Model Change(s):

Refer to the model changes described for SAMA 12 in Section F.7.2.1.6. The SAMA 12 model changes envelope the changes for SAMA 10.

Results of SAMA Quantification:

The SAMA 12 quantification is used as a bounding estimate of the SAMA 10 benefit. As documented in Section F.7.2.1.6, the baseline averted cost-risk for SAMA 12 is $813,995.

Based on a $22,572,878 cost of implementation for DCPP, the net value for this SAMA is -$21,758,883 ($813,995 - $22,572,878). When the 95th percentile PRA results are used, the averted cost-risk is increased by a factor of 3.0 to $2,441,985, which still yields a negative net value ($2,441,985 - $22,572,878 = -$20,130,893). This SAMA is not cost-beneficial.

F.7.2.1.6 SAMA 12: Use an Alternate EDG to Support Long Term AFW Operation and a 480V AC Self-Cooled PDP for Primary Side Makeup

A low cost SBO mitigation strategy is to use a small, alternate EDG to power a station battery charger for level instrumentation and AFW control. In addition, if power can be supplied to a 480V AC self-cooled, high pressure positive displacement pump, primary side makeup could be maintained to make up for normal seal leakage and potentially for boil off in longer timeframes.

Change Description:

The seismic pretree SEISPRE models the fragility of the DC system. When top event SDC fails electric power event tree ELECPWR DC top events D2F, D2G and D2H are failed. A seismically qualified DC generator that could be used to power loads requiring DC power. A way to model that is to not fail one of the DC buses due to seismic initiators and to decrease the failure probability due to the additional redundant components.

To account for the impact on DC in the long term all the split fractions for top event DF must be reduced in probability by a factor of 100.

Assume fire damage to 125V DC bus F prevents the use of the alternate DC equipment.

Top event CH models cold leg injection via the CCPs. Because this SAMA provides a redundant injection pump from a separate stand-alone AC power source, each split fraction can be reduced by the failure rate of such a system. The assumed failure rate is 1.0E-02. The guaranteed failed split fraction (CHF) is no longer 1.0E+00, but defaults to the failure rate of the stand-alone redundant train, 1.0E-02.

Charging is also modeled in top events CHI for interfacing system LOCAs, and CHM for medium LOCAs. These need to be changed as well.

The split fractions developed for fire that involve the flow control valves (8801, 8803, 8805) should not be changed in value.

Model Change(s):

In ELECPWR:

- Delete the split fraction rule (D2FF: SCD=F), which fails DC bus F due to seismic initiators.
- In rule 44 allow the bus to fail due to DC bus F initiators.
- Delete the seismic Macros (i.e., SEISA, SEISB, and SEISC) from the split fraction rules for the Long-Term DC split fractions DF*SB and DF*SC.

In MFF change the following:

- Reduce the value of SF D2F1 by a factor of 100 (DHUMFA ~=1E-2 which is an operator action to align a backup charger) to 2.5E-6 to account for the additional equipment.
- Reduce the probability of all the DF split fractions by a factor of 100 to account for the additional equipment.

Top Events CH, CHI, CHM:

- Reduce the each split fraction by a factor of 100 except for those that reflect fire failure of valves 8801, 8803, or 8805.

Event Tree(s): GENTRN, ATWT, MLOCA, ILOCA, SGENTRN, SGTREARLY

Results of SAMA Quantification:

The following table summarizes the changes to the internal events CDF, Dose-Risk, and Offsite Economic Cost-Risk resulting from the implementation of this SAMA:

	CDF	Dose-Risk	OECR
Base Value	8.64E-05	98.89	$246,912
SAMA Value	8.31E-05	84.71	$228,732
Percent Change	3.8%	14.3%	7.4%

A further breakdown of the Dose-Risk and OECR information is provided in the table below according to release category:

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$\text{Frequency}_{\text{BASE}}$	7.24E-06	6.74E-06	6.42E-05	1.79E-06	2.97E-06	1.79E-06	**8.52E-05**
$\text{Frequency}_{\text{SAMA}}$	5.82E-06	6.77E-06	6.27E-05	1.77E-06	2.94E-06	1.77E-06	**8.21E-05**
$\text{Dose-Risk}_{\text{BASE}}$	71.20	6.46	1.60	1.38	18.24	0.01	**98.89**
$\text{Dose-Risk}_{\text{SAMA}}$	57.21	6.49	1.56	1.36	18.08	0.01	**84.71**
$\text{OECR}_{\text{BASE}}$	$88,372	$48,941	$751	$9,774	$99,072	$2	**$246,912**
$\text{OECR}_{\text{SAMA}}$	$71,004	$49,150	$734	$9,647	$98,196	$2	**$228,732**

This information was used as input to the averted cost-risk calculation. The results of this calculation are provided in the following table:

SAMA 12 Averted Cost-Risk

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
DCPP Unit 1	$9,315,791	$8,501,796	$813,995

Based on a $13,560,218 cost of implementation for DCPP, the net value for this SAMA is -$12,746,223 ($813,995 - $13,560,218). When the 95th percentile PRA results are used, the averted cost-risk is increased by a factor of 3.0 to $2,441,985, which still yields a negative net value ($2,441,985 - $13,560,218 = -$11,118,233). This SAMA is not cost-beneficial.

F.7.2.1.7 SAMA 17: Install Flood Sensors to Mitigate Fire Protection System Pipe Breaks

There are multiple scenarios related to Fire Protection system pipe breaks that, if un-isolated, lead to significant equipment damage. In order to improve the likelihood of flood termination, water sensors could be installed in areas containing critical equipment that can be impacted by fire protection system floods, such as those containing the AFW, CCW, and RHR pumps. The water level sensor could be linked to logic that would trip the fire protection pumps and/or isolate a critical valve for scenarios where there is not a coincident fire alarm.

<u>Change Description:</u>

For the following initiators, change the frequency, lowering it by a factor of 100.

Related to SF WFLO2N:

- Y14AFWMP1E (break In area 14-A),
- Y3B85FWLP1 (area 3-BB-85, 3-BB-100, or 3-BB-115),
- Y54FT6IN (area not listed),
- Y31FWLP2C (area not listed),
- Y31FWMP2C1 (Areas 31, 3-Q-1, or 3-P-2),
- Y3B15FWMP1 (area not listed),
- Y3H1FWLP1A (area not listed)

Related to SF CD1FL:

- Y3Q1FWLP2A (rooms 3-Q-1 and 3-Q-2),
- Y31FWLP2A2 (area 3-Q-1),
- Y31FWMP2C1 (Areas 31, 3-Q-1, or 3-P-2)

<u>Model Change(s):</u>

Reduce the following IE frequencies by a factor of 100:

- Y14AFWMP1E from 3.998700E-004 to 3.998700E-006
- Y3B85FWLP1 from 1.060000E-003 to 1.060000E-005
- Y54FT6IN from 3.111900E-004 to 3.111900E-006
- Y31FWLP2C from 2.741700E-004 to 2.741700E-006
- Y31FWMP2C1 from 1.047500E-004 to 1.047500E-006
- Y3B15FWMP1 from 1.075000E-005 to 1.075000E-007
- Y3H1FWLP1A from 7.241200E-005 to 7.241200E-007
- Y3Q1FWLP2A from 3.820100E-004 to 3.820100E-006
- Y31FWLP2A2 from 1.390800E-004 to 1.390800E-006
- Y31FWMP2C1 from 1.047500E-006 to 1.047500E-008.

Event Tree(s): FLOOD

Results of SAMA Quantification:

The following table summarizes the changes to the internal events CDF, Dose-Risk, and Offsite Economic Cost-Risk resulting from the implementation of this SAMA:

	CDF	**Dose-Risk**	**OECR**
Base Value	8.64E-05	98.89	$246,912
SAMA Value	8.33E-05	96.95	$234,906
Percent Change	3.6%	2.0%	4.9%

A further breakdown of the Dose-Risk and OECR information is provided in the table below according to release category:

Release Category	**ST1**	**ST2**	**ST3**	**ST4**	**ST5**	**ST6**	**Total**
$\text{Frequency}_{\text{BASE}}$	7.24E-06	6.74E-06	6.42E-05	1.79E-06	2.97E-06	1.79E-06	**8.52E-05**
$\text{Frequency}_{\text{SAMA}}$	7.23E-06	6.72E-06	6.13E-05	0.00E+00	2.91E-06	0.00E+00	**8.04E-05**
$\text{Dose-Risk}_{\text{BASE}}$	71.20	6.46	1.60	1.38	18.24	0.01	**98.89**
$\text{Dose-Risk}_{\text{SAMA}}$	71.07	6.44	1.53	0.00	17.90	0.01	**96.95**
$\text{OECR}_{\text{BASE}}$	$88,372	$48,941	$751	$9,774	$99,072	$2	**$246,912**
$\text{OECR}_{\text{SAMA}}$	$88,206	$48,787	$717	$0	$97,194	$2	**$234,906**

This information was used as input to the averted cost-risk calculation. The results of this calculation are provided in the following table:

SAMA 17 Averted Cost-Risk

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
DCPP Unit 1	$9,315,791	$8,982,236	$333,555

Based on a $9,610,440 cost of implementation for DCPP, the net value for this SAMA is -$9,276,885 ($333,555 - $9,610,440). When the 95th percentile PRA results are used, the averted cost-risk is increased by a factor of 3.0 to $1,000,665, which still yields a negative net value ($1,000,665 - $9,610,440 = -$8,609,775). This SAMA is not cost-beneficial.

The cost estimate of $9,610,440 was only for an Aux Bldg flooding alarm system with local sensors and alarms at both the Aux Control Board and Main Control Room (i.e., it does not account for the changes required to perform automatic system isolation). Adding the capability to automatically isolate the Fire Protection System would significantly increase the implementation cost. The risk reduction for this SAMA, however, is based on the availability of the automatic isolation capability. Therefore, the net value for this SAMA would be more negative if the automatic isolation capability were to be included in the cost estimate.

F.7.2.1.8 SAMA 20: Use Alternate Signal (such as AMSAC) to De-energize the 480V AC Buses that Supply the Rod Drive Motor Generator Sets

In the event that the MG set breakers do not trip in an ATWS, an alternate signal, such as an AMSAC signal, could be used to depower the 480V AC supply that powers the MG sets to ensure the control rod drive units are shut down. The 480V trip could be delayed so that it is only performed after 30 seconds with a valid ATWS signal.

Change Description:

Reduce the probability of all split fractions for top event RT by the failure rate of an AMSAC-like system (use split fraction AM1), which is approximately 1.0E-02. No split fraction should be less than RT6 (6.16E-06) which is the failure probability of the control rods to insert. Split fraction RT6 is used for station blackout scenarios where power to the RPS bus is unavailable and it is certain the RPS bus has de-energized.

Model Change(s):

In MFF, set all RT split fractions to 6.16E-6 except for RT7, whose new frequency should be 1.86E-05.

Event Tree(s): MECHSUP

Results of SAMA Quantification:

The following table summarizes the changes to the internal events CDF, Dose-Risk, and Offsite Economic Cost-Risk resulting from the implementation of this SAMA:

	CDF	**Dose-Risk**	**OECR**
Base Value	8.64E-05	98.89	$246,912
SAMA Value	8.57E-05	72.99	$223,255
Percent Change	0.8%	26.2%	9.6%

A further breakdown of the Dose-Risk and OECR information is provided in the table below according to release category:

Release Category	**ST1**	**ST2**	**ST3**	**ST4**	**ST5**	**ST6**	**Total**
$\text{Frequency}_{\text{BASE}}$	7.24E-06	6.74E-06	6.42E-05	1.79E-06	2.97E-06	1.79E-06	**8.52E-05**
$\text{Frequency}_{\text{SAMA}}$	4.46E-06	7.93E-06	6.51E-05	1.83E-06	3.01E-06	1.83E-06	**8.46E-05**
$\text{Dose-Risk}_{\text{BASE}}$	71.20	6.46	1.60	1.38	18.24	0.01	**98.89**
$\text{Dose-Risk}_{\text{SAMA}}$	43.84	7.60	1.62	1.41	18.51	0.01	**72.99**
$\text{OECR}_{\text{BASE}}$	$88,372	$48,941	$751	$9,774	$99,072	$2	**$246,912**
$\text{OECR}_{\text{SAMA}}$	$54,412	$57,572	$762	$9,974	$100,534	$2	**$223,255**

This information was used as input to the averted cost-risk calculation. The results of this calculation are provided in the following table:

SAMA 20 Averted Cost-Risk

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
DCPP Unit 1	$9,315,791	$8,127,775	$1,188,016

Based on an $11,173,059 cost of implementation for DCPP, the net value for this SAMA is -$9,985,043 ($1,188,016 - $11,173,059). When the 95th percentile PRA results are used, the averted cost-risk is increased by a factor of 3.0 to $3,564,048, which still yields a negative net value ($3,564,048 - $11,173,059 = -$7,609,011). This SAMA is not cost-beneficial.

F.7.2.1.9 SAMA 22: Install Containment Combustible Gas Igniters

Early containment failure is a contributor to the LERF release category. Although inerting containment in accident conditions could help prevent burns of combustible gases, a better solution is to install battery-backed igniters throughout upper dome of containment.

Change Description:

Hydrogen burn in containment is modeled through top event HECET (within 4hrs of vessel breach) and CECET (early hydrogen burn). These associated split fractions could be reduced by the failure probability of a hydrogen ignitor system that is battery backed ~1E-03.

Top Event HECET:

- HECET1 from 7.1E-01 to 7.1E-04
- HECET2 from 7.1E-01 to 7.1E-04
- Leave HECET0 = 1.0

Top Event CECET

- CECET1 from 2.8E-02 to 2.8E-05

Model Change(s):

Top Event HECET

- HECET1 from 7.1E-01 to 7.1E-04

- HECET2 from 7.1E-01 to 7.1E-04
- Leave HECET0 = 1.0

Top Event CECET

- CECET1 from 2.8E-02 to 2.8E-05

Event Tree(s): CET, CETIT, CETML, CETORG, SCET

Results of SAMA Quantification:

The following table summarizes the changes to the internal events CDF, Dose-Risk, and Offsite Economic Cost-Risk resulting from the implementation of this SAMA:

	CDF	Dose-Risk	OECR
Base Value	8.64E-05	98.89	$246,912
SAMA Value	8.64E-05	97.90	$245,748
Percent Change	0.0%	1.0%	0.5%

A further breakdown of the Dose-Risk and OECR information is provided in the table below according to release category:

Release Category	ST1	ST2	ST3	ST4	ST5	ST6	Total
$\text{Frequency}_{\text{BASE}}$	7.24E-06	6.74E-06	6.42E-05	1.79E-06	2.97E-06	1.79E-06	**8.52E-05**
$\text{Frequency}_{\text{SAMA}}$	7.14E-06	6.74E-06	6.43E-05	1.79E-06	2.97E-06	1.79E-06	**8.52E-05**
$\text{Dose-Risk}_{\text{BASE}}$	71.20	6.46	1.60	1.38	18.24	0.01	**98.89**
$\text{Dose-Risk}_{\text{SAMA}}$	70.19	6.46	1.60	1.37	18.27	0.01	**97.90**
$\text{OECR}_{\text{BASE}}$	$88,372	$48,941	$751	$9,774	$99,072	$2	**$246,912**
$\text{OECR}_{\text{SAMA}}$	$87,108	$48,932	$752	$9,756	$99,198	$2	**$245,748**

This information was used as input to the averted cost-risk calculation. The results of this calculation are provided in the following table:

SAMA 22 Averted Cost-Risk

Unit	Base Case Cost-Risk	Revised Cost-Risk	Averted Cost-Risk
DCPP Unit 1	$9,315,791	$9,266,969	$48,822

Based on a \$13,083,120 cost of implementation for DCPP, the net value for this SAMA is -\$13,034,298 (\$48,822 - \$13,083,120). When the 95th percentile PRA results are used, the averted cost-risk is increased by a factor of 3.0 to \$146,466, which still yields a negative net value (\$146,466 - \$13,083,120 = -\$12,936,654). This SAMA is not cost-beneficial.

F.7.2.2 PHASE 2 IMPACT

As discussed above, a single factor based on the 95th percentile for the base case is used to determine the impact of the cost-benefit analysis for the proposed SAMA candidates. The uncertainty analyses that are available for the Level 1 model are not available (or not used) for the Level 2 and 3 PRA models. In order to simulate the use of the 95th percentile results for the Level 2 and 3 models, the same scaling factor calculated for the Level 1 results was implicitly applied to the Level 2 and 3 models.

The Phase 2 SAMA list was re-examined by multiplying the nominal averted cost risk by a factor of 3.0 (see Section F.7.2) to identify SAMAs that would be re-characterized as cost beneficial, i.e., positive net value. Those SAMAs that were previously determined to be not cost beneficial due to implementation costs exceeding their associated nominal averted cost risk may be potentially cost beneficial at the revised 95th percentile averted cost risk. In this case, two (2) additional Phase 2 SAMAs become potentially cost-beneficial (SAMAs 8 and 16).

F.7.2.3 95TH PERCENTILE SUMMARY

The following table provides a summary of the impact of using the 95th percentile PRA results on the detailed cost-benefit calculations that have been performed.

Summary of the Impact of Using the 95th Percentile PRA Results

SAMA ID	Cost of Implementation	Averted Cost Risk (Base)	Net Value (Base)	Averted Cost Risk (95th Percentile)	Net Value (95th Percentile)	Change in Cost Effective-ness?
1	\$3,020,424	\$584,227	-\$2,436,197	\$1,752,681	-\$1,267,743	No
2	\$17,492,616	\$792,847	-\$16,699,769	\$2,378,541	-\$15,114,075	No
3	\$376,342	\$845,287	\$468,945	\$2,535,861	\$2,159,519	No
5	\$3,133,404	\$31,219	-\$3,102,185	\$93,657	-\$3,039,747	No

Summary of the Impact of Using the 95th Percentile PRA Results

SAMA ID	Cost of Implementation	Averted Cost Risk (Base)	Net Value (Base)	Averted Cost Risk (95th Percentile)	Net Value (95th Percentile)	Change in Cost Effectiveness?
6	$9,993,910	$325,104	-$9,668,806	$975,312	-$9,018,598	No
7	$10,616,468	$339,888	-$10,276,580	$1,019,664	-$9,596,804	No
8	$1,072,493	$584,227	-$488,266	$1,752,681	$680,188	Yes
9	$25,520,160	$71,677	-$25,448,483	$215,031	-$25,305,129	No
10	$22,572,878	$813,995	-$21,758,883	$2,441,985	-$20,130,893	No
12	$13,560,218	$813,995	-$12,746,223	$2,441,985	-$11,118,233	No
14	$5,620,896	$269,718	-$5,351,178	$809,154	-$4,811,742	No
16	$372,788	$225,882	-$146,906	$677,646	$304,858	Yes
17	$9,610,440	$333,555	-$9,276,885	$1,000,665	-$8,609,775	No
20	$11,173,059	$1,188,016	-$9,985,043	$3,564,048	-$7,609,011	No
21	$256,817	$1,666,133	$1,409,316	$4,998,399	$4,741,582	No
22	$13,083,120	$48,822	-$13,034,298	$146,466	-$12,936,654	No
23	$491,021	$2,706	-$488,315	$8,118	-$482,903	No

When the 95th percentile PRA results were applied to the Phase 1 analysis, the increase in the MACR resulted in the retention of nine (9) SAMAs that were screened in the baseline Phase 1 analysis (SAMAs 2, 6, 7, 9, 10, 12, 17, 20, and 22). The Phase 2 analysis performed for these SAMAs using the 95th percentile PRA results confirmed that none are cost-beneficial.

When the 95th percentile PRA results were applied to the Phase 2 analysis, two (2) SAMAs (8 and 16) that were previously classified as not cost-effective were determined to be potentially cost-effective. The use of the 95th percentile PRA results is not considered to provide the best assessment of the cost-effectiveness of a SAMA. Instead, it is intended to address the uncertainties inherent in the SAMA analysis. Nonetheless, these additional SAMAs identified as potentially cost-beneficial through this sensitivity case (none of which is related to aging management under 10 C.F.R. Part 54) should be further evaluated for possible implementation using current, applicable plant procedures.

F.7.3 MACCS2 INPUT VARIATIONS

F.7.3.1 OVERVIEW

The MACCS2 model was developed using the best information available for the DCPP site; however, reasonable changes to modeling assumptions can lead to variations in the Level 3 results. In order to determine how certain assumptions could impact the SAMA results, a sensitivity analysis was performed on parameters that have previously been shown to impact the Level 3 results. These parameters include:

- Meteorological data
- Evacuation timing and speed
- Release height and heat
- Deposition velocity
- Population estimates
- Population resettlement planning
- Generic economic inputs
- Economic rate of return
- Value of farm and non-farm wealth

The risk metrics produced by MACCS2 that are evaluated in the sensitivity analyses are the 50 mile population dose and the 50 mile offsite economic cost. The subsections below discuss the changes in these results for each of the sensitivity parameters noted above. The final subsection, F.7.3.11, correlates the worst case changes identified in the sensitivity runs to a change in the site's averted cost-risk and discusses the implications of the sensitivity analysis on the SAMA analysis. The results of these sensitivity analyses (i.e., changes in dose and cost risk relative to the baseline values) are shown in Table F.7-1.

F.7.3.2 METEOROLOGICAL SENSITIVITIES

In addition to the year 2002 base case meteorological data, years 2004 and 2006 were also analyzed. Analysis of year 2004 and 2006 data sets yielded population dose-risks and cost risks that were 1% to 11% less than 2002 results. As no particular criteria have been defined by the industry related to determining which meteorological data set should be used as a base case for a site, the year 2002 data is chosen for DCPP given that it results in higher results than the other data sets evaluated.

F.7.3.3 EVACUATION SENSITIVITIES

The sensitivity of two evacuation parameters was assessed. The evacuation speed sensitivity decreased the average radial evacuation speed by a factor of two, from 0.76 m/sec to 0.38 m/sec. The decreased speed results in a negligible impact to dose and cost risk. A further decrease in the relatively slow base case evacuation speed did not materially impact the dose results. Cost results are not normally impacted by evacuation parameters, as discussed further below.

The delay time sensitivity explores the impact of an increased delay time before evacuation begins (i.e., vehicles begin moving in the 10 mile region). For this sensitivity, the base case delay time of 100 minutes is arbitrarily doubled to 200 minutes. For many evacuation conditions, the population dose would be expected to increase for an increased delay time since more individuals would be expected to be exposed to the release due to their later departure (i.e., they failed to out run the release). The increased delay time results in decrease in dose risk of about 20%. This decrease is attributed to people receiving some shielding from their houses during the most dominant release types (LGEARLY and ISLOCA) prior to evacuation. The shielding factor provided by structures is greater than that of automobiles and mitigates some dose to the public from passing plumes.

For many individuals in the 10 mile evacuation region, their evacuation vehicle movement will begin slightly before or nearly coincident with the arrival of the first plume (depending upon their radial distance from the site) for the LGEARLY and ISLOCA categories for the base case. At this time, individuals are leaving their homes (which provide some radiological shielding) to enter their vehicles (which provide less radiological shielding). Due to the slow evacuation speed (0.76 m/s; ~2 mph) compared to the average wind speed (~10 mph), the individuals tend to experience the plume passing over them as they progress in traffic. When the additional delay of 100 minutes is included (for a total delay of 200 minutes), the evacuation vehicle movement for many individuals will begin after the first plume passes while they were afforded more radiological shielding in their homes.

The sensitivity case with no evacuation and no population relocation for 7 days resulted in a 9% decrease in dose risk. Similar to the evacuation delay sensitivity, this decrease is attributed to people being shielded more in structures relative to automobiles.

It is noted that while evacuation assumptions do impact the population dose-risk estimates, they do not impact MACCS2 offsite economic cost-risk estimates because MACCS2 calculated cost-risks are based on land contamination levels which remain unaffected by evacuation assumptions and the number of people evacuating.

F.7.3.4 RELEASE HEIGHT & HEAT SENSITIVITIES

The release height sensitivity case quantifies the impact of the assumption related to the height of the release of the plumes. The baseline case assumes that the releases occur near the top of reactor building (67m) which tends to disperse material over a wider geographical region, generally impacting more people and creating larger cleanup costs. A ground level release height shows a decrease in dose risk and cost risk of 10% and 3%, respectively.

The release heat sensitivity case evaluates the impact of neglecting thermal plume effects. The base case assumed no thermal plume heat in the releases (e.g., no buoyant plumes). The sensitivity case assumed a heat content of 10 MW per plume segment, except for the intact containment release category. Increasing the plume heat contents resulted in differing results for individual releases (i.e., results of some release categories increased while others decreased.) The net result is a decrease in dose-risk of 14% and a negligible change to cost risk when 10 MW plume heat content values are applied.

F.7.3.5 DEPOSITION VELOCITY

The dry deposition velocity sensitivity case evaluates the impact of the fission product particle size as reflected in the deposition velocity parameter. The base case assumes a deposition velocity of 0.01 m/sec, consistent with the NRC recommendation documented in MACCS2 Sample Problem A (Reference 22). The sensitivity case uses a deposition velocity of 0.003 m/sec, reflective of a smaller particle size. The NRC's State-of-the-Art Reactor Consequence Study (Reference 90) notes that the average deposition velocity used in the analysis is approximately 0.003 m/s. Assuming a lower deposition velocity results in an increase in population dose risk of about 20%, but a decrease in cost risk of about 35%. The increase in dose is attributed to particles traveling further from the site before depositing and thereby impacting more people in the population centers located further from the site. The decrease in costs is attributed to more of the particles exiting the 50-mile analysis region prior to deposition.

F.7.3.6 POPULATION SENSITIVITY

A population sensitivity case assesses the impact of population assumptions. The base case year 2045 population is uniformly increased by 30% in all spatial elements of the 50-mile radius. This change has a significant impact on the dose risk and cost risk, increasing dose risk and cost risk by 30% and 29%, respectively. This sensitivity case demonstrates a significant dependence upon population estimates. This dependence is expected given that population dose and offsite economic costs are primarily driven by the regional population.

F.7.3.7 RESETTLEMENT PLANNING SENSITIVITIES

The MACCS2 consequence modeling incorporates an "intermediate phase" which depicts the time period following the release and immediate evacuation actions (termed the "early phase") and extends to the time when recovery efforts such as decontamination and resettlement of people are begun (termed the "long term phase"). The intermediate phase thus models the time period when decontamination and resettlement plans are being developed. MACCS2 allows the habitation of land during the intermediate phase unless projected dose criteria is exceeded, in which case individuals are relocated. MACCS2 allows an intermediate phase ranging from no intermediate phase to a maximum of one year. The intermediate phase sensitivities show significant impacts and are therefore discussed further:

- The no intermediate phase resettlement planning case is developed based on the NUREG-1150 modeling approach. The 31% reduction in cost risk seen in the sensitivity results, however, is judged too optimistic in that the land decontamination efforts are modeled as starting one week after the accident (i.e., directly after the early phase ends) such that a significant portion of population relocation costs are omitted. For instance, the costs associated with temporary housing of interdicted individuals while decontamination strategies are developed and decontamination teams are contracted are not accounted for without an intermediate phase. It is believed that the NUREG-1150 studies omitted the intermediate phase because the intermediate phase coding was not validated at that time. A competing factor is that the population dose increases (6% increase over the base case) because people are allowed to re-occupy the decontaminated land sooner.
- The 1 year intermediate phase resettlement planning case is developed based on the maximum length of time allowed by MACCS2 for the intermediate phase. A long intermediate phase can be unrealistic in that re-occupation of contaminated land is not performed during this phase even if contamination levels decrease (by natural radioactive decay and weathering) to levels which would allow it (i.e., resettlement is evaluated as part of the long term phase, not the intermediate phase). Therefore population relocation costs may be overestimated using a long (i.e., one year) intermediate phase. An intermediate phase of one year shows a 32% increase in cost risk estimates compared with the base case selection of 6 months. The population dose decreased by 3% with a longer intermediate phase due to later resettlement on decontaminated land.

The six month intermediate phase (base case) is judged to be a best estimate approach in that it provides reasonable time for both decontamination and resettlement planning to be performed. The sensitivity cases demonstrate that the six month value used in the base case provides mid-range results for the modeling choices available.

F.7.3.8 GENERIC ECONOMIC INPUTS SENSITIVITY

MACCS2 requires certain site specific economic data (fraction of land devoted to farming, annual farm sales, fraction of farm sales resulting from dairy production, and property value of farm and non-farm land) for each of the 160 spatial elements. The site specific base case values are calculated based on regional economic data.

In addition to these site specific values, generic economic data are utilized by MACCS2 to address costs associated with per diem living expenses (applied to owners of interdicted properties and relocated populations), relocation costs (for owners of interdicted properties), and decontamination costs. For the DCPP base case, these generic costs are based on values used in the NUREG-1150 study (Reference 19) as documented in the NUREG/CR-4551 (Reference 20) updated to July 2014 using the consumer price index.

This sensitivity case is performed to determine the variability in population dose risk and cost risk based on changes to these generic based values. The sensitivity case increases key generic based economic parameters as identified in Table F.7-2. In general, the inputs were arbitrarily increased by factor of 2.0. The increase in these economic parameters resulted in an increase in cost risk of 44% and a decrease in dose risk of about 2%. A significant increase in cost risk is expected since population relocation and decontamination costs are major contributors to total cost as calculated by MACCS2.

F.7.3.9 RATE OF RETURN SENSITIVITIES

One of the economic cost components included in the MACCS2 calculated cost result is the financial loss associated with property and associated improvements (e.g., buildings) not achieving their expected annual rate of return during interdiction periods. A piece of land that is interdicted (i.e., not occupied) for a period of years will not achieve the historical rate of return or the rate of return achieved by other non-impacted properties during the interdiction period. This lack of expected return is an economic loss for the owner / society. The base case assumes a 7% expected rate of return, consistent with NRC guidance (Reference 25). A sensitivity case using a 3% expected rate of return shows a decrease in the expected cost risk of approximately 9%. This decrease in cost risk associated with the lower rate of return is expected since there is a lower expectation associated with the land's return on investment. A sensitivity case using a 12% expected rate of return, the value used in NUREG-1150 MACCS2 analyses, shows an increase cost risk of approximately 11%. For both sensitivity cases the dose risk changes are minor (<=1%).

F.7.3.10 VALUE OF FARM AND NON-FARM WEALTH SENSITIVITY

This sensitivity assesses the impact of doubling the average farm and non-farm wealth values for the area surrounding DCPP. The base case wealth values, 12,241 $/hectare for farm wealth and 370,506 $/person for non-farm wealth, were increased to 24,482 $/hectare and 741,012 $/person, respectively. This increase in the wealth parameters results in a population dose risk increase of 1% and a cost risk increase of 68%. The dose risk increases slightly because it becomes feasible to decontaminate more land relative to the base case and as a result people inhabit more partially contaminated land. The cost risk increases significantly because on a per-person and per-farm basis, more wealth is being impacted. This sensitivity indicates there is significant cost risk dependency upon the farm and non-farm wealth values.

F.7.3.11 IMPACT ON SAMA ANALYSIS

Several different Level 3 input parameters are examined as part of the DCPP MACCS2 sensitivity analysis. The primary reason for performing these sensitivity runs is to identify any reasonable changes that could be made to the Level 3 input parameters that would impact the conclusions of the SAMA analysis. While the table in Section F.7.3 summarizes the changes to the dose-risk and OECR estimates for each sensitivity case, it is prudent to consider if any of these changes would result in the retention of the SAMAs that were screened using the baseline results.

Of all the MACCS2 sensitivity cases, the largest dose-risk increase, 30%, occurred in the Population (Year 2045 population uniformly increased 30%) case. The largest OECR increase, 68%, occurred in the value of farm and non-farm wealth sensitivity case (values doubled). Subsequently, the DCPP MMACR was recalculated using these results to determine the impact of using the worst case for each parameter simultaneously. The resulting MACR is a factor of 1.38 greater than the base case, which is significantly less than the factor of 3.0 used in Section F.7.2 for the 95th percentile individual SAMA PRA model results. Therefore, the 95th percentile PRA results sensitivity is considered to bound this case and no SAMAs would be retained based on this sensitivity that were not already identified in Section F.7.2.

F.7.4 IMPACT OF BINNING TRUNCATED FREQUENCY TO RC ST5

After the level 1 quantification is complete and binned as CDF, the sequences are processed by the Level 2 model logic. As part of the containment response evaluation, these sequences are further subdivided and binned into different release categories according to the events that occur in the post core damage evolution. Some of these Level 2 evolutions are very low frequency scenarios and they are truncated during the Level 2 quantification. As a result of this truncation step, the CDF is slightly larger than the sum of the Level 2 release category frequencies for the DCPP RISKMAN model. While the difference in the frequencies is relatively small at 1.18E-6/yr, there is no information available that could be used to determine how the "truncated frequency" would be distributed among the DCPP release categories. In order to assess the impact of the truncated frequency on the SAMA analysis, the entire frequency of 1.18E-6/yr is conservatively assumed to belong to the release category with the largest consequences (the ST5 release category). Binning the truncated frequency to ST5 increases the baseline MACR from $9,315,791 to $10,151,241. The increase in the MACR would result in the retention of 2 SAMAs for the Phase 2 analysis that were screened in the baseline Phase 1 analysis.

In order to assess the impact on the Phase 2 screening, the truncated frequency was assumed to be proportional to the CDF, and for each SAMA quantification, the truncated frequency was likewise binned to the ST 5 release category. The results of this change are summarized in the following table. The impact of using the 95th percentile PRA results in conjunction with binning the truncated frequency to ST5 is also included in this table to document the combined impact of these sensitivities. The impact of applying the 95th percentile PRA results was performed using the same process that is described in Section 7.2.2.

Summary of the Impact of Binning the Truncated Frequency to ST5

SAMA ID	Cost of Implementation	Averted Cost Risk (with Baseline PRA Results)	Net Value (with Baseline PRA Results)	Averted Cost Risk (with 95th Percentile PRA results)	Net Value (with 95th Percentile PRA results)
1	$3,020,424	$668,910	-$2,351,514	$2,006,730	-$1,013,694
2	$17,492,616	$874,298	-$16,618,318	$2,622,894	-$14,869,722
3	$376,342	$892,171	$515,829	$2,676,513	$2,300,171
5	$3,133,404	$36,843	-$3,096,561	$110,529	-$3,022,875
6	$9,993,910	$357,884	-$9,636,026	$1,073,652	-$8,920,258
7	$10,616,468	$387,711	-$10,228,757	$1,163,133	-$9,453,335
8	$1,072,493	$668,910	-$403,583	$2,006,730	$934,237
9	$25,520,160	$84,409	-$25,435,751	$253,227	-$25,266,933
10	$22,572,878	$846,154	-$21,726,724	$2,538,462	-$20,034,416
12	$13,560,218	$846,154	-$12,714,064	$2,538,462	-$11,021,756
14	$5,620,896	$299,525	-$5,321,371	$898,575	-$4,722,321
16	$372,788	$249,912	-$122,876	$749,736	$376,948
17	$9,610,440	$363,799	-$9,246,641	$1,091,397	-$8,519,043
20	$11,173,059	$1,194,781	-$9,978,278	$3,584,343	-$7,588,716
21	$256,817	$1,664,716	$1,407,899	$4,994,148	$4,737,331
22	$13,083,120	$49,150	-$13,033,970	$147,450	-$12,935,670
23	$491,021	$2,971	-$488,050	$8,913	-$482,108

As indicated in the table above, only SAMAs 3 and 21 are potentially cost beneficial when the baseline PRA results are considered. When the 95th percentile PRA results are applied, SAMAs 8 and 16 are also potentially cost beneficial. These conclusions are the same as those documented in Section 7.2.2. While accounting for the truncated frequency does have an impact on the MACR, it does not have a significant impact of the averted cost-risk calculations or conclusions of the SAMA analysis.

F.8 CONCLUSIONS

The benefits of revising the operational strategies in place at DCPP and/or implementing hardware modifications can be evaluated without the insight from a risk-based analysis. However, use of the PRA in conjunction with cost-benefit analysis methodologies provides an enhanced understanding of the effects of the proposed changes relative to the cost of implementation and projected impact on a larger future population. The results of this study indicate that several potential improvements were identified that warrant further review for potential implementation at DCPP.

In summary, based on the given implementation costs, a number of SAMAs have been identified as potentially cost-beneficial and may be considered for potential implementation at DCPP. While these results are believed to accurately reflect potential areas for improvement at the plant, PG&E notes that this analysis should not necessarily be considered a formal disposition of these proposed changes as other engineering reviews are necessary to determine the ultimate resolution. For the identified cost-beneficial SAMAs listed below, PG&E will disposition them using existing action-tracking and design change processes.

In the baseline analysis, two SAMAs were identified as potentially cost beneficial:

SAMA 3:	Change Procedures to Explicitly Address Vulnerability of Auto SI
SAMA 21:	Change Fire Procedures to Include Fire Area Specific Guidance on Containment Isolation Valves

When the 95th percentile PRA results are considered, SAMAs 8 and 16 are also potentially cost beneficial:

SAMA 8:	Protect RHR Cables in Fire Areas 6-A-2 and 6-A-3
SAMA 16:	Change Procedures to Caution About Spurious SI Signals in Specific Fire Areas

For SAMAs 3 and 16, it should be noted that the vulnerability for the fire areas associated with both SAMAs are the same, which is that there is the potential to damage cables/equipment associated with the generation of the SI signal. However, in some fire areas, failure to generate an SI signal is a significant risk while in other fire areas, spurious actuation of the SI signal may be a more risk significant consequence of the fire damage. Ultimately, implementation of procedure enhancements could warn of both types of consequences for fires that can damage cables and equipment associated with SI signal generation, but the SAMA analysis has delineated the procedure changes into two separate SAMAs to distinguish between the consequences of the fire related failures.

F.9 TABLES

Table F.2-1

DEFINITION OF THE PLANT DAMAGE STATE MATRIX

TABLE SECTION	PARAMETER	RATIONALE FOR CATEGORY SELECTION	CODE	WHEN APPLICABLE	BINNING LOGIC (CORE DAMAGE SEQUENCES ONLY)
1	RCS PRESSURE	PRESSURE INSIDE THE RCS AT TIME OF VESSEL MELT-THROUGH IS IMPORTANT BECAUSE HIGH PRESSURE CAN EJECT MOLTEN DEBRIS THROUGH PENETRATIONS IN THE BOTTOM HEAD OF THE REACTOR VESSEL. IF PRESSURE EXCEEDS APPROXIMATELY 200 PSIA, POTENTIAL FOR EJECTION OF DISPERSED CORE DEBRIS TO CONTAINMENT EXISTS. THIS INCREASES CONTAINMENT LOADING AT TIME OF VESSEL FAILURE. PRESSURE OF 650 PSIA REPRESENTS APPROXIMATE ACCUMULATOR PRESSURE. PRESSURE OF 2250 PSIA REPRESENTS THE NORMAL OPERATING PRESSURE. ABOVE THIS PRESSURE, THE PORV SETPOINT CAN BE REACHED.	L = LOW (<200 PSIA)	FOR LARGE OR EXCESSIVE LOCA INITIATING EVENTS OR WHERE VESSEL INTEGRITY FAILS	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES RCSPL:= INIT=LLOCA + INIT=ELOCA + VI=F (NO VI TOP EVENT FOR ATWT TREE) FOR ISLOCA TREES RCSPL:= SM=F
			I = INTERMEDIATE (200-650PSIA)	FOR SMALL LOCA'S (INCLUDING TRANSIENT INDUCED) WITH SG COOLING & HIGH PRESSURE INJECTION. FOR MEDIUM LOCAS.	SGCOOL:= AW=S FOR GENTRN TREE RCSPI:= (PR=F + SE=F)*SGCOOL*(CH=S + SI=S) FOR ATWT TREE PO=F*SGCOOL*(CH=S+SI=S)*(RS=S+ DE=S) FOR SGTR TREE RCSPI:= (PR=F+SE=F+SL=F+SL=B+OP=F)*SGCOOL* (CH=S+ SI=S) FOR LLOCA, ELOCA TREES RCSPI:= CI=S*CI=F (DOESN'T EXIST) FOR ISLOCA TREE RCSPI:= SM=S*SGCOOL*(CH=S + SI=S) FOR MLOCA TREE RCSPI:= INIT=MLOCA * VI=S
			H = HIGH (650 - 2250 PSIA)	FOR EVENTS WHERE HOT STANDBY FAILS; OR FOR SMALL LOCA'S (INCLUDING TRANSIENT INDUCED) WHERE SG COOLING FAILS AND HIGH PRESSURE ECCS INJECTION IS SUCCESSFUL; OR FOR SAMLL LOCA'S (INCLUDING TRANSIENT INDUCED) WHERE SG COOLING IS SUCCESSFUL AND HIGH PRESSURE ECCS INJECTION FAILS.	FOR GENTRN,ATWT TREES RCSPH:= (PR=F+SE=F) * -SGCOOL * (CH=S + SI=S) + (PR=F+SE=F) * SGCOOL * -(CH=S + SI=S) + -(RCSPL + RCSPI + RCSPS) FOR SGTR TREES RCSPH:= (PR=F+SE=F+SL=F+SL=B+OP=F) * -SGCOOL * (CH=S+SI=S) + (PR=F+SE=F+SL=F+SL=B+OP=F) * SGCOOL * -(CH=S+SI=S) FOR MLOCA, LLOCA, ELOCA TREES RCSPH:= CI=S*CI=F (DOESN'T EXIST) FOR ISLOCA RCSPH:= SM=S* -SGCOOL * (CH=S + SI=S) + SM=S*SGCOOL * -(CH=S + SI=S)
			S = PORV SETPOINT (> 2250	FOR ATWT CASES; OR FOR CASES WHERE PRESSURE RELIEF IS SUCCESSFUL, SG COOLING FAILS, AND	FOR GENTRN TREE RCSPS:= RT=F + -PR=F*-SGCOOL * (OB=F + CH=F) FOR ATWT TREE

Table F.2-1

DEFINITION OF THE PLANT DAMAGE STATE MATRIX

TABLE SECTION	PARAMETER	RATIONALE FOR CATEGORY SELECTION	CODE	WHEN APPLICABLE	BINNING LOGIC (CORE DAMAGE SEQUENCES ONLY)
			PSIA)	BLEED AND FEED FAILS.	(PO=S+PR=F) * -SGCOOL * CH=F + RS=F + OE=F FOR SGTR TREES RCSPS:= CI=S*CI=F (DOESN'T EXIST) FOR MLOCA, LLOCA, AND ELOCA TREES RCSPS:= CI=S*CI=F (DOESN'T EXIST) FOR ISLOCA TREE RCSPS:= MU=F*MU=S (DOESN'T EXIST)
2	STEAM GENERATOR COOLING	AVAILABILITY OF STEAM GENERATOR SECONDARY SIDE COOLING WILL DETERMINE WHETHER THE STEAM GENERATOR TUBES WILL BE SUBJECT TO HIGH TEMPERATURES AND POTENTIAL FAILURE, IF COMBINE WITH HIGH RCS PRESSURE.	A = AVAILABLE	WHEN AFW IS AVAILABLE	SGCOOL:= AW=S FOR GENTRN, ATWT, SGTR, ISLOCA TREES SGA:= SGCOOL FOR MLOCA, LLOCA, ELOCA SGA:= SGCOOL*-SGCOOL (DOESN'T EXIST)
			X = NOT AVAILABLE	WHEN AFW IS UNAVAILABLE	FOR GENTRN, ATWT, SGTR, ISLOCA TREES SGX:= -SGCOOL FOR MLOCA, LLOCA, ELOCA SGX:= SGCOOL*-SGCOOL (DOESN'T EXIST)
			N = NOT APPLICABLE	FOR LOW PRESSURE CONDITIONS	FOR GENTRN, ATWT, SGTR, ISLOCA TREES SGN:= SGCOOL*-SGCOOL (DOESN'T EXIST) FOR MLOCA, LLOCA, ELOCA TREES SGN:= INIT=MLOCA + INIT=LLOCA + INIT=ELOCA
3	RWST INJECTED	IT IS ASSUMED THAT WATER IS PRESENT IN THE REACTOR CAVITY IF THE RWST IS INJECTED. PRESENCE OF WATER IN REACTOR CAVITY AT TIME OF MELT-THROUGH IS IMPORTANT TO CONTAINMENT RESPONSE BECAUSE INTERACTION OF WATER WITH HOT CORE DEBRIS CAN • FRAGMENT AND DISPERSE THE CORE DEBRIS FROM THEE REACTOR CAVITY INTO OTHER REGIONS OF THE CONTAINMENT • CAUSE THE CONTAINMENT PRESSURE TO INCREASE BY VAPORIZATION OF THE WATER (I.E. STEAM SPIKES) AND DIRECT HEATING OF CONTAINMENT ATMOSPHERE (I.E. DIRECT CONTAINMENT HEATING) • ENHANCE RELEASE OF FISSION PRODUCTS FROM THE CORE DEBRIS DUE TO OXIDATION OF	Y = YES	CASES WHERE RWST IS SUCCESSFUL AND ECCS INJECTION IS SUCCESSFUL.	FOR GENTRN, ATWT, MLOCA, LLOCA, ELOCA TREES RWY:= RW=S * (CH=S + SI=S + (LA=S + LB=S) * LV=S + CSI*(FC=F + VI=F + INIT=ELOCA)) FOR ISLOCA TREES RWY:= RW=S * (CH=S + SI=S) (THIS PLANT DAMAGE STATE DOES NOT EXIST) FOR SGTR TREES RWY:= RW=S * (CH=S + SI=S + (LA=S + LB=S) * LV=S + CSI*(FC=F + VI=F)) * SL=S * OP=S
			N = NO	CASES WHERE RWST OR ASSOCIATED VALVES FAIL; OR ECCS INJECTION FAILS; OR FOR ISLOCAS.	FOR GENTRN, ATWT, SGTR, MLOCA, LOCA, ELOCA TREES RWN:= -RWY FOR ISLOCA TREES RWN:= -RWY

Table F.2-1

DEFINITION OF THE PLANT DAMAGE STATE MATRIX

TABLE SECTION	PARAMETER	RATIONALE FOR CATEGORY SELECTION	CODE	WHEN APPLICABLE	BINNING LOGIC (CORE DAMAGE SEQUENCES ONLY)
		THE PARTICULATES.			
4	CONTAINMENT SPRAY AND HEAT REMOVAL	STATUS OF CONTAINMENT SPRAY AND CONTAINMENT HEAT REMOVAL SYSTEMS ARE IMPORTANT BECAUSE THESE CAN PROVIDE HEAT REMOVAL FOR COOLING THE CONTAINMENT ATMOSPHERE; CONTROL PRESSURE IN THE CONTAINMENT; AND PROVIDE FISSION PRODUCT REMOVAL BEFORE AND AFTER FAILURE OF THE REACTOR VESSEL. CSI INCLUDES CASES WHERE CONTAINMENT SPRAY IS OPERATING AND CASES IN WHICH CONTAINMENT SPARY WOULD OPERATE IF DEMANDED (SUPPORT AVAILABLE AND PUMPS COULD OPERATE). CSR HAS SIMILAR DEFINITION.	A = ALL SYSTEMS AVAILABLE (CSI, CSR, AND CHR)	CASES WHERE CONTAINMENT SPRAY INJECTION, CONTAINMENT SPRAY RECIRCULATION, AND CONTAINMENT HEAT REMOVAL ARE AVAILABLE. CSI INCLUDES CS OPERATING AND CS AVAILABLE (BUT NOT REQUIRED TO OPERATE PRIOR TO CORE MELT). IT WOULD IN THAT CASE BE AVAILABLE AFTER CORE MELT.	CSI:= CS=S CSI:= CS=S*(FC=F + VI=F) FOR GT CSR:= WL=S * RF=S * (VA=S*LA=S + VB=S*LB=S) * RC=S * SR=S CHR:= FC=S + CSR FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPA:= CSI * CSR * CHR FOR ISLOCA TREES CNSPA:= CSI * -CSI (DOESN'T EXIST)
			B = ALL SPRAY SYSTEMS AVAILABLE (CSI,CSR); NO CONTAINMENT HEAT REMOVAL (CHR)	CASES WHERE ALL SPRAY SYSTEMS AVAILABLE; NO CONTAINMENT HEAT REMOVAL	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPB:= CSI * CSR * - CHR FOR ISLOCA TREES CNSPB:= CSI * -CSI (DOESN'T EXIST)
			C = SPRAY INJECTION (CSI) AND CONTAINMENT HEAT REMOVAL (CHR) AVAILABLE; SPRAY RECIRCULATION (CSR) UNAVAILABLE	CASES WHERE CONTAINMENT SPRAY INJECTION AND CONTAINMENT HEAT REMOVAL AVAILABLE; SPRAY RECIRCULATION UNAVAILABLE	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPC:= CSI * -CSR * CHR FOR ISLOCA TREES CNSPC:= CSI * -CSI (DOESN'T EXIST)
			D = SPRAY INJECTION (CSI) AVAILABLE; SPRAY RECIRCULATION (CSR) AND CONTAINMENT HEAT REMOVAL (CHR) UNAVAILABLE	CASES WHERE CONTAINMENT SPRAY INJECTION AVAILABLE; CONTAINMENT SPRAY RECIRCULATION AND CONTAINMENT HEAT REMOVAL UNAVAILABLE	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPD:= CSI * -CSR * -CHR FOR ISLOCA TREES CNSPD:= CSI * -CSI (DOESN'T EXIST)
			E = SPRAY INJECTION (CSI) UNAVAILABLE; SPRAY	CASES WHERE CONTAINMENT SPRAY INJECTION UNAVAILABLE; CONTAINMENT SPRAY RECIRCULATION AND CONTAINMENT HEAT REMOVAL	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA ELOCA TREES CNSPE:= -CSI * CSR * CHR FOR ISLOCA TREES

Table F.2-1

DEFINITION OF THE PLANT DAMAGE STATE MATRIX

TABLE SECTION	PARAMETER	RATIONALE FOR CATEGORY SELECTION	CODE	WHEN APPLICABLE	BINNING LOGIC (CORE DAMAGE SEQUENCES ONLY)
			RECIRCULATION (CSR) AND CONTAINMENT HEAT REMOVAL (CHR) AVAILABLE	AVAILABLE. ACCORDING TO DEFINITION OF CSI AND CSR, THIS MACRO IS IMPOSSIBLE.	CNSPE:= CSI * -CSI (DOESN'T EXIST)
			F = SPRAY INJECTION (CSI) AND CONTAINMENT HEAT REMOVAL (CHR) UNAVAILABLE; SPRAY RECIRCULATION (CSR) AVAILABLE	CONTAINMENT SPRAY INJECTION AND CONTAINMENT HEAT REMOVAL UNAVAILABLE; CONTAINMENT SPRAY RECIRCULATION AVAILABLE	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPF:= -CSI * CSR * -CHR FOR ISLOCA TREES CNSPF:= CSI * -CSI (DOESN'T EXIST)
			G = SPRAY INJECTION AND RECIRCULATION (CSI AND CSR) UNAVAILABLE; CONTAINMENT HEAT REMOVAL (CHR) AVAILABLE	CONTAINMENT SPRAY INJECTION AND CONTAINMENT SPRAY RECIRCULATION UNAVAILABE; CONTAINMENT HEAT REMOVAL AVAILABLE	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPG:= -CSI * -CSR * CHR + -CSI*RW=F (FAN COOLER FIX) FOR ISLOCA TREES CNSPG:= CSI * -CSI (DOESN'T EXIST)
			N = ALL CONTAINMENT SPRAY AND HEAT REMOVAL SYSTEMS ARE UNAVAILABLE	ALL CONTAINMENT SPRAY AND HEAT REMOVAL SYSTEMS UNAVAILABLE	FOR GENTRN, ATWT, SGTR, MLOCA, LLOCA, ELOCA TREES CNSPN:= -CSI * -CSR * -CHR FOR ISLOCA TREES CNSPN:= CSI * -CSI (DOESN'T EXIST)
5	CONTAINMENT INTEGRITY AT TIME OF VESSEL MELT-THROUGH	THE STATE OF THE CONTAINMENT ITSELF (INTACT OR FAILED) AT TIME WHEN SEVERE CORE DAMAGE STARTS INCLUDES CONTAINMENT ISOLATION FAILURE AND INTERFACING SYSTEM LOCA CONSIDERATIONS. ALSO EXTERNAL EVENTS THAT CAN CAUSE CONTAINMENT FAILURE SUCH AS EARTHQUAKES, SEVERE STORMS, OR EXTERNAL MISSILES ARE OF IMPORTANCE AT TIME OF CORE DAMAGE. THERE IS POTENTIAL FOR FILTRATION AND/OR OTHER MECHANISMS FOR FISSION PRODUCT REMOVAL IN CONTAINMENT	I = CONTAINMENT ISOLATED AND NOT BYPASSED	CASES (NON-ISLOCA AND NON-SGTR) WITH CONTAINMENT ISOLATION	FOR GENTRN, LLOCA, ELOCA TREES CNTINTI:= WL=S * CP=S * CI=S + (WL=F + CP=F + CI=F) * OI=S FOR MLOCA TREES CNTINTI:= WL=S * CP=S * CI=S + (WL=F + CP=F + CI=F) * OI=F + CORMLT * CP=B * VI=F FOR SGTR TREES CNTINTI:= (WL=S * CP=S * CI=S + (WL=F + CP=F + CI=F) * OI=S) * NI=S FOR ISLOCA TREES CNTINTI:= MU=F*MU=S (DOESN'T EXIST)
			S = SMALL LEAK (<3 INCHES	CASES (NON-ISLOCA AND NON-SGTR) WITH A LEAK < 3 INCHES DIAMETER	FOR GENTRN, ELOCA TREES CNTINTS:= CP=S * (WL=F + CI=F) * OI=F

Table F.2-1

DEFINITION OF THE PLANT DAMAGE STATE MATRIX

TABLE SECTION	PARAMETER	RATIONALE FOR CATEGORY SELECTION	CODE	WHEN APPLICABLE	BINNING LOGIC (CORE DAMAGE SEQUENCES ONLY)
		LEAKAGE PATH (SUCH AS AUXILIARY BUILDING FILTERS FOR INTERFACING SYSTEMS LOCA'S OR PURGE FILTERS FOR SEQUENCES INVOLVING ISOLATION FAILURE) IF CONTAINMENT IS FAILED AT TIME OF CORE DAMAGE.	DIAMETER)		FOR SGTR TREES CNTINTS:= (CP=S * (WL=F + CI=F) * OI=F) * NI=S FOR ISLOCA TREES CNTINTS:= MU=F*MU=S (DOESN'T EXIST) FOR MLOCA, LLOCA CNTINTS:= CP=S * CI=F * OI=F + CP=S * WL=F
			L = LARGE LEAK (>3 INCHES DIAMETER)	CASES (NON-ISLOCA AND NON-SGTR) WITH A LEAK > 3 INCHES DIAMETER	FOR GENTRN, LLOCA, MLOCA, ELOCA TREES CNTINTL:= CP=F * OI=F FOR SGTR TREES CNTINTL:= (CP=F * OI=F) * NI=S FOR ISLOCA TREES CNTINTL:= MU=F*MU=S (DOESN'T EXIST)
			B = SMALL BYPASS	UNISOLATED SGTR'S	FOR GENTRN, LLOCA, MLOCA, ELOCA TREES CNTINTB:= CP=F * CP=S (DOESN'T EXIST) FOR SGTR TREES CNTINTB:= NI=F FOR ISLOCA TREES CNTINTB:= MU=F * MU=S (DOESN'T EXIST)
			V = LARGE BYPASS	V SEQUENCE ISLOCA	FOR GENTRN, LLOCA, MLOCA, ELOCA, SGTR TREES CNTINTV:= CP=F * CP=S (DOESN'T EXIST) FOR ISLOCA TREES CNTINTV:= INIT=VDI + INIT=VSI

Table F.2-2
Plant Damage State Matrix

RCS CONDITIONS		WATER IN CONT. PRIOR TO VESSEL BREACH (3)	CONT. SPRAY & CHR (4)	CONTAINMENT ISOLATION AND BYPASS STATUS (5)																															
EXPECTED RCS PRESSURE AT ONSET OF CORE DAMAGE (1)	STEAM GEN COOLING (2)			CONTAINMENT ISOLATED AND NOT BYPASSED (I)								CONTAINMENT NOT ISOLATED OR FAILED												CONTAINMENT BYPASSED											
												LEAK < 3 IN. DIAMETER (S)								LEAK > 3 IN. DIAMETER (L)				SMALL BYPASS (B)								LARGE BYPASS (V)			
			SPRAYS OPER.	CSI & CSR		CSI ONLY		CSR ONLY		NONE		CSI & CSR		CSI ONLY		CSR ONLY		NONE		CSI & CSR	CSI ONLY	CSR ONLY	NONE	CSI & CSR		CSI ONLY		CSR ONLY		NONE		CSI & CSR	CSI ONLY	CSR ONLY	NONE
			CHR	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	-	-	-	-	YES	NO	YES	NO	YES	NO	YES	NO				-
				(A)	(B)	(C)	(D)	(E)	(F)	(G)	(N)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(N)	(A)	(C)	(E)	(N)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(N)	(A)	(C}	(E)	(N)
< 200 PSIA (L)	(N)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4
200 TO 600 PSIA (I)	(N)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4
600 TO 2000 PSIA (H)	YES (A)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4
	NO (X)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4,5
> 2000 PSIA (S)	YES (A)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	5
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4,5
	NO (X)	NO (N)		1	1,2	1	1	1,6	1,6			1	1,2	1	1	1,6	1,6			1	1	1,6		1	1,2	1	1	1,6	1,6			1,3	1,3	1,3	5
		YES (Y)			2			6	6				2			6	6					6			2			6	6			3	3	3	4,5

PDS MATRIX NOTES

1. IF RWST HAS FAILED, CSI AND CSR ARE IMPOSSIBLE.
2. CONTAINMENT HEAT REMOVAL IS GUARANTEED IF CSR IS SUCCESSFUL (REQUIRES MAAP CONFIRMATION).
3. CONTAINMENT SPRAY WILL NOT BE INITIATED FOR LARGE CONTAINMENT BYPASS EVENTS.
4. WON'T HAVE WATER IN REACTOR CAVITY FOR LARGE CONTAINMENT BYPASS EVENTS.
5. LARGE BYPASS WILL PREVENT RCS PRESSURE GREATER THAN 600 PSIA (REQUIRES MAAP CONFIRMATION).
6. CSR ONLY IMPOSSIBLE - (E & F IMPOSSIBLE).

Table F.2-3
DCPP Key Plant Damage States

	PDS	Cum	Cum %	Key Plant Damage State IDs															
PDS	Freq.	Freq.	of CDF	HAYDI	SXYAI	INYCI	LNYAI	HANNI	SXNNS	HANNS	SXNNI	INNGB	INNNS	LNYCI	SXYCI	SXYGS	SXYDI	INNGV	SXNNL
HAYDI	4.79E-05	4.79E-05	5.45E+01	4.79E-05															
SXYAI	8.96E-06	5.68E-05	6.47E+01		8.96E-06														
INYCI	6.78E-06	6.36E-05	7.24E+01			6.78E-06													
LNYAI	3.98E-06	6.76E-05	7.69E+01				3.98E-06												
HANNI	3.74E-06	7.13E-05	8.11E+01					3.74E-06											
SXNNS	3.67E-06	7.50E-05	8.53E+01						3.67E-06										
HANNS	2.06E-06	7.71E-05	8.77E+01							2.06E-06									
SXNNI	1.15E-06	7.82E-05	8.90E+01								1.15E-06								
INNGB	1.09E-06	7.93E-05	9.02E+01									1.09E-06							
INNNS	1.07E-06	8.04E-05	9.14E+01										1.07E-06						
LNYCI	1.06E-06	8.14E-05	9.26E+01											1.06E-06					
SXYCI	7.53E-07	8.22E-05	9.35E+01												7.53E-07				
HXYAI	6.68E-07	8.29E-05	9.42E+01		6.68E-07														
SXYGS	6.58E-07	8.35E-05	9.50E+01													6.58E-07			
SXYDI	5.40E-07	8.41E-05	9.56E+01														5.40E-07		
LNNNS	4.75E-07	8.45E-05	9.61E+01						4.75E-07										
HXYCI	3.93E-07	8.49E-05	9.66E+01												3.93E-07				
HXNNS	3.64E-07	8.53E-05	9.70E+01						3.64E-07										
HAYAI	3.16E-07	8.56E-05	9.74E+01		3.16E-07														
INYGS	2.74E-07	8.59E-05	9.77E+01													2.74E-07			
LNYGI	2.70E-07	8.62E-05	9.80E+01														2.70E-07		
HAYDS	2.64E-07	8.64E-05	9.83E+01							2.64E-07									
INNNB	2.04E-07	8.66E-05	9.85E+01									2.04E-07							
SXNGI	1.95E-07	8.68E-05	9.87E+01								1.95E-07								
HANGI	1.84E-07	8.70E-05	9.89E+01					1.84E-07											
SXYGI	1.23E-07	8.71E-05	9.91E+01														1.23E-07		
INNGV	8.16E-08	8.72E-05	9.92E+01															8.16E-08	
INYCS	7.96E-08	8.73E-05	9.93E+01													7.96E-08			
HAYCI	6.50E-08	8.73E-05	9.93E+01	6.50E-08															
INYGI	6.40E-08	8.74E-05	9.94E+01								6.40E-08								

Table F.2-3
DCPP Key Plant Damage States

	PDS	Cum	Cum %	Key Plant Damage State IDs															
PDS	Freq.	Freq.	of CDF	HAYDI	SXYAI	INYCI	LNYAI	HANNI	SXNNS	HANNS	SXNNI	INNGB	INNNS	LNYCI	SXYCI	SXYGS	SXYDI	INNGV	SXNNL
INYDI	6.35E-08	8.75E-05	9.95E+01														6.35E-08		
SAYCI	6.32E-08	8.75E-05	9.96E+01												6.32E-08				
HXYDI	6.06E-08	8.76E-05	9.96E+01														6.06E-08		
HXNNI	5.43E-08	8.77E-05	9.97E+01								5.43E-08								
SXYAS	5.13E-08	8.77E-05	9.97E+01													5.13E-08			
HXNGB	2.98E-08	8.77E-05	9.98E+01															2.98E-08	
LNYDI	2.70E-08	8.78E-05	9.98E+01														2.70E-08		
LNYCS	2.49E-08	8.78E-05	9.98E+01													2.49E-08			
LNYAS	1.58E-08	8.78E-05	9.99E+01													1.58E-08			
LNNGB	1.42E-08	8.78E-05	9.99E+01									1.42E-08							
INNNI	1.42E-08	8.78E-05	9.99E+01										1.42E-08						
HXYGI	1.17E-08	8.78E-05	9.99E+01														1.17E-08		
INNNL	8.76E-09	8.79E-05	9.99E+01																8.76E-09
LNNNI	8.27E-09	8.79E-05	9.99E+01										8.27E-09						
SXNNL	7.70E-09	8.79E-05	9.99E+01																7.70E-09
HXYAS	7.35E-09	8.79E-05	9.99E+01													7.35E-09			
HXNNB	6.88E-09	8.79E-05	9.99E+01															6.88E-09	
HXNGI	5.92E-09	8.79E-05	9.99E+01								5.92E-09								
SXYNS	5.85E-09	8.79E-05	1.00E+02						5.85E-09										
HAYGI	5.61E-09	8.79E-05	1.00E+02					5.61E-09											
LNNNL	3.74E-09	8.79E-05	1.00E+02																3.74E-09
SXYCS	3.67E-09	8.79E-05	1.00E+02													3.67E-09			
HXNNL	2.99E-09	8.79E-05	1.00E+02																2.99E-09
HANNB	2.91E-09	8.79E-05	1.00E+02															2.91E-09	
SXYDS	2.68E-09	8.79E-05	1.00E+02						2.68E-09										
INYNS	2.46E-09	8.79E-05	1.00E+02						2.46E-09										
HANNV	2.07E-09	8.79E-05	1.00E+02															2.07E-09	
HAYAS	1.87E-09	8.79E-05	1.00E+02													1.87E-09			
HXYCS	1.79E-09	8.79E-05	1.00E+02													1.79E-09			
HXYGS	1.72E-09	8.79E-05	1.00E+02													1.72E-09			

Table F.2-3
DCPP Key Plant Damage States

	PDS	Cum	Cum %	Key Plant Damage State IDs															
PDS	Freq.	Freq.	of CDF	HAYDI	SXYAI	INYCI	LNYAI	HANNI	SXNNS	HANNS	SXNNI	INNGB	INNNS	LNYCI	SXYCI	SXYGS	SXYDI	INNGV	SXNNL
REMAIN	. 7.817E-9	8.80E-05	1.00E+02															7.82E-09	
SUM	8.80E-05			4.79E-05	9.94E-06	6.77E-06	3.98E-06	3.92E-06	4.52E-06	2.32E-06	1.46E-06	1.30E-06	1.09E-06	1.06E-06	1.20E-06	1.12E-06	1.09E-06	1.31E-07	2.31E-08

Table F.2-4
General Release Category Considerations for Large, Dry Containment PWRs

Issue	Discussion
Containment Bypass	Interfacing system LOCA or SGTR bypassing containment have the potential for core melt without having the containment "involved" until after vessel failure.
RCS Pressure at Vessel Failure	High RCS pressure can lead to direct containment heating and containment failure at vessel failure. Also, fission product retention in the RCS is greater for high RCS pressure.
Time of Containment Failure	In general, the earlier the containment failure, the greater the source term.
Size of Containment Failure	In general, but not always, the larger the containment failure, the greater the source term.
Containment Spray System	Sprays are an important mechanism for fission product removal from the containment atmosphere. Additionally, recirculation spray operation may provide a mechanism for containment heat removal.
Debris Coolability	After vessel failure, if the core debris cannot be cooled, heat transfer from the debris can cause chemical decomposition of the concrete. As concrete is eroded by core debris, slag and gases are added to the debris and chemical reactions occur among the compounds. Concrete offgas acts as a carrier for volatile and semi-volatile reaction products which may be radioactive thus increasing the source term as the core-concrete interaction progresses.

Table F.2-5
Containment Event Tree Bins

RELEASE CATEGORY	RCS PRESSURE			CONTAINMENT FAILURE				DEBRIS COOLABLE	SPRAYS
	HIGH	MED.	LOW	EARLY	LATE	SMALL	LARGE		
RC01	X			X			X	X	X
RC01U	X			X			X		X
RC02	X			X			X	X	
RC02U	X			X			X		
RC03		X	X	X			X	X	X
RC03U		X	X	X			X		X
RC04		X	X	X			X	X	
RC04U		X	X	X			X		
RC05	X	X			X		X	X	X
RC05U	X	X			X		X		X
RC06	X	X			X		X	X	
RC06U	X	X			X		X		
RC07			X		X		X	X	X
RC07U			X		X		X		X
RC08			X		X		X	X	
RC08U			X		X		X		
RC09	X	X			X	X		X	X
RC09U	X	X			X	X			X

Table F.2-5
Containment Event Tree Bins

RELEASE CATEGORY	RCS PRESSURE			CONTAINMENT FAILURE				DEBRIS COOLABLE	SPRAYS
	HIGH	MED.	LOW	EARLY	LATE	SMALL	LARGE		
RC10	X	X			X	X		X	
RC10U	X	X			X	X			
RC11			X		X	X		X	X
RC11U			X		X	X			X
RC12			X		X	X		X	
RC12U			X		X	X			
RC13	X			X		X		X	X
RC13U	X			X		X			X
RC14	X			X		X		X	
RC14U	X			X		X			
RC15		X	X	X		X		X	X
RC15U		X	X	X		X			X
RC16		X	X	X		X		X	
RC16U		X	X	X		X			
RC17	SGTR								
RC18	Interfacing System LOCA								
RC19	Non-Severe Core Damage Sequence								
RC20	Long Term Containment Intact Sequence								

Table F.2-5
Containment Event Tree Bins

RELEASE CATEGORY	RCS PRESSURE			CONTAINMENT FAILURE				DEBRIS COOLABLE	SPRAYS
	HIGH	MED.	LOW	EARLY	LATE	SMALL	LARGE		
RC21	Basemat Melt-Through Sequence								

Table F.2-6
Release Category Group Definition

Release Category Group Name	Description of Release Category Group	Release Categories in Group
ST1	Large, Early Containment Failures	RC01, RC01U, RC02, RC02U, RC03, RC03U, RC04, RC04U
ST2	Small, Early Containment Failure	RC13, RC13U, RC14, RC14U, RC15, RC15U, RC16, RC16U
ST3	Late Containment Failures	RC05, RC05U, RC06, RC06U, RC07, RC07U, RC08, RC08U, RC09, RC09U, RC10, RC10U, RC11, RC11U, RC12, RC12U, RC21
ST4	Containment Bypass	RC17[1]
ST5	Interfacing System LOCA	RC17[1], RC18
ST6	Long-Term Containment Intact	RC19, RC20

Note 1 – The frequency of sequences initiated by SGTR with containment not isolated (SGTRN) are allocated to ST5. SGTRN contributes approximately 50% of the ST4 frequency and the remainder is moved to ST5.

Table F.2-7
Mapping between Release Category Group, Individual Release Category, and Key Damage Plant State

Release Category Group Name	Release Category Group	Release Category	Frequency	KDPS (Note 1)
ST1	Large, Early Containment Failures	RC01	3.73E-10	SXYAI
		RC01U	8.26E-11	SXYAI
		RC02	5.87E-06	SXNNS
		RC02U	1.02E-10	SXYCI
		RC03	8.46E-11	SXYAI
		RC03U	1.40E-09	SXYAI
		RC04	1.28E-06	HAYDI
		RC04U	9.27E-08	HAYDI
ST2	Small, Early Containment Failures	RC13	6.20E-13	SXYAI
		RC13U	1.02E-13	Note 2
		RC14	3.39E-06	SXNNS
		RC14U	9.96E-07	SXNNS
		RC15	0.00E+00	Note 2
		RC15U	3.05E-12	SXYAI
		RC16	2.84E-10	HANNS
		RC16U	2.35E-06	SXNNS
ST3	Late Containment Failures	RC05	9.66E-11	SXYAI
		RC05U	0.00E+00	Note 2
		RC06	8.97E-06	HAYDI
		RC06U	2.44E-06	HANNI
		RC07	1.83E-11	SXYAI
		RC07U	0.00E+00	Note 2

Table F.2-7
Mapping between Release Category Group, Individual Release Category, and Key Damage Plant State

Release Category Group Name	Release Category Group	Release Category	Frequency	KDPS (Note 1)
		RC08	1.92E-08	HAYDI
		RC08U	3.80E-06	HAYDI
		RC09	0.00E+00	Note 2
		RC09U	0.00E+00	Note 2
		RC10	2.81E-05	HAYDI
		RC10U	7.55E-06	HANNI
		RC11	0.00E+00	Note 2
		RC11U	0.00E+00	Note 2
		RC12	6.84E-08	HAYDI
		RC12U	1.11E-05	HAYDI
		RC21	2.17E-06	INYCI
ST4	Containment Bypass	RC17[4]	3.59E-06	INNGB
ST5	Interfacing System LOCA	RC18	1.28E-08	INNGV
ST6	Long-Term Containment Intact	RC19	9.12E-07	Note 3
		RC20	1.32E-06	SXYAI

Note 1: The assignment of a representative key damage plant state (KPDS) to each release category is based on Table 4.7-4 of the individual plant examination (IPE) submittal.

Note 2: No KPDS is assigned because of zero or very low release frequency.

Note 3: Non-severe Core Damage Sequence

Note 4: The frequency of sequences initiated by SGTR with containment not isolated (SGTRN) are allocated to ST5. SGTRN contributes approximately 50% of the ST4 frequency andthe remainder is moved to ST5.

TABLE F.3-1
COUNTY BASED POPULATION GROWTH RATES 2010 – 2045

California County	2010 Census Population	2045 Projected Population[1]	Growth Rate 2010 - 2045 Percentage
Kern	841,146	1,747,402	107.7%
Monterey	416,259	529,005	27.1%
San Luis Obispo	269,713	333,135	23.5%
Santa Barbara	424,050	499,987	17.9%

Note to Table F.3-1:

(1) Projection from California Department of Finance (Reference 92).

TABLE F.3-2

INCLUDED TRANSIENT POPULATION WITHIN A 20-MILE RADIUS OF DIABLO CANYON[1], YEAR 2010

Sector	0-1 mile	1-2 miles	2-3 miles	3-4 miles	4-5 miles	5-10 miles	10-20 miles	0-20 miles Total
N	0	0	0	333	0	2,081	7,724	10,138
NNE	0	0	0	0	0	1,150	0	1,150
NE	0	0	0	0	0	18	7,981	7,999
ENE	0	0	0	0	0	3,519	38,582	42,101
E	0	0	0	0	0	640	5,936	6,576
ESE	0	0	0	0	0	3,195	38,576	41,771
SE	0	0	0	0	0	0	512	512
SSE	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0
Total	0	0	0	333	0	10,603	99,311	110,247

Note to Table F.3-2:

(1) Transient population includes employees and special facilities based on data in the DCPP ETE (Reference 67). Although most site ETEs only cover regions out to about 10 miles from the site, the DCPP ETE covers regions out to 20 miles in some directions. Transient data in the 10-20 mile radial interval were conservatively included.

TABLE F.3-3

SECPOP 4.2 BASED RESIDENTIAL POPULATION DISTRIBUTION WITHIN A 50-MILE RADIUS OF DIABLO CANYON(1), YEAR 2010

Sector	0-10 miles	10-20 miles	20-30 miles	30-40 miles	40-50 miles	50-mile Total
N	10,325	13,136	800	3,182	603	28,046
NNE	4,095	2,023	48,399	24,097	441	79,055
NE	345	12,350	9,076	1,256	1,271	24,298
ENE	7,081	40,617	727	118	130	48,673
E	1,591	5,432	200	21	158	7,402
ESE	1,209	52,074	22,055	1,328	154	76,820
SE	0	1,261	69,326	68,146	4,619	143,352
SSE	0	0	11	3,338	51,477	54,826
S	0	0	0	0	0	0
SSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
WSW	0	0	0	0	0	0
W	0	0	0	0	0	0
WNW	0	0	0	0	0	0
NW	0	0	0	0	19	19
NNW	0	103	6,332	821	364	7,620
Total	24,646	126,996	156,926	102,307	59,236	470,111

Note to Table F.3-3:

(1) Resident population for 0-50 miles does not include transient, employee, or special facility populations.

TABLE F.3-4

PROJECTED POPULATION DISTRIBUTION WITHIN A 20-MILE RADIUS OF DIABLO CANYON[1], YEAR 2045

Sector	0-1 mile	1-2 miles	2-3 miles	3-4 miles	4-5 miles	5-10 miles	10-20 miles	0-20 miles Total
N	0	0	0	411	0	15,321	25,762	41,494
NNE	0	0	0	0	0	6,478	2,498	8,976
NE	0	0	0	0	0	448	25,109	25,557
ENE	0	0	0	0	7	13,084	97,811	110,902
E	0	0	0	0	0	2,755	14,039	16,794
ESE	0	0	0	1	0	5,438	111,953	117,392
SE	0	0	0	0	0	0	2,190	2,190
SSE	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	127	127
Total	0	0	0	412	7	43,524	279,489	323,432

Note to Table F.3-4:

(1) Population projection for 0-20 miles includes transients, employees, special facilities, and permanent residents. This population projection is based on year 2010 census data.

TABLE F.3-5

PROJECTED POPULATION DISTRIBUTION WITHIN A 50-MILE RADIUS OF DIABLO CANYON(1), YEAR 2045

Sector	0-10 miles	10-20 miles	20-30 miles	30-40 miles	40-50 miles	50-mile Total
N	15,732	25,762	988	3,936	766	47,184
NNE	6,478	2,498	59,773	29,760	556	99,065
NE	448	25,109	11,209	1,551	1,788	40,105
ENE	13,091	97,811	898	146	183	112,129
E	2,755	14,039	247	26	195	17,262
ESE	5,439	111,953	27,238	1,611	182	146,423
SE	0	2,190	83,053	80,480	5,446	171,169
SSE	0	0	13	3,936	60,691	64,640
S	0	0	0	0	0	0
SSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
WSW	0	0	0	0	0	0
W	0	0	0	0	0	0
WNW	0	0	0	0	0	0
NW	0	0	0	0	23	23
NNW	0	127	7,820	1,014	456	9,417
Total	43,943	279,489	191,239	122,460	70,286	707,417

Note to Table F.3-5:

(1) Population projection for 0-20 miles includes transients, employees, special facilities, and permanent residents. Although most site ETEs only cover regions out to about 10 miles from the site, the DCPP ETE covers regions out to 20 miles in some directions. Transient data in the 10-20 mile radial interval were conservatively included. Population projection for 20-50 miles includes permanent residents only. This population projection is based on year 2010 census data.

TABLE F.3-6

COUNTY SPECIFIC LAND USE AND ECONOMIC PARAMETERS INPUTS

CALIFORNIA COUNTY	FRACTION FARM	FRACTION DAIRY	FARM SALES ($/HECTARE)	FARM PROPERTY VALUE ($/HECTARE)	NON-FARM PROPERTY VALUE ($/PERSON)
Kern	0.448	0.124	4,399	11,373	286,033
Monterey	0.604	0.001	6,024	12,539	357,274
San Luis Obispo	0.634	0.007	1,273	10,803	362,787
Santa Barbara	0.400	0.011	4,307	18,880	397,357

TABLE F.3-7

MACCS2 ECONOMIC PARAMETERS INPUTS

Variable	Description	Base Case Value
DPRATE(1)	Property depreciation rate (per yr)	0.20
DSRATE(2)	Investment rate of return (per yr)	0.07
EVACST(3)	Daily cost for a person who has been evacuated ($/person-day)	58.59
RELCST(3)	Daily cost for a person who is relocated ($/person-day)	58.59
POPCST(3)	Population relocation cost ($/person)	10,850
CDFRM0(3)	Cost of farm decontamination for two levels of decontamination ($/hectare)(5)	1,221 2,713
TIMDEC(1)	Decontamination time for each level(5)	2&4 months
CDNFRM(3)	Cost of non-farm decontamination per resident person for two levels of decontamination ($/person) (5)	6,510 17,360
DLBCST(3)	Average cost of decontamination labor ($/man-year)	75,950
TFWKF(1)	Time workers spend in farm land contaminated areas(5)	1/10 1/3
TFWKNF(1)	Time workers spend in non-farm land contaminated areas(5)	1/3 1/3
VALWF0(4)	Weighted average value of farm wealth ($/hectare)	12,241
VALWNF(6)	Weighted average value of non-farm wealth ($/person)	370,506

Notes to Table F.3-7:

(1) Uses NUREG/CR-4551 (Reference 20) value.
(2) DSRATE based on NUREG/BR-0058 (Reference 25).
(3) These parameters use the NUREG/CR-4551 (Reference 20) value, updated to the July 2014 using the CPI.
(4) VALWF0 is based on the 2012 Census of Agriculture (Reference 63), Bureau of Labor Statistics (Reference 64), and Bureau of Economic Analysis (Reference 2) data, updated to July 2014 using the CPI for the counties within 50 miles.
(5) Two decontamination levels are modeled. The first value is associated with a dose reduction factor of 3. The second value is associated with a dose reduction factor of 15.
(6) VALWNF is based on 2007 data from the Bureau of Labor Statistics (Reference 64), U.S. Census Bureau (References 88 and 86), National Resources Conservation Service (Reference 87), Bureau of Economic Analysis (Reference 2), 2007 and 2012 U.S. Census of Agriculture (Reference 85 and 63), and the Journal of Monetary Economics (Reference 91).

TABLE F.3-8
COMIDA2 RELATED INPUT PARAMETER VALUES

Parameter	Parameter Description	Value Effective (Rem)	Value Thyroid (Rem)
DOSEMILK	Maximum allowable food ingestion dose from milk crops during the year of the accident	0.25	2.5
DOSEOTHER	Maximum allowable food ingestion dose from non-milk crops during the year of the accident	0.25	2.5
DOSELONG	Maximum allowable long term annual dose to an individual from ingestion of the combination of milk and non-milk crops.	0.50	5.0

TABLE F.3-9
MACCS2 SOURCE TERM

Nuclide	Activity (Bq)	Nuclide	Activity (Bq)
Co-58	2.44E+16	Te-131m	6.54E+17
Co-60	7.96E+14	Te-132	4.79E+18
Kr-85	3.44E+16	I-131	3.33E+18
Kr-85m	8.35E+17	I-132	4.88E+18
Kr-87	1.67E+18	I-133	6.87E+18
Kr-88	2.32E+18	I-134	7.62E+18
Rb-86	6.45E+15	I-135	6.56E+18
Sr-89	3.28E+18	Xe-133	6.88E+18
Sr-90	3.02E+17	Xe-135	1.88E+18
Sr-91	4.06E+18	Cs-134	5.64E+17
Sr-92	4.32E+18	Cs-136	1.76E+17
Y-90	3.23E+17	Cs-137	4.07E+17
Y-91	4.26E+18	Ba-139	6.08E+18
Y-92	4.36E+18	Ba-140	6.12E+18
Y-93	3.32E+18	La-140	6.33E+18
Zr-95	5.91E+18	La-141	5.54E+18
Zr-97	5.72E+18	La-142	5.42E+18
Nb-95	5.96E+18	Ce-141	5.61E+18
Mo-99	6.26E+18	Ce-143	5.19E+18
Tc-99m	5.55E+18	Ce-144	4.25E+18
Ru-103	5.23E+18	Pr-143	5.07E+18
Ru-105	3.59E+18	Nd-147	2.25E+18
Ru-106	1.70E+18	Np-239	6.53E+19
Rh-105	3.30E+18	Pu-238	1.26E+16
Sb-127	2.84E+17	Pu-239	1.15E+15
Sb-129	1.06E+18	Pu-240	1.52E+15
Te-127	2.79E+17	Pu-241	4.93E+17
Te-127m	4.60E+16	Am-241	6.48E+14
Te-129	1.01E+18	Cm-242	1.63E+17
Te-129m	2.05E+17	Cm-244	1.30E+16

TABLE F.3-10

MACCS2 RADIOISOTOPE GROUPS VS. DCPP LEVEL 2 RADIOISOTOPE GROUPS

MACCS2 Radioisotope Groups	DCPP Level 2 Radioisotope Groups$^{(4)}$
Xe/Kr	1 – noble gases
I	2 – CsI
Cs	6 & 2 – CsOH and CsI$^{(3)}$
Te	3, 10 & 11- TeO_2, $Sb^{(2)}$ & $Te_2^{(1)}$
Sr	4 – SrO
Ru	5 – MoO_2 (Mo is in Ru MACCS category)
La	8 – La_2O_3
Ce	9 & 12 – CeO_2 & $UO_2^{(1)}$
Ba	7 – BaO

Notes:

(1) These release fractions are typically negligible compared to others in the group.
(2) The mass of Sb in the core is typically much less than the mass of Te.
(3) The mass of Cs contained in CsI is typically much less than the mass of Cs contained in CsOH.
(4) The DCPP Level 2 radioisotope groups represent the twelve (12) MAAP 4.0.7 radioisotope groups.

TABLE F.3-11

REPRESENTATIVE MAAP LEVEL 2 CASE DESCRIPTIONS AND KEY EVENT TIMINGS

Source Term	Release Category	MAAP Case	Representative Case Description	CSI RF[(1)]	TCD (HRS)[(2)]	TVF (HRS)[(3)]	TCF (HRS)[(4)]	TEND (HRS)[(5)]
ST1	LG/EARLY	RC04U	Loss of all injection, AFW, containment sprays. Depressurize SGs at 15 min. Large (7 ft^2) containment breach at time of vessel failure.	6.01E-02	2.6	3.7	3.7	48
ST2	SM/EARLY	RC16U	Loss of all injection, AFW, containment sprays. Low pressure core melt with hot leg creep rupture, pre-existing containment failure.	4.30E-02	2.8	6.5	0.0	48
ST3	LATE	RC10	180 gpm/pump seal LOCA. AFW OK, CS OK. Containment failure when pressure > 150 psia.	4.05E-04	3.8	6.1	37.9	72
ST4	BYPASS w/ AFW	RC17	SGTR with loss of all injection and with AFW. SG PORV stuck open.	2.60E-02	42.1	66.5	0.0	72
ST5	ISLOCA	RC18	6" RHR pipe break, release directly to environment, no inj, w/ AFW	8.70E-01	1.1	2.5	NA	48
ST6	INTACT	RC20	MLOCA with failure to recirc. HPI OK. AFW OK. CS with heat removal OK.	3.17E-05	6.9	9.3	NA	48

Notes:

(1) CsI RF – Cesium Iodide release fraction to the environment
(2) Tcd - Time of core damage (maximum core temperature >1800°F)
(3) Tvf - Time of vessel breach
(4) Tcf – Time of containment failure
(5) Tend – Time at end of run

TABLE F.3-12

DCPP SOURCE TERM RELEASE SUMMARY

	Release Category					
	ST 1 LEARLY	**ST 2 SMEARLY**	**ST 3 LATE**	**ST 4 BYPASS w AFW**	**ST 5 ISLOCA**	**ST 6 INTACT**
MAAP Case	**RC04U**	**RC16U**	**RC10**	**RC17 W AFW**	**RC18**	**RC20**
Run Duration	**48 hr**	**48 hr**	**72 hr**	**72 hr**	**48 hr**	**48 hr**
Time after Scram when GE is declared(1)	**2.6 hr**	**2.8 hr**	**3.8 hr**	**36 hr**	**1.1 hr**	**6.9 hr**
Fission Product Group:						
1) Noble						
Total Release Fraction	7.60E-01	3.70E-01	9.70E-01	1.00E+00	1.00E+00	1.80E-03
Total Plume 1 Release Fraction	5.80E-01	2.80E-01	6.40E-01	8.10E-01	9.70E-01	3.00E-04
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	9.00E-02	9.00E-02	2.30E-01	6.00E-02	3.00E-02	5.00E-04
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	9.00E-02	0.00E+00	1.00E-01	1.30E-01	0.00E+00	1.00E-03
Start of Plume 3 Release (hr)	6.00		58.00	63.00		24.00
End of Plume 3 Release (hr)	16.00		68.00	66.00		34.00
2) CsI						
Total Release Fraction	6.00E-02	4.30E-02	4.00E-04	2.60E-02	8.70E-01	3.20E-05
Total Plume 1 Release Fraction	5.50E-02	4.10E-02	3.00E-04	2.50E-02	8.20E-01	2.80E-05
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	5.00E-03	2.00E-03	7.00E-05	0.00E+00	2.00E-02	1.00E-06
Start of Plume 2 Release (hr)	4.00	8.00	48.00		2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00		5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	3.00E-05	1.00E-03	3.00E-02	3.00E-06
Start of Plume 3 Release (hr)			58.00	63.00	5.00	24.00
End of Plume 3 Release (hr)			68.00	66.00	15.00	34.00
3) TeO2						
Total Release Fraction	2.60E-02	6.10E-02	1.00E-04	1.30E-02	8.30E-01	2.20E-05
Total Plume 1 Release Fraction	2.50E-02	6.00E-02	9.00E-05	1.10E-02	7.90E-01	2.00E-05
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	1.00E-03	1.00E-03	1.00E-05	1.00E-03	4.00E-02	2.00E-06
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	0.00E+00	1.00E-03	0.00E+00	0.00E+00
Start of Plume 3 Release (hr)				63.00		
End of Plume 3 Release (hr)				66.00		

TABLE F.3-12

DCPP SOURCE TERM RELEASE SUMMARY

	Release Category					
	ST 1 LEARLY	**ST 2 SMEARLY**	**ST 3 LATE**	**ST 4 BYPASS w AFW**	**ST 5 ISLOCA**	**ST 6 INTACT**
MAAP Case	**RC04U**	**RC16U**	**RC10**	**RC17 W AFW**	**RC18**	**RC20**
Run Duration	**48 hr**	**48 hr**	**72 hr**	**72 hr**	**48 hr**	**48 hr**
Time after Scram when GE is declared(1)	**2.6 hr**	**2.8 hr**	**3.8 hr**	**36 hr**	**1.1 hr**	**6.9 hr**
Fission Product Group:						
4) SrO						
Total Release Fraction	4.30E-02	5.30E-04	1.60E-05	3.50E-04	2.30E-02	7.00E-07
Total Plume 1 Release Fraction	4.20E-02	5.20E-04	1.30E-05	3.10E-04	1.40E-02	5.80E-07
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	1.00E-03	1.00E-05	2.00E-06	2.00E-05	8.00E-03	1.10E-07
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	1.00E-06	2.00E-05	1.00E-03	1.00E-08
Start of Plume 3 Release (hr)			58.00	63.00	5.00	24.00
End of Plume 3 Release (hr)			68.00	66.00	15.00	34.00
5) MoO2						
Total Release Fraction	4.40E-02	9.50E-03	1.80E-05	2.40E-03	3.80E-02	9.10E-06
Total Plume 1 Release Fraction	4.20E-02	9.40E-03	1.50E-05	2.20E-03	3.70E-02	7.10E-06
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	2.00E-03	1.00E-04	3.00E-06	2.00E-04	1.00E-03	2.00E-06
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Start of Plume 3 Release (hr)						
End of Plume 3 Release (hr)						
6) CsOH						
Total Release Fraction	1.50E-02	3.20E-02	1.20E-04	2.40E-02	8.50E-02	2.20E-05
Total Plume 1 Release Fraction	1.40E-02	3.10E-02	7.00E-05	2.20E-02	8.20E-01	2.10E-05
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	1.00E-03	1.00E-03	2.00E-05	0.00E+00	2.00E-02	1.00E-06
Start of Plume 2 Release (hr)	4.00	8.00	48.00		2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00		5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	3.00E-05	2.00E-03	1.00E-02	0.00E+00
Start of Plume 3 Release (hr)			58.00	63.00	5.00	
End of Plume 3 Release (hr)			68.00	66.00	15.00	

TABLE F.3-12

DCPP SOURCE TERM RELEASE SUMMARY

	Release Category					
	ST 1 LEARLY	**ST 2 SMEARLY**	**ST 3 LATE**	**ST 4 BYPASS w AFW**	**ST 5 ISLOCA**	**ST 6 INTACT**
MAAP Case	**RC04U**	**RC16U**	**RC10**	**RC17 W AFW**	**RC18**	**RC20**
Run Duration	**48 hr**	**48 hr**	**72 hr**	**72 hr**	**48 hr**	**48 hr**
Time after Scram when GE is declared(1)	**2.6 hr**	**2.8 hr**	**3.8 hr**	**36 hr**	**1.1 hr**	**6.9 hr**
Fission Product Group:						
7) BaO						
Total Release Fraction	4.30E-02	2.60E-03	1.60E-05	9.50E-04	3.70E-02	1.90E-06
Total Plume 1 Release Fraction	4.10E-02	2.60E-03	1.30E-05	8.40E-04	3.30E-02	1.50E-06
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	2.00E-03	0.00E+00	3.00E-06	8.00E-05	4.00E-03	4.00E-07
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	0.00E+00	3.00E-05	0.00E+00	0.00E+00
Start of Plume 3 Release (hr)				63.00		
End of Plume 3 Release (hr)				66.00		
8) La2O3						
Total Release Fraction	4.30E-02	1.70E-05	1.60E-05	8.20E-06	9.10E-04	1.70E-08
Total Plume 1 Release Fraction	4.20E-02	3.00	1.30E-05	5.30E-06	2.90E-04	1.40E-08
Start of Plume 1 Release (hr)	3.60	8.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	0.00E+00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	1.00E-03	8.00	2.00E-06	1.10E-06	6.00E-04	3.00E-09
Start of Plume 2 Release (hr)	4.00	11.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	0.00E+00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00		1.00E-06	1.80E-06	2.00E-05	0.00E+00
Start of Plume 3 Release (hr)			58.00	63.00	5.00	
End of Plume 3 Release (hr)			68.00	66.00	15.00	
9) CeO2						
Total Release Fraction	4.30E-02	3.80E-05	1.60E-05	5.20E-05	1.00E-02	4.20E-08
Total Plume 1 Release Fraction	4.20E-02	3.70E-05	1.30E-05	4.30E-05	1.00E-03	3.70E-08
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	1.00E-03	1.00E-06	2.00E-06	4.00E-06	8.00E-03	4.00E-09
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	1.00E-06	5.00E-06	1.00E-03	1.00E-09
Start of Plume 3 Release (hr)			58.00	63.00	5.00	24.00
End of Plume 3 Release (hr)			68.00	66.00	15.00	34.00

TABLE F.3-12

DCPP SOURCE TERM RELEASE SUMMARY

	Release Category					
	ST 1 LEARLY	**ST 2 SMEARLY**	**ST 3 LATE**	**ST 4 BYPASS w AFW**	**ST 5 ISLOCA**	**ST 6 INTACT**
MAAP Case	**RC04U**	**RC16U**	**RC10**	**RC17 W AFW**	**RC18**	**RC20**
Run Duration	**48 hr**	**48 hr**	**72 hr**	**72 hr**	**48 hr**	**48 hr**
Time after Scram when GE is declared(1)	**2.6 hr**	**2.8 hr**	**3.8 hr**	**36 hr**	**1.1 hr**	**6.9 hr**
Fission Product Group:						
10) Sb (Grouped with TeO2)						
Total Release Fraction	5.20E-02	3.80E-02	3.10E-04	6.30E-03	4.50E-01	2.40E-05
Total Plume 1 Release Fraction	5.00E-02	3.70E-02	7.00E-05	5.20E-03	3.70E-01	1.70E-05
Start of Plume 1 Release (hr)	3.60	3.00	38.00	42.10	1.10	6.90
End of Plume 1 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
Total Plume 2 Release Fraction	2.00E-03	1.00E-03	9.00E-05	1.00E-04	5.00E-02	6.00E-06
Start of Plume 2 Release (hr)	4.00	8.00	48.00	46.00	2.00	14.00
End of Plume 2 Release (hr)	6.00	11.00	58.00	56.00	5.00	24.00
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	1.50E-04	1.00E-03	3.00E-02	1.00E-06
Start of Plume 3 Release (hr)			58.00	63.00	5.00	24.00
End of Plume 3 Release (hr)			68.00	66.00	15.00	34.00
11) Te2 (Grouped with TeO2)						
Total Release Fraction	1.30E-04	0.00E+00	2.20E-05	4.00E-07	9.60E-04	0.00E+00
Total Plume 1 Release Fraction	1.30E-04	0.00E+00	1.40E-05	0.00E+00	0.00E+00	0.00E+00
Start of Plume 1 Release (hr)	3.60	3.00	38.00			
End of Plume 1 Release (hr)	4.00	8.00	48.00			
Total Plume 2 Release Fraction	0.00E+00	0.00E+00	5.00E-06	0.00E+00	9.20E-04	0.00E+00
Start of Plume 2 Release (hr)		8.00	48.00		2.00	
End of Plume 2 Release (hr)		11.00	58.00		5.00	
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	3.00E-06	4.00E-07	4.00E-05	0.00E+00
Start of Plume 3 Release (hr)			58.00	63.00	5.00	
End of Plume 3 Release (hr)			68.00	66.00	15.00	
12) UO2 (Grouped with CeO2)						
Total Release Fraction	3.80E-08	0.00E+00	0.00E+00	2.20E-09	5.00E-05	0.00E+00
Total Plume 1 Release Fraction	3.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Start of Plume 1 Release (hr)	3.60	3.00				
End of Plume 1 Release (hr)	4.00	8.00				
Total Plume 2 Release Fraction	2.00E-09	0.00E+00	0.00E+00	0.00E+00	4.60E-05	0.00E+00
Start of Plume 2 Release (hr)	4.00	8.00			2.00	
End of Plume 2 Release (hr)	6.00	11.00			5.00	
Total Plume 3 Release Fraction	0.00E+00	0.00E+00	0.00E+00	2.20E-09	4.00E-06	0.00E+00
Start of Plume 3 Release (hr)				63.00	5.00	
End of Plume 3 Release (hr)				66.00	15.00	

Note to Table F.3-12

(1) General Emergency (GE) declaration estimated from DCPP Emergency Classification Guide (Reference 60). All scenario GE times correspond to the time to core damage except for the ST 4 "BYPASS w AFW" where the GE is evaluated to occur at t = 36 hours.

TABLE F.3-13

MACCS2 BASE CASE MEAN RESULTS

Source Term	Release Category	Dose (p-rem)	Offsite Economic Cost ($)	Freq. (/yr)	Dose-Risk (p-rem/yr)	OECR ($/yr)
ST1	LGEARLY	9.83E+06	1.22E+10	7.24E-06	7.12E+01	8.84E+04
ST2	SMEARLY	9.59E+05	7.26E+09	6.74E-06	6.46E+00	4.89E+04
ST3	LATE	2.49E+04	1.17E+07	6.42E-05	1.60E+00	7.51E+02
ST4	BYPASS w AFW	7.68E+05	5.45E+09	1.79E-06	1.38E+00	9.77E+03
ST5	ISLOCA	6.15E+06	3.34E+10	2.97E-06	1.82E+01	9.91E+04
ST6	INTACT	3.68E+03	9.31E+05	2.24E-06	8.23E-03	2.08E+00
			FREQUENCY WEIGHTED TOTALS	8.52E-05	9.89E+01	2.47E+05

Table F.5-1
DCPP Level 1 Importance List Review

EVENT NAME	PROBABILITY	RISK REDUCTION WORTH	DESCRIPTION	POTENTIAL SAMAS
ZHTRP2	1.60E-01	1.11E+00	Elevated human error probability due to fire-induced degraded instrument-cue to operator to trip potentially dead-headed RHR pumps	This event represents the failure to trip the RHR pumps before failure when they have been "deadheaded" without CCW flow to the RHR heat exchangers. A potential means of precluding the need to trip the RHR pumps would be to install a normally open CCW flow bypass line around the RHR Hx outlet valve. This would ensure that minimum cooling flow would be available to prevent damage to the RHR pumps when they are running with the RCS at high pressure (SAMA 1).
AWR1	2.93E-04	1.07E+00	Failure to provide long-term supply water from FWST or RWR (non seismic) to auxiliary feedwater pumps to meet 24 hours mission time for the decay heat removal (DHR) function	This event represents the failure to align a long-term water source (e.g., the fire water storage tank) to AFW upon depletion of the CST to meet 24 hour mission time. The top contributors including this SF are cases where service water or CCW have failed and the CST is depleted. The HFE for this action is based on a relatively long process that is assumed to include venting of the initially operating pump. This function becomes important, especially when the decay removal via the RHR system is not available for a long-term cooling. The improvement of the reliability of the RHR system via SAMA 1 is one of two options. Another alternate approach would be to provide an engine driven SG makeup pump that can be aligned in time to mitigate loss of SG makeup scenarios. This could simplify alignment in cases where CST rupture may have resulted in air entrainment in the initially operating pump (SAMA 2).
PRB1A	1.76E-01	1.07E+00	PR Failed due to PORV 455C 8000B Failure - FOR FIRE AREA 1A and 9A	For fires in the containment annular area (91' and 115'), the cables for PORV 455C are impacted, leading to an induced LOCA scenario. In most of the scenarios including this split fraction, the failure to trip the RHR pumps while "deadheaded" leads to loss of the containment heat removal function. A potential means of precluding the need to trip the RHR pumps would be to install a normally open CCW flow bypass line around the RHR Hx outlet valve. This would ensure that minimum cooling flow would be available to prevent damage to the RHR pumps when they are running with the RCS at high pressure (SAMA 1).

Table F.5-1
DCPP Level 1 Importance List Review

EVENT NAME	PROBABILITY	RISK REDUCTION WORTH	DESCRIPTION	POTENTIAL SAMAS
RECSR	6.50E-02	1.06E+00	Recovery actions for CSR Scenarios from HSP	This SF represents the failure of recovery actions performed at the hot shutdown panel for cable spreading room fires. The cable spreading room (area 7A) is (or will be) equipped with multiple types of fire detection equipment, including smoke, heat, and incipient smoke detectors. Auto CO2 suppression is also installed to help reduce the frequency of the fires. Fires in this area, however, can lead to the need to perform a large number of mitigating actions at the remote shutdown panel. The significant sequence that include this SF, however, all include the SF for failure to trip a "deadheaded" RHR pump and an otherwise available low pressure injection/heat removal system is lost. A potential means of precluding the need to trip the RHR pumps would be to install a normally open CCW flow bypass line around the RHR Hx outlet valve. This would ensure that minimum cooling flow would be available to prevent damage to the RHR pumps when they are running with the RCS at high pressure (SAMA 1).
OSZ1	5.30E-02	1.06E+00	MANUAL ACTUATION IN EVENT SSPS FAILS: Instrumentation degraded	This event represents the failure to manually initiate SI in fire scenarios in which auto initiation has been failed by the fire and the instrumentation used for action diagnosis has been degraded (at least one train impacted by the fire). The fire procedure already identifies the instruments and equipment that can potentially be impacted for each fire area and directs actions to mitigate those failures. A potential means of improving the response would be to update the fire procedures to explicitly identify that auto SI is vulnerable to failure and to identify the instruments that should be used to check for the need to manually initiate SI (SAMA 3).