument panel PY-15), which has bus 1H as a normal source. 3/10/05 JKP It appears that this item has no impact on Calc E.2. Deleted E.2 from the affected calc list.	To include LCV-8 and the valve controller (loss of power) as a contributors to CST unavailability in top event AW, etc. The expected increase in AFW unavailability is about 6% for all support available case. The impact on the CDF/LERF is small. This impact is insignificant for the other boundary conditions.	Not significant since impact on risk results • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	261	OPS will not use transfer switch to restore power to CRVS train	One CRVS HEP exists in the model, to transfer CRVS to the backup train when the running train fails. All the actions are in the control room and the HEP is used as such in the model. It is also used to model the operators transferring power to restore a CRVS train. That transfer switch is located in the auxiliary building, and would likely have a larger failure rate than what is used in ZHECV1. Additionally, during the December 2001 operator interviews, the operators were firm that they would not align backup power when the selected source failed. Instead, they would simply open the door between the computer and SSPS rooms IAW CP M-10. The reasoning was that if they had lost the selected bus, they would be concentrating on restoring that bus for all of the loads, and when/if they got an alarm on SSPS room temperature, they would do the easy solution of opening the door, and not waste time changing the power source. We should quantify ZHECV1 for switching trains in the control room, delete its use for aligning to a separate power source, and add the HEP for opening the door between the SSPS and computer rooms as ZHECV2. Also not that the alternate power source is less important in the current model (as compared to the LTSP) because cross-tying the vital buses will restore power to the CRVS. This may or may not affect CDF. If there is an effect, it will be small, since CRVS worth is so small.	HEPs ZHECV1 and ZHECV2 evaluated. Need to update CRVS models to incorporate operator actions. Impact on CRVS is insignificant. Also see Item #272	Not significant since impact on CRVS unavailability is small. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	263	CCW model has Header 'C' and HEP combined	While researching HEPs, it was noticed that credit is taken for the operator to reduce heat loads for LLOCA (and MLOCA and SLBI), even though they may not have enough time. In other words, we are using the HEP for heat load reduction for all initiators. For LLOCA, MLOCA and SLBI, we generally have HI-HI containment pressure ("P" signal), which will isolate CCW non-vital Header C. The various CCW calculations support one CCW pump as adequate for flow and heat loads when Header C is isolated. This implies that failure of the HEP roughly approximates the hardware failure of Header C to isolate. To more accurately model the worth of the HEP and FCV-355 (Header C), they should probably be split out into separate items. Also note that the current modeling does not model the support for Header C automatic isolation (SSPS for "P" signal and Bus H for MOV power). This should have little affect on CDF or LERF, but will affect some basic event importances. 07/11/02 Further research during the NRC inspection also noticed FCV-355. We need to investigate if Header 'C' Isolation is required for Phase "B" actuation even if two CCW pumps are running. 11/12/02 Upon reviewing E.11 revision 9, it was noticed by AXA that the calc file talks about isolating Header 'C' (implied by INIT=SLBI for general transient) and failing to trip the RCPS should give a failure of the seals. There is logic in top event for this in RP, but no logic for it in SE. so on INIT=SLBI if the RCPS are still running, and charging has failed the rules use split fraction SE2. But it should use SE2 only if -INIT=SLBI, and if INIT=SLBI (and charging AHS failed, it should use SEF). On reviewing past calculation files it appears that it has been this way since Revision 1 and possibly Revision 0 of C.4.2. A quick review of INIT=SLBI in PLG-0637 did not clarify anything as none of the SBLI sequences showed any SE failing (almost like it was bypassed in the tree.	Revise rule for split fraction SE2 and SEF associated with SLBI initiator. This has an insignificant impact on the CDF/LERF.	Not significant since impact on CDF/Level 2 results is also insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	264	Add unavailability of Unit 2 cross-tie to recovery	The ability to use a Unit 2 DEG to supply Unit 1 during a station blackout is Appendix H of the ECA series of emergency procedures. This was added to the PRA model as part of the 2000 update. However, the vital bus crosstie is periodically removed from service during a Unit 2 refueling outage. This unavailability was not factored into the model, so there is some over-recovery. When we gather information for refueling outage unavailability, the vital bus crosstie should also be gathered. That unavailability should then be factored into the split fraction equation RER.	Include unavailability of Unit 2 x-tie when Unit 2 is in a refueling outage.	Not significant since impact on CDF/Level 2 results is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	270	I-38 testing is modeled to two separate top events	Surveillance Test Procedure (STP) I-38 tests both SSPS and reactor trip breakers. It is in the model as two separate sets of testing. The first is in SSPS (top events S1 through S6 in alignments Test2 and Test3) and the second is reactor trip (top event RT in alignments Test1 and Test2). So there is double counting of the testing unavailability. Additionally, this lets RISKMAN quantify time when opposite trains are out of service for testing at the same time. This conservatism should be a small overall contributor, but may affect component importance, particularly if DCPP goes for a risk-informed Tech Spec submittal on SSPS/reactor trip. Also note there is another action to add the backup reactor trip breakers.	Need to account for STP I-38, define RT split fraction for specific SSPS train. This involves split fractions RT4 and RT5. Current model is slightly conservative with respect to opposite train testing of RT breakers and SSPS.	The current SSPS and RT breaker results are conservative, but even with the conservative results, the related SAMAs are not cost beneficial (e.g., 20, 22). Eliminating conservative modeling issues will not impact the conclusions for these SAMAs or any other SAMAs.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	272	Change HEP in CRVS to correspond to what OPS will actually perform	The modeling of HEPs in CRVS is done in four places, three in top event CV and one in top event CVI (initiator LOCV): 1. CVHE Operator fails to align backup power and standby sub-train 2. CVHE1 Operator fails to switch to backup power on running train 3. CVHE2 Operator fails to start standby sub-train H 4. CVIHE2I Operator fails to start standby sub-train H Note: Item 2 (CVHE1) is set to success in all split fractions. Item 1 (CVHE) is only used in one split fraction. Even though there are three HEPs only item 3 was analyzed under LOSP conditions and it was assumed that the number was conservative for all the other items (even though items 1 & 2 require manipulation outside the control room). The action to open the doors between the SSPS room and computer room for cooling is not in the model, but there has been some discussion of adding it in the past (we might have used it as part of a justification on some model simplifications). During the operator interviews (Dec 2001), the scenario for starting the standby sub-train was run through. Even though the procedures do not give explicit step-by-step instructions, the action was obvious. Even the NO, who was looking at the annunciator response, was able to get to start the standby train. However, when it came to the scenario of aligning the backup source of power upon failure of the normal source, the operators chose instead to open the doors to the computer room, even though they were familiar with the two sources. The reasoning was they have just lost a vital bus and are in the ECA procedures. They are concentrating on restoring that bus for more important and timely reasons than SSPS cooling. Instead of dispatching an operator to go into the auxiliary building to switch power around, they would open the doors to the room (in the procedure) because it was a lot quicker, and less distraction from the major evolutions. So items 1 and 2 would not get used, and in fact the only time they switch power around is when the primary bus is cleared for maintenance in an outage.	Proposed changes for top event CV: 1. Model the operator starting the standby sub-train if the primary fails. 2. If the running train fails due to loss of support (AC power), start the standby sub-train. 3. If in either #1 or #2 the standby train does not have support, open the doors for cooling. For top event CVI: 1. Model the operator only starting the standby sub-train (like it is presently modeled). Note: Expect the HEPs for both of these evolutions to be about an order of magnitude less than the existing SLIM-MAUD quantified HEP. See Item #261	Not significant since impact on CRVS unavailability is small. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	277	E.8 has hard coded hours/year cont vent pens are open	E.8 has hard coded hours per year the containment ventilation penetrations are open. This number may be incorrect. It may be from when there was a Tech Spec limit on the hours per year the vent paths could be open. This does not affect CDF, but LERF impact is unknown.	Update the fraction of time the containment penetrations are open. Current result is conservative since period the penetration is based on Tech Spec limit instead of actual plant experience.	Changing the basis for the time the containment ventilation penetrations from a tech spec limit to an estimate based on plant experience is expected to have only a small impact on Level 2 results. • No change in CDF. • No significant change in Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	280	CCW pressurization unavailability is overstated in the model	While performing the LCO evaluation for H.1.2, the following inconsistency between the LCO sheets and the model (DCC0) was noticed. The CCW pressurization system was added to the model in the DC1997 update. Since it was a new system, the amount of time it was unavailable for maintenance was unknown, so 24 hours was assumed in alignment "MAINT4". for the H.1.2, a total of 4.62 hours was tabulated for the eight (reactor) year period. The amount of time in the alignment should up updated to be more consistent with the plant experience.	Update maintenance unavailability (in particular the maintenance duration) of Pressurization system in data analysis update. The maintenance contribution is modeled as a basic event CCSTPS_MN in the current model and is conservative. This affects the CDF only slightly.	Not significant since impact on CDF/Level 2 results is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	289	STP M-75 unavailability is not modeled in the average mode	While performing the LCO evaluation for H.1.2, the following inconsistency between the LCO sheets and the model (DCC0) was noticed. STP M-75 is now done online. The present frequency is every 18 months. There is an LAR in progress to increase this to 24 months like the rest of the refueling cycle length STPs. Presently, the unavailability is not accounted for in the system calculation file. It should be added. Presently, the STP is done in conjunction with the yearly DEG MOW. Therefore, operations will short cycle this test to every 12 months so it stays with the DEG MOW (to minimize unavailability).	Include contribution from M-75 (in conjunction with DEG MOW).	A small change to the unavailability of the EDGs to account for any time required to perform STP M-75 will have only a small impact on the CDF and Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	290	Split out turbine trip and generator trip	The present trip initiator includes both the generator trip (Unit trip) and a plain turbine trip. However, the plant response to both of these items is not the same. A unit trip (generator trip) is caused by an electrical fault. Most of these would preclude backfeeding from the 500 kV since the fault could be in that area. Even if the fault was not in that area, there would be a lot investigation to make sure that part was undamaged (read SHIFTS0 before backfeeding. Also on a unit trip the auxiliary breaker is opened. If a DEG was running the M-9A then it should carry the bus ok. It is unclear what the DEG would do for say a loss of offsite power. The DEG breaker may trip before the auxiliary breaker.	To separate Generator trip events from Turbine trip events and model generator trip IE. When conservatively assume no credit for 500kV backfeed for Turbine Trip initiating event, the increase in CDF/LERF is less than 0.3% of the total plant CDF/LERF value. (See Item #169)	Impact on CDF/Level 2 is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	297	AS - 17 - Update the ATWT Model to new WOG Model "C"	The DCPRA includes a plant-specific model for ATWS response. Although the model appears to be reasonable, it is different than the WOG model which the WOG plans to submit to NRC for review and approval for use in risk-informed licensing applications. In particular, the WOG model is intended to eventually allow plants to demonstrate acceptable risk with aggressive (high reactivity) fuel cycles. Although the DCPRA ATWS model is adequate for existing applications, the comment is directed at potential future ability to obtain fuel design and operating flexibility benefits using results of the WOG program.	Consider updating the ATWT model to conform with the WOG ATWS model. Note that DCPRA model is adequate.	No impact on SAMA application since current model is adequate for this application purpose.
J	A	326	Four failure modes for SGTR	The draft of SDP for S/G inspection, appendix J, talks about 4 failure modes of tubes of which only one is usually modeled in the PRA. They are: 1-Spontaneous rupture of a tube (DCPP models as an initiator) 2-Steam side depressurization causing a degraded tube to rupture 3-Induced SGTR due to high and dry (DCPP models this from LERF) 4-ATWT with high RCS pressure causing a degraded tube to rupture We might want to consider enhancing our model if we need to address these issues in the future.	Consider additional failure modes for SGTR in future update. Some of these have been considered and found to have no significant impact on the CDFD/LERF.	Not significant since the impact on CDF/Level 2 is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	331	Vital instrument backup transformers	The vital backup transformers have a maintenance unavailability of 3.417E-5/year which uses generic component unavailability. In the mid 1990's the maintenance on these items was moved from the outage to online. This will increase the maintenance unavailability significantly.	Update Transformer maintenance unavailability in data analysis. Contribution of transformer maintenance to Instrument AC power unavailability is insignificant.	Not significant since impact on Instrument AC power unavailability is insignificant and AC power's contribution to CDF/Level 2 is also insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	332	Class 1 PORV control channels change	The DCN which upgrades the controls for the two class one PORV'S (to take credit for pressurizer over fill), moves the input channels from the normal control racks to Eagle 21. This will probably change our split fraction logic, since a lot of it depends upon the source of power for the normal control channels. I am not sure how this DCN affects the switchability of which is the normal controlling channel (which we do not model since presently most of the time DCPP operates in the normal lineup).	This DCN would improve the reliability of the PORVs. Current model is conservative.	Current model is conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.
J	A	356	2002 Tech Spec review for Unit 2 power	During the 2002 Tech Spec review the following items were noticed: D.2.1.4 top events BB and BBS have local variable @TSF at a yearly frequency for battery charger test STP M-12B. ITS is now a 2 your test. The charger test is usually done as part of the MOW which is on an 18 month interval. Therefore the frequency in the model should be changed from 12 months to 18 months	Revise test frequency from 12 to 18 months. Insignificant impact on results. CDF may decrease very slightly. Current model results are conservative.	Current model is conservative. Even with conservative results, this was not an issue for the SAMA analysis and resolution of the issue will have no significant impact on the application.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	368	Add AMSAC failure rate variable to D.2.8 and H.1.5	During the data update in 2002/2003, failure data was collected for AMSAC (new variable ZTAMSR). Additional research should be performed to collect all AMSAC failure data (since 1988 for Unit 1 and 1989 for Unit 2) by searching PIMS for system 35 failures. This information should be used to develop a plant-specific prior failure rate, which should then be added to the AMSAC and data calculations.	Update database variable ZTAMSR for AMSAC with plant specific data. No significant impact on risk is expected.	Not significant since the impact on CDF/Level 2 is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	369	Loss of 2 vital buses does not mean phase C	In the documentation for top event RP, it has several conditions for loss of CCW to the RCP'S. One of the conditions is on loss of two vital buses the operators will isolate Header C to preserve CCW to the other loads. This is not what the operating procedure now says. The procedure has the operators reducing heat loads in accordance with Appendix B of AP-11, and there is nothing in there about isolating Header C. In fact, The steps for isolating non-vital CCW to the containment have the operators ensuring that the RCPS have already been tripped. Also note if one of the two vital buses that is lost in "H" then there is no power to isolate Header C. Top event CC already takes into account the reducing of heat loads if there is only one CCW pump running, and that HEP is not very time constrained. These double vital bus failures should not count as an immediate loss of CCW to the RCP'S, requiring them to be tripped within 10 minutes, and probably should be deleted. Since loss of two vital buses has a low probability, this should not make much difference to the overall CDF.	Current model is conservative. Impact on risk is not significant.	Not significant since current model is slightly conservative and the impact on CDF/Level 2 is not significant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	400	Database Variable ZTDRYP	The database variable ZTDRYP is used in E.12 Rev. 0 for the instrument air dryers 0-1 and 0-2. ZTDRYP is also used in D.2.4 Rev. 6 as the filter dryer for the control room ventilation system. According to Shobha (ABS), the instrument air dryers have a much higher failure rate than the control room filter dryer and should not use the same distribution. In fact, ZTDRYP has never been updated with a failure in 192,000 hours. The instrument air dryers, on the other hand, have at least a few failures that were not including when updating ZTDRYP. We may want to separate these distributions at some point.	Consider developing separate failure rates for Instr. Air dryer and CRVS filter dryer. Currently both use ZTDRYP.	This may affect the unavailability of instrument air system, but the change will be minor and it will have only a small impact on CDF and Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis. In addition, SAMA 9 would address IA failures and since it was determined to be cost beneficial, increasing the failure rate of the IA system would not impact this conclusion.
J	A	408	STP V-18E - New Procedure - Affects H.1.5 AFW test starts.	During H.3 Rev2. procedure review, it was noticed that STP V-18E (a new procedure) tests check valves in the AFW system once per refueling outage. During the test, each of the pumps are started and FCV-95 is exercised. This should be accounted for in the next H.1.5 review.	Include STP V-18E in database update for AFW pump starts and FCV-95 demands. Data update issue. No significant impact on risk results is anticipated due to increase count in the number of equipment demand counts in data update.	Not significant since no significant impact on CDF/Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	409	Include STP V-13D, Vital 4KV Bus Startup Feeder Breakers Operability Test, in H.1.5.	In reviewing procedures for H.3 Rev 2, it was discovered that STP V-13D (new procedure, replaces PEP 63.01) should be included in the scope for H.1.5. This test procedure cycles the startup feeder breakers to determine operability following x-tie maintenance.	Include STP V-13D in database update for 4kV Bus startup breaker demands. Data update issue. No significant impact on risk results is anticipated due to increase count in the number of equipment demand counts in data update.	Not significant since no significant impact on CDF/Level 2 results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	417	Remove 4kV/480V dependency from top event OB.	Top event OB does not include the Block valves. Therefore there should be no direct AC dependency. Remove the AC power dependency from the split fraction rules. This comment affect the split fraction rules for OB in GENTRN and SGTR trees.	Remove AC dependency from the OB split fraction rules via macros. Include short term DC power in macros. Current result is conservative.	The block valves and their dependency on AC power are modeled indirectly by including the dependency in the boundary conditions for top event OB. AC power would only be required to operate the block valves if a PORV were stuck open, so this approach is slightly conservative, but otherwise correct. No changes to split fractions or their rules are necessary. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	419	No conditional SFs are considered for the Instrument AC channel top events.	Consider including the conditional split fractions or common cause basic events in the Instrument AC top events.	Consider common cause failures of instrument channel equipment. No industry data on CCF of inverters is currently available (See NUREG/CR-6268) (see Item #88)	Even with the addition of inverter CCF (when it becomes available), Instrument AC unavailability will be driven by power supply failure (Power Distribution Panel) rather than inverter failure. Given that SAMAs were developed to address power supply failures and that the impact of adding inverter CCF is expected to be small, this issue will not impact the SAMA analysis in any significant way.
J	A	420	Consider COMMON CAUSE failures for Instrument AC system (I1, I2, I3, I4)	Four instrument AC channels contain similar type of electrical/electromechanical equipments. However current model (2005) does not consider potential common cause failure.	Consider common cause failures of instrument channel equipment. No industry data on CCF of inverters is currently available (See NUREG/CR-6268). (see Items #88 and #419)	Even with the addition of inverter CCF (when it becomes available), Instrument AC unavailability will be driven by power supply failure (Power Distribution Panel) rather than inverter failure. Given that SAMAs were developed to address power supply failures and that the impact of adding inverter CCF is expected to be small, this issue will not impact the SAMA analysis in any significant way.

Addendum 1 Evaluation of PRA Open Items / Issues on SAMA Process

PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	421	Review effect of loss of 4KV bus H on Feed and Bleed function	During the sequence review of FCDF IE=FS7, it was discovered that the feed and bleed function was guaranteed failed because of MACRO OBF2 was satisfied due to AH=F. The failure of a single 4kV bus (e.g., AH) should not necessarily disable DC panel 13 (DH) and a Class I PORV (i.e., PORV 456) and Instrument Air to 455C (via failure of containment isolation valve FCV-584). Please check if MACRO OBF2 definition is correct. This impacts all event trees with OB function.	Check OB dependency on AC power. (See Item #417)	Refer to the comment on Record # 417.
J	A	427	Modification of power supply to AMSAC	A design change will be made which will replace the existing power supply with a new and improved model, as well as changing the normal and by-pass sources of AC power. The second design change package installs the new panel PD27, which is the alternate DC source for the new power supply, fed from the Non-Vital Battery 25. There is no change in the system design function of the EJUPS replacement. However, the AC and DC input sources of the UPS have been enhanced, eliminating the battery back-up unit, EDU17, providing the DC source. instead, the 120 VDC UPS source is now fed through a DC distribution panel, PD-27, from station battery 25. the 120 VAC normal source was changed from the existing configuration where the normal and the bypass AC sources were fed from the same distribution panel, PYNM. The new normal 120 VAC source is now fed from a separate distribution panel, which is the PLAAA panel. and the bypass 120 VAC source, is the existing feed from the PYNM panel. The output of the new EJUPS is changed to 120 VAC, single phase, from the existing 208/120 VAC, three phase. this changes the load distribution panel PYUCC into a single phase, 120 VAC distribution panel.	Investigate and model (if necessary) new design for power supply to AMSAC. Design change would reduce the unavailability of AMSAC.	Current model is conservative. Even with the conservative results, AMSAC failures were not an issue for the SAMA analysis. Modification of the power supplies will not impact the SAMA analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	431	Vital battery life for electric power recovery	D.2.1.2 Rev. 8 references "A Review of Systems Analysis in the DCPRA – Electric Power Systems (Except Diesel Generator and Diesel Fuel Transfer System)" DCL-90-046 when it states that the electric power recovery model assumes a battery life of 12 hours. A more recent update to the battery calculation has determined that the battery life for Batteries 12 and 22 is 5 hours 45 minutes and 7.5 hours for the other vital batteries (A0564461 AE01 from 369-DC Rev. 1). G.4 Revision 8 assumes a 7 hour battery life in calculating electric power recovery probabilities (used in DCPP MAAP calculation). Given that battery 12 has a calculated life of only 5 hours 45 minutes, determine the rationale for using the 7 hour MAAP assumption. Also, what impact does this lower battery life have on electric power recovery? (New MAAP runs assuming 5 hours 45 minute battery life for certain functions and reanalysis with STADIC.)	Investigate impact of battery of 5 hrs 45 mins on EPR results.	A change in battery life from 7 to 5:45 hours represents an increase in non-recovery probability of about 25% based on CR 6890 table 4-1. Even if it is assumed that an increase in the non-recovery failure probability of 25% would increase the LOOP CDF by 25%, which is conservative given the power recovery value is a convolution calculation, the internal events LOOP contribution would only increase from about 6% to 7.5%. This is a relatively minor change. For SAMAs that do not impact LOOP or SBO, the impact on the averted cost risk would be minimal given that it is calculated as a “delta” (LOOP contribution is the same before and after implementation of the SAMA). The cost benefit analysis for the SAMAs that address LOOP scenarios would be impacted, but because the fire analysis does not credit AC power recovery and the seismic model only credits it for low magnitude events, the changes would be limited to a portion of the seismic scenarios and the internal events contribution to the averted cost risk. Of the SAMAs evaluated that impact LOOP, the one closest to being cost beneficial is SAMA 18 (based on the response to follow-up RAI 11.b.ii). A rough estimate of the impact on SAMA 18’s averted cost-risk can be calculated by increasing the lower magnitude seismic contribution and the internal events contribution by 25%. Internal Events addition (95th percentile): ($1,300,000 - $1,096,208) * 0.25 * 2.36 = $120,237 For seismic events, the SEIS1 and SEIS2 initiators (the initiators that credit AC power recovery) do not include large LOOP

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
						contributions. The largest contribution from a SEIS1 or SEIS2 event that includes failure of offsite power is sequence 129 (only 0.09% of the seismic CDF). The implication is that changes to the AC power non-recovery probability will have a small impact on the results. For this estimate, 20% of the SAMA 18 benefit is assumed to be linked to SEIS1/SEIS2 LOOP events. The Seismic Event addition (95th percentile) would be: ($3,740,625 - $1,889,016) * 0.20 * 0.25 * 2.36 = $218,490 Even when these two additional contributions are added to the averted cost-risk for SAMA 18, it is not cost beneficial: 95th% Net Value = ($5,510,253 + $120,237 + $218,490) - $6,441,418 = -$592,438 This is considered to demonstrate that the change to the offsite power recovery non-recovery probability would not impact the conclusions of the SAMA analysis.
J	A	435	E.4 Rev. 7 incorrectly states that SI-1-8807A is powered by 480V bus G.	E.4 Rev. 7 incorrectly states that SI-1-8807A is powered by 480V bus G. Drawing 437916 sheet 1 and the block diagram component list in E.4 indicate that 8807A is off of bus F not G. This error is also in the split fraction impact for HRC (Bus G unavailable). Correct error by properly documenting and impacting 8807A.	Revise impact for split fraction HRC. Since loss of Bus F impacts 8807A, split fractions HR5 through HR8 should also be revised. The affected split fractions has very small impact on risk.	Not significant since impacted split fractions have very small impact on risk results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	437	Current model does not include ASW X-tie HEP for SLOCA	The current model DC01 credits ASW inter-unit cross-tie for SLOCA and non-SLOCA conditions. The same HEP is used for both scenarios and has timing based on a non-LOCA scenario. G.2 rev. 5 has HEPs for SLOCA sequences (ZHEAS6, ZHEAS7, ZHEAS8) but they are not used. If these are to be included, fire PRA HEPs need to be created from ZHEAS6,7, and 8.	Revise model to include x-tie for TLOCA scenarios. Corresponding HEP has been evaluated. These HEPs are somewhat higher than the HEPs currently used due to the shorter time windows involved. This would only impact sequences in which a transient induced small LOCA has occurred and both unit 1 ASW pumps have failed. The affected split fraction has small impact on risk.	Not significant since impacted split fractions have very small impact on risk results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
J	A	438	AFW Split Fraction AW7 is incorrect.	During sequences review for the fire PRA model it was noticed that the rule for AW7 was incorrect. AW7 represents the boundary condition in which instrument power to PCVs is lost and the TDP is not available. The rule for AW7 in GENTRN is for AFW Pump 3 and the TDP unavailable. I suggest that the rule INSTPWR*(-MDPA*MDPB)*TDP be changed to INSTPWR*(-MDPA*-MDPB)*TDP.	Revise rule for split fractions AW7, AW7B, AW7L in GENTRN event tree. The affected split fraction has insignificant impact on risk results.	Not significant since impacted split fractions have very small impact on risk results. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application
J	A	444	Evaluate success criteria for seal LOCA	Currently the injection success criteria for seal LOCA is 1 of 4 charging/SI pumps. In the event of a small seal LOCA where RCS pressure remains too high for SI, should this success criteria be changed. This point is also applicable to very small LOCAs which are not currently modeled in the DCPP PRA. The SLOCA initiator includes LOCAs from 0 to 2" equivalent break diameter.	Evaluate CH/SI success criteria for small seal LOCA, that is, cooldown and depressurization of RCS required for SI.	Except for very small breaks, during a SBLOCA, the RCS pressure will fall enough to allow the SIPs to inject. If AFW is available, even for these breaks, the pressure can be maintained so long as the CST has water. The combination of a small break and no AFW such that core SIP injection is not possible is still a slow enough process that operators would have to time to manually depressurize the RCS to allow SIP injection. No impact on the SAMA analysis.
K	A	454	Dual Unit Initiators - Evaluate jellyfish attack	On 10/21/2008, high DP traveling screen alarms indicated the presence of debris loading at the intake. Unit 2 began ramping down and was manually tripped at power. Unit 1 successfully ramped to 50%. Evaluate this event as a dual unit trip precursor. Currently, DCPP does not consider a dual unit	Include such dual unit trip in model. This has been looked into. With an estimated frequency of about 0.05 per year and resulting in a reactor trip, the estimated CDF for this initiator is about 0.1% of the total CDF.	Not significant since impact on risk results is insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.
K	A	136	Split LCV into two IEFs - KELP and other types	As an enhancement, split up the loss of condenser vacuum into two initiators for analysis purposes. The first one would be loss of condenser vacuum due to kelp clogging of the screens. The second would be the loss of condenser vacuum for all other causes. Insignificant impact.	Add new initiating event associated with intake screening plugging - kelp. Jelly fish, etc. See Item #454	Not significant since impact on risk results is insignificant. • No significant change in CDF or Level 2 results. • No significant change in the SAMA cost benefit analysis.

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PRA Issue	Status	Record #	Action Title/ Applicable SR	Action Description	Current Status/ Comment	Importance to SAMA Application

References:

(1) Diablo Canyon Power Plant PRA Self-Assessment (Draft Report), ERIN Engineering and research, December 2006.

(2) Diablo Canyon Power Plant PRA Self-Assessment, ERIN P0114060001-2717 R1, January 2008

(3) “Review and Reevaluation of Specific Issues of internal Floods Analysis” by Scientech/Jacobson Engineering, Draft - January 2006.

(4) Diablo Canyon Follow-On Peer Review of HRA Update, Final Report, R-1736044-1728, July 31, 2007

(5) Transmittal of Resolution/Disposition of ASME PRA Peer Review Findings for LERF for Diablo Canyon Units 1 and 2, by Westinghouse Electric Company, LTR-RAM-II-07-021, November 30, 2007.

(6) Fauske and Associates, Inc. "MAAP - Modular Accident Analysis Program Users Manual," Technical Report on IDCOR Tasks 16.2 and 16.3, May 1983.

Note: Items #169, #290 and #250 has been resolved and removed since no action required.

6. RAIs 2.b and 2.c

The response to RAI 2.c indicated that ST4 is made up solely of RC17 while ST 5 is made up solely of RC18. The frequencies for these RCs provide in response to RAI 2.b are different from those provided for ST4 and ST5 in Table F.3-7 of the ER as shown below.

		Freq. In Table F.3-7	*Freq. In RAI 2.b Response*
ST4	*RC17*	*1.23E-06*	*1.34E-06*
ST5	*RC18*	*2.88E-07*	*1.82E-07*

It appears from the response to RAI 2.e that a portion of the SGTR events (RC17) is allocated to ST5. Clarify the derivation of these ST frequencies.

PG&E Response to RAIs 2.b and 2.c

The original individual plant examination (IPE) evaluation only included a bin for Containment Bypass accidents. This bin originally included all steam generator tube rupture (SGTR) and interfacing system loss-of-coolant accident (LOCA) (ISLOCA) events. The Level 2 quantification revealed that some portion of the SGTR accidents involved successful operation of auxiliary feed water (AFW), which could significantly reduce the releases by scrubbing the radionuclides prior to release from the steam generator. In order to account for this, the original containment bypass bin was subdivided into 2 separate release categories. The first, ST4, was used to represent the SGTR events that included scrubbing of the releases. ST5 was then used to represent the non-scrubbed SGTR events along with any ISLOCA events. The correct release category frequencies are those listed in Table F.3-7.

7. RAI 2.c

The response to this RAI indicates that the grouping of the 37 release categories into 6 source term categories was performed in a manner similar to that described in IPE Section 4.8. The IPE release category groups were stated to be for the purposes of gaining insights. In the SAMA analysis the Source Term categories function to provide a representation of radioactive release that can be used in the level 3 analysis to provide a reasonable estimate of the consequences. The IPE release category groups termed small and large are based on containment break size and not amount of fission products released. The appropriateness of the release category grouping for providing source terms that yield a reasonable consequence analysis is not clear. Provide further justification for the appropriateness of the release categories assigned to the source term categories and of the resulting consequence analysis.

PG&E Response to RAI 2.c

With the exception as described in the above response to RAI 2.b, all release category groupings were based on the original IPE and were not updated for severe accident mitigation alternative (SAMA). As most PRAs include only release categories for large early release frequency (LERF) and non-LERF, the Diablo Level 2 release category designations were judged to adequately capture the difference in the non-LERF categories to give a better representation of the off-site consequences. Specifically, it is important to separate out the non-LERF cases into accidents that have the potential for a late release and those with the containment remaining intact. Where the existing “small early containment failure” bin is described as failures less than 3 inches in diameter, it is expected that releases associated with this failure mode would not exceed the “Large” threshold. A review of the individual release categories making up the “small early containment failure” bin shows that the volatile release fractions are all less than 10%. 10% is a typical “Large” threshold value.

8. RAI 2.d and 2.e

The response to RAI 2.d indicates that the representative MAAP case chosen for each source term category for the consequence analysis was based on their contribution to the total RC (ST) frequency. This approach does not account for release categories of lower frequency but higher release fractions.

The response to RAI 2.e indicates that for small early releases (ST2) the release category selected (RC14) represents over 50% of the RC frequency and would tend to represent the highest consequence conditions. RC16U makes up 36 % of the ST2 category and appears to be similar except that the debris is uncoolable.

Provide further support for the selection of representative cases for each ST category and specifically confirm that use of RC16U release fractions would not result in a higher dose-risk or OECR.

Also clarify the use of the term release category versus source term category in the response to this RAI. For example, in the above discussion and the discussion of containment bypass.

PG&E Response to RAIs 2.d and 2.e

Some amount of engineering judgment is involved in the selection of representative MAAP calculations for each of the release categories. This judgment combines the probability of the dominant contributors to the potential consequences of a specific accident. As indicated by the reviewer, there is a potential for lower frequency contributors to have higher consequences. Since the risk is the product of the accident frequency and the calculated dose, both the source term magnitude and frequency need to be considered in the selection process. As described in the earlier response to RAI 2.e, typically the case with the highest potential consequence is selected as the represented scenario. As described in that same response for the small early category, case RC14 was selected as it involved a high pressure core melt, pre-existing containment failure, and no containment sprays. From the IPE analysis, this case resulted in approximately 5% Cs release. Case RC16U involved a medium to low pressure core melt, a small pre-existing containment failure, and no containment sprays. A detailed comparison of the ZISOR bin designators reveals the following major differences between the sequences.

- RC14
    - High pressure melt ejection (HPME) due to elevated pressure
    - No core-concrete interaction (due to dispersion of debris)

- RC16U
    - No HPME due to reduced pressure
    - CCI (due to confined debris)

A review of the source term shows a Cs release of 5% for RC14 and 9% for RC16U. This difference would not be expected to impact the consequences by a significant amount.

The terms “release category” and “source term category” are used interchangeably and define the binning of the Level 2 end states based on similar attributes that impact the source term magnitude and the timing of the release. As described in previous responses, the original 37 release categories (also called source term release categories in the response to RAI 2.c), were originally collapsed into 5 unique release categories and then later increased to 6 to address the differences in containment bypass events.

9. RAI 2.h

The response to this RAI indicates that no post core damage recoveries are included in the L2 model (except, for limited cases, containment isolation). Is recovery of AC power post core damage credited?

PG&E Response to RAI 2.h

Offsite power recovery is not credited or considered after core damage. Offsite power in the DC01B model is a convolution of time to core damage and offsite power recovery. Time available after core damage is not considered in the offsite power recovery analysis.

10. RAI 2.j

a. The response to this RAI notes that the individual fission product release shows a stable condition at the end of the simulation except for the noble gas release for ST2 and ST6 which does increase beyond the 50 hour analysis cut off, but that the sensitivity analyses described in the ER bound the potential impact on the SAMA analysis. However, the release fractions reported in Table F.3-6 are in many cases appreciably less than those reported in Table F.2-8. For example, the total release fraction for ST2 noble gases is shown to be 0.36 in Table F.3-6 and 0.89 in Table F.2-8 (similar results are shown for other source terms), suggesting that the dose-risk could potentially be double that reported in the ER for ST2. Provide further justification for the conclusion in the RAI response that the simulation time cut off does not impact the results of the SAMA analysis

b. The response to this RAI also notes the potential for onsite or offsite mitigation measures for releases that extend beyond the simulation time. Provide a discussion of these mitigation measures and clarify the reason for why these measures were not considered as SAMAs.

PG&E Response to RAI 2.j

a) Table F.2-8 of the Environmental Report (ER) reports source terms generated by ZISOR and by MAAP 3.0B analyses performed in support of the IPE. The actual source terms used for the severe accident mitigation alternative (SAMA) evaluation reflect updated calculations using the most recent MAAP 4.0.7 code. As described in section 4.7 of the IPE, ZISOR was originally developed to quantify source terms for the Zion plant and was used in the Diablo IPE to provide a simple and quick method of generating source terms based on expert opinions. From Table F.2-8, it is seen that the typical MAAP 3.0B calculation resulted in smaller source terms when compared to the ZISOR estimate. ZISOR represented an approximation and would typically provide conservative estimates. Modeling differences between MAAP 3.0B and the current version 4.0.7 can be shown to explain even lower source terms. For example, MAAP 3.0B did not include a model for vessel breach and a typical analysis would assume instant failure of the lower head once debris is relocated. MAAP 4.0.7 has a detailed mechanistic model for lower head failure that typically results in over an hour difference between debris relocation and vessel breach. The IPE methodology was used to define the release categories; however, plant specific MAAP 4.0.7 analyses were used for the SAMA consequence evaluation summarized in Table F.3-6.

Typical accident analyses have selected a termination period of 36-48 hours for Level 2 calculations. The rationale for selecting a termination time is based on experience at Three Mile Island (TMI) and Chernobyl that would indicate a high

likelihood of intervention beyond this period of time. Therefore, where we have performed sensitivity analysis to help bound the source terms and corresponding consequence values, it is fully expected that beyond some period of time, off-site measures would be implemented to mitigate any further releases.

b) For longer term accident scenarios, DCPP already has Severe Accident Management Guidelines (SAMG) that were developed to mitigate and recover from severe accidents. The types of actions proceduralized include spraying and/or flooding the containment breakpoint to reduce airborne releases, using a fire truck to provide a pumping source for steam generator (SG) makeup (or for spraying containment), starting the EDGs without a DC power source, flooding containment to provide core debris cooling/release scrubbing, etc. In addition, the B.5.b program resulted in the implementation of measures that are not available to the public. Neither the SAMG nor the B.5.b strategies are included as SAMAs because they are already implemented as procedures at the site.

11. RAI 3.c

a. A portion of the response to this RAI discusses the evaluation of SAMA 18 and that credit could not be taken for seismic events larger than 1.75g because most of the Class I equipment needed for safe shutdown is only seismically qualified up to that level. While this may be true, is it possible that sufficient equipment needed for safe shutdown may have a realistic capacity above 1.75g so that all the modification included in SAMA 26 is not needed. Discuss this potential.

b. Updated results are provided for SAMAs 5, 9 and 18. Relative to these SAMAs provide the following:

i. Given that the change in results is substantial for each SAMA, it appears that the "Assumptions" and the "PRA Model Changes Made to Model SAMA" descriptions in the ER may have changed for these SAMAs. Provide updated "Assumptions" and "PRA Model Changes Made to Model SAMA" for each of these SAMAs.

ii. The revised evaluations of SAMAs 5 and 18 did not include the revised quantification method provided in response to RAI 6.o even though the change in dose-risk and OECR was greater than the change in internal event CDF. Provide an updated evaluation of SAMAs 5 and 18 for both the DC01A and DC01B models that uses the revised quantification method described in the response to RAI 6.o.

iii. Table 3.C-3 indicates that SAMA 9, evaluated using the DC01B model, is potentially cost-beneficial. Provide the detailed cost-benefit results for the DC01A model. Also, describe PG&E's plans regarding further evaluation of this SAMA and any other SAMAs determined to be cost-beneficial in response to RAIs.

c. Table 3.C-3 provides the change in averted cost-risk due to the change in seismic hazard modeled in DC01B and other non-seismic related changes made to other SAMAs in response to RAI 3.c and RAI 6.o. However, the averted cost-risk was reported to have changed for all SAMAs, even those that were not impacted by RAI responses (e.g., SAMAs 2, 7, 8, and 12-17). Describe the significant changes made to PRA Model DC01A to develop PRA Model DC01B.

PG&E Response to RAI 3.c

a) The seismic model does not guarantee failure of offsite power or vital 4kV buses at the upper G-levels. The credit not taken at upper G-levels is credit for recovery of offsite power because of the low likelihood of sufficient power distribution remaining available, as mentioned in the 3c response. In addition,

direct current (DC) power failures are assumed to be non-recoverable. Otherwise, the model employs a non-unity probability of failure for plant components for G-levels above the component's design. The component failure probability is taken from the site- and component-specific fragility curves. In some cases the failure probability can be quite high (92.7%) as in the case of offsite power for higher G-levels. So probabilitistically, the model does consider the likelihood of the availability of the Class I equipment.

However, a majority of the contributors to core damage include scenarios in which alternating current (AC) power is not available and for seismic events over 1.75g, seal loss-of-coolant accidents (LOCAs) always occur. Ultimately, these cases will lead to core damage even if severe accident mitigation alternative (SAMA) 18 is initially successful given the lack of the recirculation function. Even with a seismically durable water source, the source would either eventually be depleted or containment overfill could lead to additional plant failures. The implication is that a comprehensive response system is required to address the larger seismic events.

In most of the seismic events larger than 1.75g, the Class I safe shutdown equipment is unavailable due to support system unavailability even if the equipment has not seismically failed. Loss of offsite power, in conjunction with failure of the 4kV distribution system, the emergency diesel generators (EDG), or the DC power systems prevents use of the equipment to prevent core damage. Other seismically induced failures may also exist, but the sequence results do not provide that information (the lack of equipment support alone is sufficient to fail the equipment). Therefore, it is possible that some systems, or portions of systems, would be available to respond in the event if the required support systems were also available. For example, Residual Heat Removal (RHR) is a robust system; the pumps and heat exchanger have HCLPF values in the range of 3.4g each. However, in order to use the RHR system, a new seismically durable 4kV power source and power distribution system (along with the DC power infrastructure) would have to be installed. Given that recirculation mode is required in the large seismic events, a heat sink is required for the RHR system. At Diablo Canyon Power Plant (DCPP), this requires operation of Component Cooling Water, Auxiliary Saltwater, and the associated support systems (or substitutes). The power supply required for this strategy is essentially equivalent to an entire emergency power division. DCPP installed the sixth EDG in 1992 for approximately $70 million dollars, and that EDG was not required to meet the additional seismic requirements that would be needed for this enhancement. It also did not include installation of a new AC/DC power infrastructure. While using existing plant equipment may initially appear to be a less costly alternative than what was proposed in SAMA 26, the costs associated with ensuring the availability of support systems would prevent this approach from being a less costly alternative. No cost beneficial approach has been identified to address seismic events of 1.75g or greater.

b)
i) While the results for SAMAs 5, 9, and 18 did change substantially, the changes were not related to any undocumented probabilistic risk assessment (PRA) modeling assumptions. The responses to RAIs 6c and 6d [PG&E Letter DLC-10-106] provide descriptions of the PRA modeling assumptions that were used to quantify these SAMAs. As described in the response to RAI 3c, the reasons for the changes in the results were specific to each SAMA:

- SAMA 5: The model originally used to perform the quantification may have been corrupted or otherwise changed beyond what was intended. The quantification was re-performed using the base model as the starting point and the expected results were obtained.

- SAMA 9: The quantification was performed properly, but the final set of PRA results has not been transferred to the cost benefit calculation.

- SAMA 18: Additional logic was identified that should have been addressed as part of the quantification. The logic changes are included in the responses to 6c and 6d.

ii) Updated evaluations for SAMAs 5 and 18 are provided below for both the DC01A and DC01B models. The relatively large Level 3 contributions are accounted for in the evaluations using the same methodology that was developed for the response to RAI 6.o.

SAMA 5, DC01A
The response to RAI 3c (Reference PG&E Letter DLC-10-106) includes the results of the corrected SAMA 5 quantification and, those results are used as the starting point for the DC01A evaluation. The exception is that the baseline DC01A seismic CDF of 3.77E-05 is used in conjunction with the SAMA 5 seismic CDF of 3.72E-05 (from the ER) to reflect the DC01A seismic contributions:

SAMA 5 PRA Results, DC01A

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.77E-05
SAMA Value	7.52E-06	7.31	$27,897	1.25E-05	3.72E-05
Percent Change	10.9%	16.8%	17.2%	10.1%	1.3%

SAMA 5 Internal Events Results By Release Category, DC01A

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.63E-08	1.66E-06	3.50E-06	1.23E-06	1.53E-07	9.04E-07	**7.52E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	2.99	0.12	1.55	1.56	0.00	**7.31**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,114	$11,919	$31	$8,346	$6,487	$1	**$27,897**

Since the OECR reduction is larger than the Dose-Risk reduction, it will be used as the basis for the external events change modifier:

Change Modifier = Percent Change OECR - Percent Change Internal Events CDF

Change Modifier = 17.2% - 10.9% = 6.3%

The revised Percent Change values are as follows:

Revised SAMA 5 Percent Change Results, DC01A

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.9%	16.8%	17.2%	16.4%	7.6%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $842,605. After accounting for “round up” of the base internal events cost-risk, this value is $843,237. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$843,237 * 1.3 = $1,096,208

The fire cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base fire cost-risk of $1,642,571:

$$\text{Fire Cost-Risk}_{SAMA5} = \$1{,}642{,}571 * (1 - 0.164) = \$1{,}373{,}189$$

The seismic cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base seismic cost-risk of $4,455,031:

$$\text{Seismic Cost-Risk}_{SAMA5} = \$4{,}455{,}031 * (1 - 0.076) = \$4{,}116{,}449$$

The total cost-risk for SAMA 5 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

$$\text{SAMA 5 Cost-Risk} = \$1{,}096{,}208 + \$1{,}373{,}189 + \$4{,}116{,}449 = \$6{,}585{,}846$$

The averted cost-risk is the difference between this value and the baseline MACR of $7,400,000:

$$\text{SAMA 5 Averted Cost-Risk} = \$7{,}400{,}000 - \$6{,}585{,}846 = \$814{,}154$$

In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$$\$814{,}154 * 2.36 = \$1{,}921{,}403$$

Since the cost of implementation is $6,441,418, the net value is negative, which is consistent with the conclusion in the ER:

$$\$1{,}921{,}403 - \$6{,}441{,}418 = -\$4{,}520{,}015$$

<u>SAMA 5, DC01B</u>

The response to RAI 3c (Reference PG&E Letter DLC-10-106), which includes corrected results for SAMA 5, provides the following information for SAMA 5 based on the DC01B model:

SAMA 5 PRA Results, DC01B

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.15E-05
SAMA Value	7.52E-06	7.31	$27,897	1.25E-05	3.12E-05
Percent Change	10.9%	16.8%	17.2%	10.1%	1.0%

SAMA 5 Internal Events Results By Release Category, DC01B

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.63E-08	1.66E-06	3.50E-06	1.23E-06	1.53E-07	9.04E-07	**7.52E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	2.99	0.12	1.55	1.56	0.00	**7.31**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,114	$11,919	$31	$8,346	$6,487	$1	**$27,897**

Since the OECR reduction is larger than the Dose-Risk reduction, it will be used as the basis for the external events change modifier:
Change Modifier = Percent Change OECR - Percent Change Internal Events CDF

Change Modifier = 17.2% - 10.9% = 6.3%

The revised Percent Change values are as follows:

Revised SAMA 5 Percent Change Results, DC01B

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.9%	16.8%	17.2%	16.4%	7.3%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $842,605. After accounting for "round up" of the base internal events cost-risk, this value is $843,237. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$843,237 * 1.3 = $1,096,208

The fire cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base fire cost-risk of $1,650,625:

$$\text{Fire Cost-Risk}_{SAMA5} = \$1{,}650{,}625 * (1 - 0.164) = \$1{,}379{,}923$$

The seismic cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base seismic cost-risk of $3,740,625:

$$\text{Seismic Cost-Risk}_{SAMA5} = \$3{,}740{,}625 * (1 - 0.073) = \$3{,}467{,}559$$

The total cost-risk for SAMA 5 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

SAMA 5 Cost-Risk = $1,096,208 + $1,379,923 + $3,467,559 = $5,943,690

The averted cost-risk is the difference between this value and the baseline MACR of $6,700,000:

SAMA 5 Averted Cost-Risk = $6,700,000 - $5,943,690 = $756,310

In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$756,310 * 2.36 = $1,784,892

Since the cost of implementation is $6,441,418, the net value is negative, which is consistent with the conclusion in the ER:

$1,784,892 - $6,441,418 = -$4,656,526

SAMA 18, DC01A

Since the response to RAI 3c (Reference PG&E Letter DLC-10-106) includes the results of the corrected SAMA 18 quantification and, those results are used as the starting point for the DC01A evaluation. The exception is that the baseline DC01A seismic CDF of 3.77E-05 is used in conjunction with the SAMA 18 seismic CDF of 2.26E-05 to reflect the DC01A seismic contributions. The updated seismic CDF is the result of quantifying the DC01A model with the same changes that were implemented for the DC01B model in the response to RAI 3C:

SAMA 18 PRA Results, DC01A

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.77E-05
SAMA Value	7.52E-06	7.31	$27,886	1.25E-05	2.26E-05
Percent Change	10.9%	16.8%	17.2%	10.1%	40.1%

SAMA 18 Internal Events Results By Release Category, DC01A

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.63E-08	1.66E-06	3.50E-06	1.23E-06	1.53E-07	9.04E-07	**7.52E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	2.99	0.12	1.55	1.56	0.00	**7.31**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,114	$11,919	$31	$8,346	$6,487	$1	**$27,897**

Since the OECR reduction is larger than the Dose-Risk reduction, it will be used as the basis for the external events change modifier:
Change Modifier = Percent Change OECR - Percent Change Internal Events CDF

Change Modifier = 17.2% - 10.9% = 6.3%

The revised Percent Change values are as follows:

Revised SAMA 18 Percent Change Results, DC01A

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.9%	16.8%	17.2%	16.4%	46.4%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $842,605. After accounting for “round up” of the base internal events cost-risk, this value is $843,237. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$843,237 * 1.3 = $1,096,208

The fire cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base fire cost-risk of $1,642,571:

$$\text{Fire Cost-Risk}_{SAMA18} = \$1{,}642{,}571 * (1 - 0.164) = \$1{,}373{,}189$$

The seismic cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base seismic cost-risk of $4,455,031:

$$\text{Seismic Cost-Risk}_{SAMA18} = \$4{,}455{,}031 * (1 - 0.464) = \$2{,}387{,}897$$

The total cost-risk for SAMA 18 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

SAMA 18 Cost-Risk = $1,096,208 + $1,373,189 + $2,387,897 = $4,857,294
The averted cost-risk is the difference between this value and the baseline MACR of $7,400,000:

SAMA 18 Averted Cost-Risk = $7,400,000 - $4,857,294 = $2,542,706
In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$$\$2{,}542{,}706 * 2.36 = \$6{,}000{,}786$$

Since the cost of implementation is $6,441,418, the net value is negative, which is consistent with the conclusion in the ER:

$$\$6{,}000{,}786 - \$6{,}441{,}418 = -\$440{,}632$$

<u>SAMA 18, DC01B</u>

The response to RAI 3c (Reference PG&E Letter DLC-10-106), which includes corrected results for SAMA 18, provides the following information for SAMA 18 based on the DC01B model:

SAMA 18 PRA Results, DC01B

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.15E-05
SAMA Value	7.52E-06	7.31	$27,897	1.25E-05	1.79E-05
Percent Change	10.9%	16.8%	17.2%	10.1%	43.2%

SAMA 18 Internal Events Results By Release Category, DC01B

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.63E-08	1.66E-06	3.50E-06	1.23E-06	1.53E-07	9.04E-07	**7.52E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	2.99	0.12	1.55	1.56	0.00	**7.31**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,114	$11,919	$31	$8,346	$6,487	$1	**$27,897**

Since the off-site economic cost risk (OECR) reduction is larger than the Dose-Risk reduction, it will be used as the basis for the external events change modifier:

Change Modifier = Percent Change OECR - Percent Change Internal Events CDF

Change Modifier = 17.2% - 10.9% = 6.3%

The revised Percent Change values are as follows:

Revised SAMA 18 Percent Change Results, DC01B

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.9%	16.8%	17.2%	16.4%	49.5%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $842,605. After accounting for “round up” of the base internal events cost-risk, this value is $843,237. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$843,237 * 1.3 = $1,096,208

The fire cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base fire cost-risk of $1,650,625:

$$\text{Fire Cost-Risk}_{SAMA18} = \$1{,}650{,}625 * (1 - 0.164) = \$1{,}379{,}923$$

The seismic cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base seismic cost-risk of $3,740,625:

$$\text{Seismic Cost-Risk}_{SAMA18} = \$3{,}740{,}625 * (1 - 0.495) = \$1{,}889{,}016$$

The total cost-risk for SAMA 18 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

SAMA 18 Cost-Risk = $1,096,208 + $1,379,923 + $1,889,016 = $4,365,147
The averted cost-risk is the difference between this value and the baseline MACR of $6,700,000:

SAMA 18 Averted Cost-Risk = $6,700,000 - $4,365,147 = $2,334,853
In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$$\$2{,}334{,}853 * 2.36 = \$5{,}510{,}253$$

Since the cost of implementation is $6,441,418, the net value is negative, which is consistent with the conclusion in the ER:

$$\$5{,}510{,}253 - \$6{,}441{,}418 = -\$931{,}165$$

iii) Since the response to RAI 3c (Reference PG&E Letter DLC-10-106) includes the results of the corrected SAMA 9 quantification, those results are used as the basis for the DC01A evaluation. The exception is that the baseline DC01A seismic CDF of 3.77E-05 is used in conjunction with zero reduction in the SAMA 9 seismic CDF (remains at 3.77E-05) to reflect the DC01A seismic contributions.

SAMA 9 PRA Results, DC01A

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.77E-05
SAMA Value	8.41E-06	8.80	$33,730	4.23E-06	3.77E-05
Percent Change	0.4%	0.0%	-0.1%	69.6%	0.0%

SAMA 9 Internal Events Results By Release Category, DC01A

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	7.15E-08	1.66E-06	3.95E-06	1.23E-06	2.88E-07	1.20E-06	**8.41E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.17	3.00	0.13	1.55	2.93	0.01	**8.80**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,201	$11,949	$35	$8,345	$12,199	$1	**$33,730**

Using the methodology described in section F.4 of the ER, the cost-risk for the configuration with SAMA 9 implemented is $6,254,557. The averted cost-risk is the difference between this value and the baseline MACR of $7,400,000:

SAMA 9 Averted Cost-Risk = $7,400,000 - $6,254,557 = $1,145,443

In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$1,145,443 * 2.36 = $2,703,245

Since the cost of implementation is $1,628,122, the net value is positive, which is a change to the conclusion reached in the ER:

$2,703,245 - $1,628,122, = $1,075,124

This is the only SAMA that was determined to be cost beneficial that was originally determined not to be cost beneficial in the ER. PG&E will consider the four SAMAs using the appropriate DCPP design process. These SAMAs do not relate to the management of aging during the period of extended operation, and are therefore unrelated to any of the technical matters that must be addressed pursuant to 10 CFR 54.

c) The only changes made to the DC01A mode to obtain the DC01B model were the updates to the seismic initiating event frequencies, which were described in the response to RAI 3c (Reference PG&E Letter DCC-10-106). Because the total external events CDF and the relative contributions of the external events initiators impact the potential averted cost-risk value for each external events initiator type (fire, seismic, non-fire/non-seismic), the change in the seismic CDF impacted all of the cost benefit results.

12. RAI 3.d

The third highest seismic CDF sequence is described as involving seismic failure of the auxiliary feedwater system. A review of the importance analysis provided in response to RAI 3.c includes important events (OB1SE and AW1S) that are described to include AFW failure due to operator error. Clarify the cause of AFW failure for this sequence.

PG&E Response to RAI 3.d

The split fractions OB1SE and AW1S are each dominated by operator failures and are required after seismic failure of the normal auxiliary feed water (AFW) water source(s) (CST, RWSR).

For OB1SE, 96.6% of the contribution is due to the failure of the operator to initiate bleed and feed cooling.

AWS1 is an intermediate split fraction for AW1S, which includes an 81% contribution from the failure to align an alternate water source for AFW. As noted in the response to RAI 3.c, (Reference PG&E Letter DCL-10-106), the sequences including this split fraction also generally include failure to initiate feed and bleed.

13. RAI 3.e

The response to this RAI attributes the changes in FS type fire scenario results to routine changes in the internal events models that are used in evaluating the FS fire scenarios as opposed to relatively minor changes in the CSR1/CSR2 fire scenarios that utilize their own simplified event trees that have not had as many changes. The reason for the reduction in the VB1 fire scenario CDF contribution from the IPEEE is not discussed. As the IPEEE notes, this control room fire scenario utilizes its own special event tree and not the internal events event tree. Discuss the reasons for the reduction in the VB1 fire scenario CDF from that given in the IPEEE.

PG&E Response to RAI 3.e

The reason for the reduction in the VB1 fire scenario core damage frequency (CDF) contribution from the IPE external events (IPEEE) is due to an update to the Fire probabilistic risk assessment (PRA) in 1998 as documented in PRA Calc F.3.2, Rev 1. The update included reassessment of the main control fire (including VB1) and re-development of the uncertainty model.

This update resulted in a reduction to the following split fraction values and an associated reduction in CDF.

VB1 Split Fraction	Description	IPEEE value	Updated Value
FEF1	VB1 Geometry/Severity Factor	2.46E-02	1.21E-02
FCR1	CR Evacuation Frequency	5.0E-2	4.4E-02
FEB0	CR Equip Failure Occurs Post Evacuation	0.5	0.0

14. RAI 5.b

The response to this RAI discusses the potential for a specific cost beneficial SAMA (strengthening a block wall) that focuses on one of the contributors to a split fraction rather than a SAMA that addresses the overall function represented by the split fraction. While this particular SAMA may not be cost beneficial, it does illustrate that there are potential SAMAs that can be identified from a review of the individual contributors to a split fraction. It is stated that basic event level results are often reviewed during the sequence analysis to determine what the dominant contributors to a split fraction may be, but that the process is not documented. Provide further assurance that a review of the basic event contributors to the important split fractions will not yield additional SAMAs that may be cost beneficial.

PG&E Response to RAI 5.b

As the initial response to this RAI indicated, it is rare that a severe accident mitigation alternative (SAMA) is developed to address a single component. SAMAs are developed for systems or functions that are needed in response to an accident with specific conditions. These specific conditions are often referred to as system boundary conditions. System or subsystem functions under specific boundary conditions are split fractions in RISKMAN.

Ranking split fraction importance gives us a quantitative means to prioritize system functions under accident boundary conditions. If, instead, we were to rank component or basic event importance and attempt to develop SAMAs for them, we would be left without the context of the accident boundary conditions. RISKMAN cannot provide the context under which a basic event might be important.

SAMAs are developed to bolster system functions under specific boundary conditions or circumstances. Risk ranking of split fractions provides this information. Once the split fraction is selected, the function, its components used to support that function, and the accident context can be understood by an analyst familiar with the model. At that point, SAMAs can be postulated to improve the reliability of the function under the accident context. The relative risk ranking of the basic event to that split fraction typically provides little additional insight. Since the function in the accident context is known, it is clear what the associated components are, and an experienced analyst can link the important contributors in that system to that function.

Explicitly documenting how the basic event contributors to important split fractions were dispositioned would be an extremely resource intensive effort that would provide little additional benefit. While that documentation would serve as proof of effort and improve traceability, model comprehension is a basic task of

the responsible PRA analyst. In addition, the nature of the SAMAs developed demonstrates that the lower level contributors to the split fractions were considered as part of the review process. For example, for split fractions OB1SE and AW1S, the dominant contributors were operator errors associated with initiating bleed and feed and swapping AFW to an alternate water source, respectively. These split fractions were dispositioned with an automated function given that little benefit would be gained from a SAMA that required additional operator actions to restore similar functions.

15. RAI 6.e

The response to this RAI indicates that there is a 2% reduction in the seismic CDF for SAMA 3 and that the cost benefit analysis results are provided in response to SAMA RAI 3.c. Table 3.C-2 indicates that there is no change in seismic CDF for SAMA 3. Clarify and provide complete CDF results and the C/B evaluation for SAMA 3 for the DC01A and DC01B models. Also update the response to RAI 6.o for SAMA 3.

PG&E Response to RAI 6.e

The responses developed for RAIs 3.c and 6.o (Reference PG&E Letter DLC-10-106) were not updated to reflect the change in the seismic core damage frequency (CDF) identified in the response to RAI 6e. The SAMA 3 seismic frequency has been updated for both the DC01A (3.68E-05/yr) and DC01B (3.10E-05/yr) models and the results are provided below.

Given that the following "SAMA 3, DC01A" section would directly replace the "SAMA 3" section of the response to RAI 6.0, the entire RAI 6.o response has not been reproduced here.

SAMA 3, DC01A

Section F.6.2 of the environmental report (ER) provides the appropriate probabilistic risk assessment (PRA) results for SAMA 3, with the exception that the seismic CDF has been updated to 3.68E-05/yr:

SAMA 3 PRA Results, DC01A

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.77E-05
SAMA Value	7.56E-06	7.46	$28,618	4.40E-06	3.68E-05
Percent Change	10.4%	15.2%	15.1%	68.3%	2.4%

SAMA 3 Internal Events PRA Results by release Category, DC01A

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.64E-08	9.98E-07	3.78E-06	1.21E-06	2.86E-07	1.22E-06	**7.56E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	1.80	0.13	1.52	2.91	0.01	**7.46**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,116	$7,166	$33	$8,188	$12,114	$1	**$28,618**

Given that the Dose-Risk reduction is larger than the OECR reduction, it will be used as the basis for the external events change modifier:

Change Modifier = Percent Change Dose-Risk - Percent Change Internal Events CDF

Change Modifier = 15.2% - 10.4% = 4.8%

The revised Percent Change values are as follows:

Revised SAMA 3 Percent Change Results, DC01A

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.4%	15.2%	15.1%	73.1%	7,2%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $858,968. After accounting for “round up” of the base internal events cost-risk, this value is $859,600. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$859,600 * 1.3 = $1,117,480

The fire cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base fire cost-risk of $1,642,500:

$$\text{Fire Cost-Risk}_{SAMA3} = \$1{,}642{,}500 * (1 - 0.731) = \$441{,}833$$

The seismic cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base seismic cost-risk of $4,455,000:

$$\text{Seismic Cost-Risk}_{SAMA3} = \$4{,}455{,}000 * (1 - 0.072) = \$4{,}134{,}240$$

The total cost-risk for SAMA 3 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

SAMA 3 Cost-Risk = $1,117,480 + $441,833 + $4,134,240 = $5,693,553

The averted cost-risk is the difference between this value and the baseline MACR of $7,400,000:

SAMA 3 Averted Cost-Risk = $7,400,000 - $5,693,553 = $1,706,447

In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2) is applied:

$1,706,447 * 2.36 = $4,027,215

Since the cost of implementation is $5,863,176, the net value is negative, which is consistent with the conclusion in the ER:

$4,027,215 - $5,863,176 = -$1,835,961

SAMA 3, DC01B

Section F.6.2 of the ER provides the appropriate PRA results for SAMA 3, with the exception that the seismic CDF has been updated to 3.10E-05/yr:

SAMA 3 PRA Results, DC01B

	CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Base Value	8.44E-06	8.79	$33,699	1.39E-05	3.15E-05
SAMA Value	7.56E-06	7.46	$28,618	4.40E-06	3.10E-05
Percent Change	10.4%	15.2%	15.1%	68.3%	1.6%

SAMA 3 Internal Events PRA Results by release Category, DC01B

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$Frequency_{BASE}$	7.18E-08	1.66E-06	3.97E-06	1.23E-06	2.88E-07	1.22E-06	**8.44E-06**
$Frequency_{SAMA}$	6.64E-08	9.98E-07	3.78E-06	1.21E-06	2.86E-07	1.22E-06	**7.56E-06**
$Dose\text{-}Risk_{BASE}$	1.18	2.99	0.13	1.55	2.94	0.01	**8.79**
$Dose\text{-}Risk_{SAMA}$	1.09	1.80	0.13	1.52	2.91	0.01	**7.46**
$OECR_{BASE}$	$1,206	$11,919	$35	$8,327	$12,211	$1	**$33,699**
$OECR_{SAMA}$	$1,116	$7,166	$33	$8,188	$12,114	$1	**$28,618**

Since the Dose-Risk reduction is larger than the OECR reduction, it will be used as the basis for the external events change modifier:

Change Modifier = Percent Change Dose-Risk - Percent Change Internal Events CDF

Change Modifier = 15.2% - 10.4% = 4.8%

The revised Percent Change values are as follows:

Revised SAMA 3 Percent Change Results, DC01B

	Internal CDF	Dose-Risk	OECR	Fire CDF	Seismic CDF
Percent Change	10.4%	15.2%	15.1%	73.1%	6.4%

Applying the process described in Section F.4 of the ER yields an internal events cost-risk of $858,968. After accounting for “round up” of the base internal events cost-risk, this value is $859,600. The non-fire/non-seismic external events contributions are accounted for by multiplying this value by 1.3:

$859,600 * 1.3 = $1,117,480

The fire cost-risk can be obtained by multiplying the complement of the revised “percent change” fraction by the base fire cost-risk of $1,650,625:

$$\text{Fire Cost-Risk}_{SAMA3} = \$1{,}650{,}625 * (1 - 0.731) = \$444{,}018$$

The seismic cost-risk can be obtained by multiplying the complement of the revised "percent change" fraction by the base seismic cost-risk of $3,740,625:

$$\text{Seismic Cost-Risk}_{SAMA3} = \$3{,}740{,}625 * (1 - 0.064) = \$3{,}501{,}225$$

The total cost-risk for SAMA 3 is the sum of the fire, seismic, and non-fire/non-seismic cost-risk values:

$$\text{SAMA 3 Cost-Risk} = \$1{,}117{,}480 + \$444{,}018 + \$3{,}501{,}225 = \$5{,}062{,}723$$

The averted cost-risk is the difference between this value and the baseline MACR of $6,700,000:

$$\text{SAMA 3 Averted Cost-Risk} = \$6{,}700{,}000 - \$5{,}062{,}723 = \$1{,}637{,}277$$

In order to account for the 95th percentile PRA results, a multiplier of 2.36 (refer to Section F.7.2 of the ER) is applied:

$$\$1{,}637{,}277 * 2.36 = \$3{,}863{,}974$$

Since the cost of implementation is $5,863,176, the net value is negative, which is consistent with the conclusion in the ER:

$3,863,974 - $5,863,176 = -$1,999,202

16. RAI 7

The response to this RAI dismisses the feasibility of using a gagging device for closing a SG SV based on the challenging work environment. Expand on this rationale particularly if gagging is implemented for a SGTR prior to the onset of core damage. If considered feasible in this situation, provide an assessment of the cost-benefit of using such a device.

PG&E Response to RAI 7

The response to RAI 7 (Reference PG&E Letter DCL-10-106) does not dismiss the use of the safety valve gags on a "challenging work environment". The response indicates that the physical limitations of the valves/gagging devices are the disqualifying factor; the working conditions are only identified as additional concerns that would complicate the use of the devices.

With regard to the existing Diablo Canyon Power Plant (DCPP) safety valve gagging devices, the following excerpts from the Dresser gagging procedure characterize the conditions under which they are expected to be used:

1. "Gags should be applied only finger tight"– Conclusion: They are only made to load the valve spindle a small amount to assist the spring to prevent opening.

2. The "bulk of the force to close the valve comes from the spring" – Conclusion: A "stuck open" safety valve caused by a broken spring would be impossible to close with a gag.

3. "Over-gagging will cause damage to the (valve) seating surface" – Conclusion: High gagging load can damage the valve seat working against closing an open safety.

4. "It is very difficult to stop a (valve) leak by additional gagging force once it has started" – Conclusion: The extra force caused by increased effective disc area due to the dynamic nozzle effect cannot be overcome by the gag. Only reducing pressure by a significant amount and letting the spring force close the valve is effective.

For the reasons discussed above, the design of the Dresser type 3700 safety valves used in the DCPP units makes it unlikely that a gagging device would be capable of closing an open safety valve. The valve spindle is not intended to withstand a large compressive force and the expectation is that it would fail (buckle) or cause valve seat damage under the load required to close an open safety valve. In order to provide DCPP with the capability to use a manual gagging device to close a stuck open safety valve, PG&E believes the safety valves would have to be re-designed to accept a large closing force through the valve spindle. The cost of the valve re-design, valve requalification, and

installation would greatly exceed any benefit that could be provided by the gagging devices.