Florida Power & Light Company, 9760 SW 344 St., Fla City, FL 33035

FPL

L-2001-59
10 CFR 51
10 CFR 54

MAR 30 2001

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Response to Request for Additional Information for the Review of the Turkey Point Units 3 and 4 License Renewal Application

By letter dated January 31, 2001, the NRC requested additional information regarding the Turkey Point Units 3 and 4 License Renewal Application (LRA) Environmental Report Severe Accident Mitigation Alternatives. Attachment 1 to this letter contains the responses to the Requests for Additional Information (RAIs) associated with the Severe Accident Mitigation Alternatives of the LRA Environmental Report. Attachment 2 to this letter contains a revised LRA Environmental Report Table 9.1-1, "Environmental Authorizations for Current Turkey Point Units 3 and 4 Operations."

Should you have any further questions, please contact E. A. Thompson at (305) 246-6921.

Very truly yours,

RJH

R. J. Hovey
Vice President - Turkey Point

RJH/EAT/hlo

Attachments (2)

A084

cc: U.S. Nuclear Regulatory Commission, Washington, D.C.

Chief, License Renewal and Standardization Branch
Project Manager - Turkey Point License Renewal
Project Manager - Turkey Point License Renewal-Environmental
Project Manager - Turkey Point

U.S. Nuclear Regulatory Commission, Region II
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

Other

Mr. Robert Butterworth
Attorney General
Department of Legal Affairs
The Capitol
Tallahassee, FL 32399-1050

Mr. William A. Passetti, Chief
Department of Health
Bureau of Radiation Control
2020 Capital Circle, SE, Bin #C21
Tallahassee, FL 32399-1741

Mr. Joe Meyers, Director
Division of Emergency Management
2555 Shumard Oak Drive
Tallahassee, FL 32399-2100

County Manager
Miami-Dade County
111 NW 1 Street 29th Floor
Miami, FL 33128

Mr. Douglas J. Walters
Nuclear Energy Institute
1776 I Street NW
Suite 400
Washington, D.C. 20006

Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251

Response to Request for Additional Information for the Review of the Turkey Point Units 3 and 4, License Renewal Application

STATE OF FLORIDA)
) ss
COUNTY OF MIAMI-DADE)

R. J. Hovey being first duly sworn, deposes and says:

That he is Vice President - Turkey Point of Florida Power and Light Company, the Licensee herein;

That he has executed the foregoing document; that the statements made in this document are true and correct to the best of his knowledge, information and belief, and that he is authorized to execute the document on behalf of said Licensee.

R. J. Hovey

Subscribed and sworn to before me this

30 day of March, 2001.

OLGA HANEK
MY COMMISSION # CC 926970
EXPIRES: June 18, 2004
Bonded Thru Notary Public Underwriters

Olga Hanek
Name of Notary Public (Type or Print)

R. J. Hovey is personally known to me.

ATTACHMENT 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION DATED JANUARY 31, 2001 FOR THE REVIEW OF THE TURKEY POINT UNITS 3 AND 4, LICENSE RENEWAL APPLICATION ENVIRONMENTAL REPORT SEVERE ACCIDENT MITIGATION ALTERNATIVES

QUESTION 1

In the Severe Accident Management Alternative (SAMA) analysis reported in Reference [1], the base case Core Damage Frequency (CDF) appears to be based on the internal events CDF that is estimated from the current PRA model (which is a modification to the original Individual Plant Examination (IPE) [2] that was reviewed by the U. S. Nuclear Regulatory Commission (NRC) [3-5]). Reference [1] reports several different numbers as the base case CDF, namely:

> *On Page 4.20-11, the reported CDF is 1.62 x 10^{-5} per reactor year.*
>
> *On Page 4.20-18, the reported CDF is 6.12 x 10^{-5} per reactor year.*
>
> *The sum total of the release frequencies over all possible release modes (i.e., if all the release modes are considered, this should be the same as the total CDF) listed in Table F.1-2 (on Page F.1-4) is about 9.14 x 10^{-6} per reactor year.*

On the other hand, the internal events CDF from the original IPE was 3.7 x 10^{-4} per reactor year [2-3], whereas the CDF following the plant modification resulting from the IPE process was 1.0 x 10^{-4} per reactor year.

Please provide the following:

a. *The correct internal events CDF that is the basis for the present SAMA evaluation [1], including the detailed rationale behind the use of the CDF estimate in this type of analysis for license renewal. Specifically, please provide the reasons for the reduction in the internal events CDF from the IPE estimate of 1.0 x 10^{-4} per reactor year, to the current level (1.62 x 10^{-5}, 6.12 x 10^{-5}, etc.).*

b. *In the original IPE, the Steam Generator Tube Rupture (SGTR), and the Interfacing System LOCA (ISLOCA) were found to contribute each, about 4 percent (or about 4 x 10^{-6} per reactor) [2-3], to the total internal events CDF. In Table F.1-2, the core damage frequencies for SGTR (i.e., BP-SGTR), and ISLOCAs (i.e., BP-V) are listed as 1.71 x 10^{-8} and 6.24 x 10^{-8} per reactor year, respectively. Please provide an explanation for the reductions of about a factor of 60 for ISLOCA and 250 for SGTR (i.e., were these reductions due to changes in procedures or inspection programs, or as a result of modifications to the PRA parameters?).*

c. *Please provide justifications for the seemingly low releases shown in Table F.1-2 for SGTR release mode. This should include either detailed plant-specific results of calculations and/or generic results for other plants, including a documentation of their technical bases. Please show the sensitivity of conditional consequences resulting from SGTR scenarios if accident source terms more representative of other published PRAs (e.g., NUREG-1150) were to be used in the SAMA analyses.*

d. *Depending on the correct value of total CDF, the contribution to late containment failure for scenarios for which the containment sprays are operational (i.e., release modes C3-L and C3-R) ranges from 3 percent to 23 percent. Please list the main reasons for late containment failure when the containment sprays are operating. This issue was identified as an inconsistency in the NRC review of the original IPE submittal (see Page 20 of Reference [4]).*

e. *Due to inconsistencies in the reported base-case CDF, it is difficult to determine the number of accident sequences that have been included in the level-3 consequence (i.e., Table F.1-4) and risk calculations. Please confirm the scope of accident consequence calculations in terms of the core damage sequences and the radiological release modes.*

Response to QUESTION 1:

a. The original model documented in the 1991 Turkey Point IPE submittal has a core damage frequency (CDF) of 1.0E-04/Yr (Ref. [2]). This model was revised following a detailed "Level 2" review by the NRC and submittal of the revised Turkey Point IPE in 1992 to address the NRC's comments. The Turkey Point PSA model was updated in 1993, 1995, and 1997 to incorporate plant changes and modeling changes. The CDF for the 1997 update was 6.12E-05/Yr. Plant upgrades incorporated in the model included modifications to the service water system, standby steam generator feed water pump (from motor driven to diesel driven) and instrument air system upgrade. Major modeling changes included time-dependent recovery of offsite power, more consistent recovery actions (use of rule based recovery), and data updates. In 1999, the 1997 Turkey Point PSA model was modified to account for several plant features that have significant impact on the benefit calculations, but were not included in the plant risk model. This modified baseline model with a core damage frequency of 1.62E-05/Yr was used to evaluate SAMAs related to CCW performance, RCP seal Loss of Coolant Accident (LOCA), secondary heat removal, and equipment ventilation, and takes credit for the following features:

- Crosstie of the Unit 3 and Unit 4 Component Cooling Water (CCW) systems reducing the loss of CCW initiator and allowing recovery post-accident.
- Alternate feedwater sources for the steam generators, including opposite unit main feedwater and condensate.
- Revised dependency on Reactor Auxiliary Building ventilation, to reflect that only RHR pumps require the RAB fans.
- Revised common cause start and run failure beta factors for High Head Safety Injection (HHSI) pump, based on INEL-94/0064 Volume 6.

- Revised likelihood for RCP seal LOCA upon loss of seal cooling (partially due to the new O-ring for the Reactor Coolant Pumps).

Throughout this document the terms "SAMA baseline model" and "SAMA baseline CDF" will refer to the modified baseline model with a CDF of 1.62E-05/Yr.

b. The CDF reduction for SGTR was primarily based on crediting the redundant and diverse secondary heat removal mechanisms. The SGTR Emergency Operating Procedure (EOP) provides detailed guidance on bringing the reactor to stable conditions. Additional Severe Accident Management Guidelines (SAMGs) supplement the EOP, which in combination with the additional and diverse means for decay heat removal, make the CDF for SGTR low, but not unreasonable.

   The frequency of an ISLOCA initiating event was calculated to be 6.2E-06/Yr. It was estimated that the probability of failing to prevent the ISLOCA sequence from proceeding to core damage was 0.01 (given that 6 hours is available to use the other unit HHSI), resulting in an ISLOCA CDF of 6.2E-08/Yr. This improvement was based on taking credit for proceduralized operator actions and the shared HHSI system.

c. Due to the low SGTR core damage frequency, the results of the SAMA analysis are not sensitive to the conditional consequences resulting from SGTR scenarios if accident source terms more representative of other published PRAs (e.g., NUREG-1150) are used. The release fractions for SGTR and ISLOCA were obtained from the plant specific Modular Accident Analysis Program (MAAP) runs. Procedures to refill the ruptured steam generator and control the fission product release for SGTR provide guidance to reduce the source terms for SGTR sequences.

d. The Turkey Point IPE Level 2 study was based on a Turkey Point IPE Level 2 generic framework and was conservative. In the response to the RAI and for SAMA analysis, plant-specific MAAP runs were used. Environmental qualification (EQ) limits for containment spray were used in these MAAP runs such that if the pressure/temperature EQ limits were met or exceeded for more than 10 minutes, containment spray was assumed to fail.

   The release fraction for the late containment failure includes a fixed bias, overestimating the offsite release. SAMAs involving improved spray are modeled to result in the Plant Damage States (PDS) frequency reduction. A somewhat higher release fraction due to the bias in the late containment failure (which should be zero if EQ does not fail the spray) will result in an overestimate of the benefits. Recovery actions to reduce the containment failure and fission product release have been incorporated in the SAMGs.

e. The accident sequences considered are those in the Level 1 internal events analysis. The two different CDFs used are for screening and more detailed assessment respectively. The 6.12E-05/Yr was used for initial scoping estimates as the importance of the SAMAs were overestimated based on the importance of the PSA model risk contribution. The PSA model with a CDF of 1.62E-05/Yr was then used to do the SAMA analyses for those requiring more detailed cost-benefit assessment. Only those PDSs leading to containment failures (either early

or late) are included in *Table F.1-4* (Ref. [1]). The remaining 40 percent or so of the accident sequences do not involve releases.

QUESTION 2

According to the original IPE [2], the transient-induced loss of coolant accident (LOCA) resulting from the reactor coolant pump (RCP) seal failure contributed almost 60 percent to the total internal events CDF. As a countermeasure against the risk-dominant sequence of RCP seal LOCAs, plant modifications were introduced. The SAMA analysis documented in Reference [1] is believed to be based on the risk profile following the IPE-based plant modifications. To support using the updated risk model in the SAMA identification and evaluation processes, please provide the following.

a. *A description of the level-1 and level-2 risk profiles, results, and insights in terms of the major contributions (hardware and human failures) to the core damage frequency and release frequencies following the IPE-based plant modifications.*

b. *A specific discussion of the major differences between the SAMA PRA as compared with the original IPE, explaining any plant and/or modeling changes that have resulted in the new CDF and release frequencies. What quality programs are in place to ensure that the plant modeled in the SAMA PRA is consistent with the as-built configuration of the plant? In addition, please provide a description of any internal and external peer review of the latest level -1, -2, and -3 portions of the PRA.*

c. *A list of key equipment failures and human actions that dominate CDF and the large early and late release frequencies, which have the greatest potential for reducing the risk of severe accidents at Turkey Point, along with the results of any supporting importance analyses (e.g., Fussel-Vesely and/or risk reduction importance measures).*

Response to QUESTION 2:

a. Major contributors (hardware and human failures) to the SAMA baseline CDF are listed below in Table (1a) in the order of their respective cutset probability. Table (1a) below provides a listing of the top 20 cutsets corresponding to the SAMA baseline CDF.

Table (1a)
Top 20 Cutsets of Dominant Level 1 Hardware and Human Failures

#	Description	Event Prob	Probability
1	SMALL LOCA	1.00E-03	1.56E-06
	FAILURE TO CONTINUE INJECTION	2.00E-01	
	OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)	7.80E-03	
2	SMALL-SMALL LOCA	1.00E-03	1.06E-06
	COMMON CAUSE FAILURE OF HHSI PUMP TO START	1.06E-03	
3	SMALL LOCA	1.00E-03	1.06E-06
	COMMON CAUSE FAILURE OF HHSI PUMP TO START	1.06E-03	
4	SMALL-SMALL LOCA	1.00E-03	3.81E-07
	COMMON CAUSE FAILURE OF MOV-843A, B	3.81E-04	
5	SMALL LOCA	1.00E-03	3.81E-07
	COMMON CAUSE FAILURE OF MOV-843A, B	3.81E-04	

Table (1a)
Top 20 Cutsets of Dominant Level 1 Hardware and Human Failures

#	Description	Event Prob	Probability
6	REACTOR TRIP	1.04E+00	3.56E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	MTC UNFAVORABLE	1.90E-01	
7	SMALL-SMALL LOCA	1.00E-03	3.45E-07
	COMMON CAUSE FAILURE OF HHSI PUMP TO RUN	3.45E-04	
8	SMALL LOCA	1.00E-03	3.45E-07
	COMMON CAUSE FAILURE OF HHSI PUMP TO RUN	3.45E-04	
9	MEDIUM LOCA	1.00E-04	2.92E-07
	FAILURE TO CONTINUE INJECTION	2.00E-01	
	OPERATOR FAILS TO SWITCHOVER TO COLD LEG RECIRC (MEDIUM LOCA)	1.46E-02	
10	SMALL-SMALL LOCA	1.00E-03	2.88E-07
	COMMON CAUSE FAILURE TO ISOLATE NCC/CRDM COOLERS	1.44E-03	
	OPERATOR FAILS TO ESTABLISH CCW CROSSTIE	2.00E-01	
11	SPURIOUS SAFETY INJECTION SIGNAL	1.50E-01	2.70E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
12	REACTOR TRIP	1.04E+00	2.57E-07
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	MTC UNFAVORABLE	1.90E-01	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
13	SMALL LOCA	1.00E-03	2.56E-07
	FAILURE TO CONTINUE INJECTION	2.00E-01	
	MANUAL VALVE 887R TRANSFERS CLOSED	1.28E-03	
14	SMALL LOCA	1.00E-03	2.13E-07
	FAILURE TO CONTINUE INJECTION	2.00E-01	
	COMMON CAUSE FAILURE OF HHSI PUMPS	1.06E-03	
15	SPURIOUS SAFETY INJECTION SIGNAL	1.50E-01	1.95E-07
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE.	1.00E-01	
16	LOSS OF IA	9.20E-02	1.55E-07
	COMMON CAUSE FAILURE OF 3 OUT OF 3 AFW TURBINE-DRIVEN PUMPS TO START	4.20E-04	
	OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	
	FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	
17	LARGE LOCA	1.00E-05	1.46E-07
	FAILURE TO CONTINUE INJECTION	2.00E-01	
	OPERATOR FAILS TO SWITCHOVER TO LOW HEAD COLD LEG RECIRC (LARGE LOCA)	7.29E-02	
18	LOSS OF IA	9.20E-02	1.41E-07
	COMMON CAUSE FAILURE OF THE AFW FLOW CONTROL AOVS	3.83E-04	
	OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	
	FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	
19	SMALL-SMALL LOCA	1.00E-03	1.36E-07
	COMMON-CAUSE FAILURE OF THE RAB EXHAUST FANS	1.36E-04	
20	MEDIUM LOCA	1.00E-04	1.28E-07
	MANUAL VALVE 865B TRANSFERS CLOSED	1.28E-03	

It is not straightforward to obtain the cutsets associated with the early and late release due to the "coagulation" of the PDSs leading to the same release modes. The dominant PDS that contributes to both early and late release fractions is PDS IIIC. Table (1b) provides the top 20 cutsets for the dominant PDS for early and late releases. It is apparent that these scenarios involve high-pressure sequences with no spray failure. The main reason that sprays or fan coolers are not credited is because their actuation setpoints are not reached. However, if SAMGs are credited, these scenarios may be reduced further. This is additional conservatism that exists in the SAMA baseline model.

Table (1b): Top 20 Cutsets of Dominant Level 2 Hardware and Human Failures Contributors (IIIC.CUT)

#	Description	Event Prob	Probability
1	REACTOR TRIP	1.04E+00	3.56E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	MTC UNFAVORABLE	1.90E-01	
2	SPURIOUS SAFETY INJECTION SIGNAL	1.50E-01	2.70E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
3	REACTOR TRIP	1.04E+00	2.57E-07
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	MTC UNFAVORABLE	1.90E-01	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
4	SPURIOUS SAFETY INJECTION SIGNAL	1.50E-01	1.95E-07
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
5	LOSS OF IA	9.20E-02	1.55E-07
	COMMON CAUSE FAILURE OF 3 OUT OF 3 AFW TURBINE-DRIVEN PUMPS TO START	4.20E-04	
	OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	
	FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	
6	LOSS OF IA	9.20E-02	1.41E-07
	COMMON CAUSE FAILURE OF THE AFW FLOW CONTROL AOVS	3.83E-04	
	OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	
	FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	
7	REACTOR TRIP	1.04E+00	1.14E-07
	SEAL LEAKAGE PRE ACCIDENT	6.08E-02	
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	OPERATOR FAILS TO DETECT AND ISOLATE THE SEAL COVER GAS	1.00E+00	
8	REACTOR TRIP	1.04E+00	1.13E-07
	DIESEL GENERATOR FAILS TO RUN	8.38E-02	
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
9	SPECIAL INITIATOR - LOSS OF 4KV BUS C	2.99E-01	1.02E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	MTC UNFAVORABLE	1.90E-01	
10	LOSS OF MAIN FEEDWATER - RECOVERABLE	2.97E-01	1.02E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	MTC UNFAVORABLE	1.90E-01	
11	EXCESSIVE FEEDWATER	2.97E-01	1.02E-07
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
	MTC UNFAVORABLE	1.90E-01	
12	LOSS OF IA	9.20E-02	9.96E-08
	COMMON CAUSE FAILURE OF 3 OUT OF 3 AFW TURBINE-DRIVEN PUMPS TO RUN	2.71E-04	
	OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	
	FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	
13	REACTOR TRIP	1.04E+00	8.23E-08
	SEAL LEAKAGE PRE ACCIDENT	6.08E-02	
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	OPERATOR FAILS TO DETECT AND ISOLATE THE SEAL COVER GAS	1.00E+00	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
14	SPECIAL INITIATOR - LOSS OF 4KV BUS C	2.99E-01	7.39E-08
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	MTC UNFAVORABLE	1.90E-01	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	
15	LOSS OF MAIN FEEDWATER - RECOVERABLE	2.97E-01	7.34E-08
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	MTC UNFAVORABLE	1.90E-01	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	

Table (1b):
Top 20 Cutsets of Dominant Level 2 Hardware and Human Failures Contributors (IIIC.CUT)

#	Description	Event Prob	Probability
16	EXCESSIVE FEEDWATER	2.97E-01	7.34E-08
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	MTC UNFAVORABLE	1.90E-01	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE.	1.00E-01	
17	REACTOR TRIP	1.04E+00	7.28E-08
	CHARGING PUMP B OUT DUE TO TEST OR MAINTENANCE	3.89E-02	
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
18	REACTOR TRIP	1.04E+00	7.28E-08
	CHARGING PUMP B OUT DUE TO TEST OR MAINTENANCE	3.89E-02	
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
19	REACTOR TRIP	1.04E+00	7.28E-08
	CHARGING PUMP C OUT DUE TO TEST OR MAINTENANCE	3.89E-02	
	FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	
20	REACTOR TRIP	1.04E+00	5.59E-08
	FAILURE OF 4Kv BUS BREAKERS TO CLEAR	4.13E-02	
	TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	
	OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	

b. The major differences between the SAMA PRA and the original Turkey Point IPE are discussed in the response to Question-1.a. With regard to quality control of the model, the FPL Reliability and Risk Assessment Group (RRAG) has developed internal standards and procedures in addition to the stringent Quality Assurance Program procedures governing engineering performance of calculations, evaluations, etc. RRAG standards provide specific instructions and guidance for PSA-related evaluations and updates. They require periodic review of plant changes so that the model is consistent with the as-built configuration of the plant. Past and proposed changes to the PSA models are tracked in a single database. As the changes are implemented, their status is recorded in the database.

In terms of peer reviews, each PSA model change and update was documented via calculation or evaluation and reviewed internally by two independent reviewers in accordance with the FPL Quality Assurance Program procedures and RRAG standards. However, the most recent peer review was performed independently by industry experts on the Level 1 and Level 2 analyses as part of FPL's preparations for PSA Certification scheduled to be performed in 2002.

c. Table (2) provides a listing of top hardware and human actions contributing to the SAMA baseline CDF and release frequencies according to Fussell-Vesely importance ranking and their reduction worth.

Table (2)
Importance Measures of Top Hardware and Human Actions that Dominate CDF & Release Frequencies

Description	Probability	Fus Ves	Red W
FAILURE TO CONTINUE INJECTION	2.00E-01	2.28E-01	1.295
OPERATOR FAILS MANUAL ROD INSERTION WITHIN 1 MINUTE	1.00E-01	1.53E-01	1.181
COMMON CAUSE FAILURE OF HHSI PUMP TO START	1.06E-03	1.47E-01	1.173
TRIP BREAKER FAILS TO OPEN DUE TO COMMON CAUSE	1.30E-05	1.39E-01	1.161
FAILURE OF CONTROL RODS TO INSERT WITH POWER REMOVED	1.80E-06	1.30E-01	1.15
OPERATOR FAILS TO CROSSTIE ONE OF ALTERNATE SG FEED SOURCES	2.50E-01	1.02E-01	1.114
OPERATOR FAILS TO SWITCHOVER TO HIGH HEAD COLD LEG RECIRC (SMALL LOCA)	7.80E-03	9.95E-02	1.11
FAILURE TO MANUALLY OPEN MFW BYPASS VALVE	1.60E-02	5.64E-02	1.06
OPERATOR FAILS TO ESTABLISH CCW CROSSTIE	2.00E-01	5.37E-02	1.057
COMMON CAUSE FAILURE OF MOV-843A, B	3.81E-04	5.28E-02	1.056

QUESTION 3

Risk analyses at other commercial nuclear power plants indicate that external events could be large contributors to core damage and the overall risk to the public. The Turkey Point IPE [2] has estimated the CDF for control room fires to be as high as 1.9×10^{-4} per reactor year, and the CDF for the storm surges1 at the site ranging from 1×10^{-4} to about 1×10^{-6} per year. Even though Reference [2] claims that there are conservatisms associated with the control room fire-induced CDF, the fire and other external events (e.g., storm surge events) have contributions that are of the same order of magnitude as the internal events CDF. The quantitative influence of SAMAs applicable to internal fires/floods and external events have been evaluated by just doubling the estimated internal events CDF. Specifically:

a. *In view of the fact that the characteristics of the internal and external events scenarios are, in general, considerably different, please demonstrate (i.e., through sound PRA arguments), considering the uncertainties in PRA results, that by doubling the internal events CDF, one can reliably bound the risk of core damage due to all initiators at Turkey Point.*

b. *Provide a justification for including only a very limited number of SAMA candidates that involve external and other events (i.e., one seismic event [SAMA 150], one tornado event [SAMA 164], two candidates address internal flooding events [SAMAs 99 and 100]). In this regard, please discuss how plant-specific external and other CDF initiators (e.g., fires, flood, storm surges, etc.) were considered in the SAMA identification and assessment process. Furthermore, how was the quantitative impact of SAMA 99 explicitly assessed?*

Response to QUESTION 3a:

At the outset, it should be noted that the CDF estimates for fires and storm surges in the 1991 Turkey Point IPE were extremely conservative estimates that overestimated risk for screening purposes. Further, those estimates predated plant and procedural improvements (such as the many changes made to further reduce risk due to hurricanes), as well as improvements in modeling. Consequently, the risk from fires and storm surges are believed to be orders of magnitude below the very conservative 1991 screening estimates. As a general matter, risk of core damage from external events at Turkey Point is very small, to the point of being remote and speculative, and external events are not considered a significant contributor to core damage and overall risk.

Additionally, FPL's risk analysis considers the very different characteristics of internal and external events scenarios. The Turkey Point Individual Plant Examination of External Events (IPEEE) (Ref. [4]) and recent experience from reviews of the estimated risk associated with external events including fires, hurricanes, and earthquakes has demonstrated the following:

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1 The Turkey Point IPE [2] concluded that the storm surge dominates all other hurricane hazard component.

1. In general, the methodology and the data used for the Turkey Point IPEEE are for screening purposes, and are therefore very conservative.

2. Plant procedures (e.g., to prepare for hurricanes and to reduce risk for fire related initiators) and design are aimed at reducing risk. The limitations of the Turkey Point IPEEE screening methods make it impractical, if not impossible, to quantify these mitigating factors as accurately as that for internal events.

3. More recent advances in understanding and modeling of risk (for both hurricanes and fires) indicate that such risks have been overestimated.

The risk from external events is discussed below.

I. Fires

The Fire Induced Vulnerability Evaluation (FIVE) methodology for fire risk screening has been enhanced by the industry to include a more detailed assessment of the severity factors, fire modeling, and fire protection compensatory actions. Turkey Point fire protection features have also been improved by hardware changes (e.g., Turbine Building suppression system to mitigate hypothetical fires in Turbine Building).

Specific risk insights of refining the Turkey Point IPEEE fire risk for the cable spreading room and control room provide reasonable assurance that the fire risk for those areas is very low. The revised fire risk estimates for the cable spreading room and control room are at least two orders of magnitude lower than that reported in the original Turkey Point IPEEE. The Turkey Point IPEEE had concluded that there were no severe accident vulnerabilities due to internal fires and other external events.

II. Hurricanes

From the risk perspective, the following discussion shows that the severe accident risk contribution from hurricanes is also very small, to the point of being remote and speculative, and is already minimized as much as practical.

1. Plant In Shutdown Condition

From a severe accident risk perspective, hurricanes are much less significant than other external events, because they develop slowly and with advance warning that allows both preparation and elimination of many accident sequences. For example, accident scenarios such as LOCAs, SGTR, and ATWS are reduced significantly or totally eliminated for Turkey Point because plant procedures require the units to be in a shutdown condition prior to the onset of a hurricane. The decay heat is therefore reduced by a factor of two to three depending on when the loss of critical safety functions are postulated. The time available to take actions after hurricane-induced failures is thus increased, significantly reducing the core damage frequency.

2. *Low Initiator Frequency*

The CDF from storm surges in the 1991 Turkey Point IPE was based on an assumption that a Category 5 hurricane could result in a storm surge exceeding the design basis surge level of 19 feet, but recent advances in the modeling of storm surges associated with hurricanes indicate that the maximum storm surge level for Category 5 hurricanes is approximately 15 feet at the Turkey Point site, well below the 18 feet site ground level, and 20 feet addressed by plant emergency procedures. The probability of a hurricane that would challenge the plant for external flooding is thus very low and far below the very conservative estimate in the 1991 Turkey Point IPE.

Similarly, Class I structures at Turkey Point are designed for 225 mph winds and can accommodate 337 mph winds with no loss of function. It is also noted that as a result of the damage of Hurricane Andrew, the stacks of the adjacent fossil units 1 and 2 have been upgraded to a design wind load of 225 mph. Thus, the risk from hurricane force winds is very small.

3. *Summary*

Although not quantified directly, a reduced likelihood of the maximum storm surge level, placing the units in shutdown conditions, and other procedural enhancements are expected to reduce the core damage frequency to less than 1.0E-06/Yr.

Based on the above discussions, doubling the internal events CDF bounds the risk of core damage due to all initiators at Turkey Point.

III. Earthquakes

The Turkey Point IPEEE submittal for seismic risk was based on the seismic analysis resolving USI A-46. The Turkey Point IPEEE submittal indicated that the seismic risk was perceived to be low.

A plant-specific seismic adequacy evaluation identified components as seismic outliers. These outliers were addressed by implementing relevant plant improvements or procedures. The capacities of Condensate Storage Tanks (CSTs) and Refueling Water Storage Tanks (RWSTs) were evaluated and determined to meet the seismic design basis of 0.15g Peak Ground Acceleration (PGA).

For beyond design basis postulated earthquakes, the quantified risk is very conservative to compensate for the uncertainties in seismic hazard and fragility. Nevertheless, given the large safety factor generally embedded in the seismic design, in combination with measures taken in the resolution of A-46 issues, the seismic risk is low for Turkey Point.

Based on the above, the seismic risk is low and dominated by the uncertainties associated with the likelihood of the earthquakes beyond the design basis of 0.15g PGA. Assuming that the SAMAs will avert the same amount of risk from earthquakes and other external events as from internal events, doubling the CDF in the SAMA analysis is conservative and reasonable for the objectives of SAMA evaluation.

IV. Tornadoes and other external events

The core damage frequency contribution from external events reported in the Turkey Point IPEEE submittal (tornado, transportation and nearby facilities and others) is estimated to be less than 7.0E-07/Yr. The PSA model used for the SAMA would make the risk contribution from these external events even lower due to a smaller seal LOCA probability (partially due to new seal O-rings for the reactor coolant pumps) and the capability to cross-tie CCW from the opposite unit that was not credited in the Turkey Point IPEEE submittal.

V. Conclusion

Certain SAMAs are most likely to reduce the risk from a specific external event, and may not affect the internal event risk; and vice versa. The benefit (cost of averting the risk) of a SAMA is overestimated by assuming that the SAMA will have equal benefit in reducing the CDF associated with internal and external events.

In summary, the risk due to all external events has been evaluated in light of the more recent advances in fire risk study, procedural enhancements, and refined modeling. Although the risk from the external events is not quantified with the same level of detail and accuracy as that from the internal events, the external events risk is expected to be lower than that of the internal events risks. Therefore, it is reasonable, for SAMA purposes, to bound the risk of core damage due to all initiators at Turkey Point by doubling the internal events CDF.

Response to QUESTION 3b:

SAMA candidates were selected based on knowledge of the results of the 1991 Turkey Point IPE, the results of the 1994 Turkey Point IPEEE, and subsequent enhancements that have been implemented. Extensive actions to mitigate hurricane risk were implemented after Hurricane Andrew. Therefore no additional SAMAs related to hurricanes, wind, or storm surge warranted further consideration.

On the issue of fires, SAMA candidates were limited because:

1) Turkey Point fire protection features have been improved by hardware changes (e.g. Turbine Building suppression system).

2) The revised fire risk estimates for the cable spreading room and control room are at least two orders of magnitude lower than that reported in the original Turkey Point IPEEE.

SAMAs 99 and 100 are related to improvements to reduce the risk due to internal flooding. In the Turkey Point IPE submittal, internal flooding was discussed in detail. The Turkey Point IPE concluded that there is no credible internal flood/spray scenario that provides a significant risk contribution. The internal flooding risk was estimated to be less than 5.0E-07/Yr based on the original Turkey Point IPE model of 1991. There were no significant internal flooding issues in the Turkey Point IPE analysis. Therefore, SAMA improvements would not be expected to yield any measurable benefit. With no benefit, this potential improvement was eliminated. Although not quantified, the risk contribution is expected to be lower if the 1999 SAMA baseline PSA model is used further supporting that SAMAs 99 and 100 would not have any measurable benefit.

QUESTION 4

As described in Generic Letter 88-20, an important objective of the IPE/IPEEE program was to identify plant-specific vulnerabilities to severe accidents. The IPE study for Turkey Point Units 3 and 4 identified the following items of potential enhancement to the plant's accident management capability:

- *Replenishment of Refueling Water Storage Tank (RWST)*
- *Primary System Depressurization*
- *AC Power Recovery*
- *Cross-connection of Component Cooling Water (CCW)*
- *Manual Actuation of Containment Spray (Cavity Flooding)*

In this regard, please discuss the potential design enhancements and procedural modifications identified through the Turkey Point IPE, IPEEE and any other follow-on studies, and the disposition/status of these items. For those that have not been implemented2, please provide your results of their assessment within the context of SAMAs, showing their potential viability for implementation within your risk management program. Also please discuss how the insights gained from examination of these potential improvements were addressed in the SAMA identification process.

In the staff SE (Reference [3], Pages 12-14), it is pointed out that your original IPE conditional failure probability for late containment failure was 62 percent. Subsequent analysis, in response to staff questions, took credit for certain recovery actions and conservatisms. Your new value for the conditional failure probability for late containment failure was 7 percent. Please describe the procedures and/or hardware fixes that allow for the recovery actions. Do you have an estimate of the reduction in risk that resulted from such recovery actions? Are there opportunities for SAMAs to further reduce the containment failure probability? (Although the staff recognizes that many "containment" candidate SAMAs are excessively expensive [such as SAMA 46], there are others that are much less expensive and can effectively mitigate the consequences of some core damage accidents [for example passive autocatalytic recombiners for hydrogen control cost about $40,000 per recombiner].)

Some of the reduction from 62 percent to 7 percent was attributed to the removal of conservatisms. (The staff noted that some of the assumptions "appear somewhat optimistic.") In light of this, what uncertainties do you associate with the risk and risk reduction values that make up your SAMA assessment?

In the ER (Page 4.20-20), you state that "an expert panel reviews the benefit to determine whether the SAMA can be implemented for a cost equivalent to twice the benefit." Please provide the cost determination for a sampling of procedural and hardware SAMA candidates, which were close to

2 For instance, flooding of a failed steam generator following a SGTR event has been considered as a potential severe accident mitigation measure in severe accident mitigation studies for other plants.

your "twice the benefit" guideline. For example, you screened out candidate SAMA 47, "Use fire water spray pump for containment spray." What are the cost and benefit estimates for this SAMA?

Response to QUESTION 4:

POTENTIAL DESIGN ENHANCEMENTS

The original plant IPE (IPEEE) identified five potential enhancements to the plant's accident management capability as identified in this RAI. All potential enhancements to the plant's accident management capability have been implemented and considered in more detail in the PSA as described below.

Replenishment of Refueling Water Storage Tank (RWST): This enhancement has been proceduralized in the EOP for loss of emergency coolant recirculation. In addition, the units can also share the high head safety injection systems, meeting the intent of RWST replenishment to prolong the injection for LOCAs by pending steps allowing use of the postulated non-accident units' RWST inventory.

Primary System Depressurization: Procedures exist to use spray, auxiliary spray or PORVs to depressurize. For beyond design basis severe accidents, a Severe Accident Guideline (SAG) was generated to provide guidance for RCS depressurization to prevent high RCS pressure at a postulated vessel breach.

AC Power Recovery: The importance of AC power recovery has been highlighted in operator training. Hurricane procedures also emphasize the importance of verifying the performance of Diesel Generators. A more detailed time-dependent recovery analysis varying the mission time and the time to recover offsite power also more realistically quantified the risk related to the loss of offsite power and blackout scenarios.

Cross-connection of Component Cooling Water (CCW): This enhancement has been implemented at Turkey Point by providing specific steps in the applicable Off-Normal Operating Procedure to cross-connect the units' CCW. This action is also highlighted during operator training.

Manual Actuation of Containment Spray (Cavity Flooding): This enhancement has already been implemented at Turkey Point. A Severe Accident Guideline (SAG) was generated to provide guidance for injecting water to the containment from a variety of sources including containment spray.

Since these enhancements were already implemented, they were not selected in the SAMA candidate identification process.

CONDITIONAL FAILURE PROBABILITY

The Turkey Point IPE containment failure probability is driven by the assumptions related to the degraded core phenomena. In the original Turkey Point IPE submittal, very conservative assumptions were used with plant specific MAAP runs performed for understanding, and the values reported were conservative. After the Turkey Point IPE submittal, a better understanding of the degraded core phenomena, in combination with existing plant-specific MAAP runs and favorable plant design features (e.g., wet cavity configuration and relatively large containment free volume) have been incorporated in the Level 2 model. In addition, generic insights incorporated in the SAMGs provide enhanced procedural guidance to reduce the risk of containment failure. The specific operator actions which played a role in reducing the probability of containment failure below the original estimate were depressurizing the RCS and injecting water into containment. Guidance for these actions is contained in the Severe Accident Guidelines. Nevertheless, the current SAMA baseline model maintains a conservative estimate of a late containment failure probability of approximately 55%.

The SAMA baseline model shows the assumptions referenced in the NRC's Safety Evaluation (SE) (Ref [3]) are still conservative. Improved understanding of the degraded core phenomena subsequent to the SE indicates the assumptions used in the SAMA baseline model are comparable to those used in the published PRA. As described in the response to SAMA RAI questions 1d and 2b, the dominant late containment failure sequences were due to the conservative assumptions made with respect to exceeding the EQ limit for a short period of time, thus failing the containment heat removal capabilities. PDSs with successful containment spray but with hypothesized late containment failures are due to non-condensible gas generation. Basemat melt-through (which is another conservative assumption made, given that wet cavity design could have averted containment failure and SAMGs provide instructions to inject water into containment) contributes about 25%, and loss of containment integrity due to hydrogen burn contributes about 25%. If these conservative assumptions were removed, the late containment failure contribution is expected to drop from approximately 55% to 25% (assuming hydrogen burn causes the late containment failure). The benefit of the autocatalytic recombiners for hydrogen control is well outweighed by the additional late containment failure contribution not credited because of the wet cavity and SAMGs. Although the estimated cost of the autocatalytic recombiner seems attractive, when additional requirements such as design, qualification, installation, testing, maintenance, procedures and training are included, the cost is expected to be substantially higher.

COST DETERMINATION

For the purpose of this analysis, it is estimated that the cost of making a change to a procedure and for conducting the necessary training on a procedure change is expected to exceed $30,000. Similarly, the minimum cost associated with development and implementation of an integrated hardware modification package (including post-implementation costs, e.g. training) was assumed to be $70,000. These values were used for

comparison with the benefit of SAMAs.

The benefits resulting from the bounding estimates presented in the benefit analysis are in general rather low. In most cases, the benefits are so low that it is obvious that the implementation costs would exceed the benefit, even without a detailed cost estimate. Expert panel judgement is applied in assessing whether the benefit approaches the expected implementation costs in many cases. No detailed cost estimate was provided for SAMA #47 since extensive plant design changes would be required to implement this SAMA candidate and benefit was determined to be low. Detailed cost estimating is only applied in those situations in which the benefit is significant and application of judgement would be questioned. A sample of a detailed SAMA cost estimate analysis is provided in Table (3).

Table (3)
Detailed SAMA Cost Estimate Analysis

Digital Feedwater Control System

Equipment and Installation	Material	Labor hrs	Rate	Total labor	Total
Control system	$ 218,867				$ 218,867
Installation labor		16	$30.50	$ 488	$ 488
Process manager system	$ 106,270				$ 106,270
Process manager I/O	$ 30,780				$ 30,780
Installation labor		18	$30.50	$ 549	$ 549
Logic manager system	$ 47,390				$ 47,390
Logic manager I/O 32 in, 32 out	$ 2,538				$ 2,538
Installation labor		18	$30.50	$ 549	$ 549
Conduit installation (est at 800' of ¾")	$ 862	80	$30.20	$ 2,416	$ 3,278
Conduit bends, fittings, boxes (use conduit cost)	$ 862	80	$30.20	$ 2,416	$ 3,278
Cable 14AWG (est at 1200')	$ 64	7.2	$30.20	$ 217	$ 281
Terminations (est 200)	$ 112	16	$30.20	$ 483	$ 595
SUBTOTAL					$ 414,863

Engineering & Design; Operations & Management	Hours	Rate	Total
System specification, vendor documentation	200	$80	$ 16,000
Panel mounting calc, dwgs	80	$80	$ 6,400
Conduit supports	120	$80	$ 9,600
Electrical physical dwgs	60	$80	$ 4,800
Cable routing	40	$80	$ 3,200
Electrical loop/schematic diagrams	120	$80	$ 9,600
Electrical termination dwgs	160	$80	$ 12,800
Mod package doc, safety eval, procedure changes, etc.	160	$80	$ 12,800
System testing	80	$80	$ 6,400
Management and administrative	100	$80	$ 8,000
SUBTOTAL	1120		$ 89,600
TOTAL			$ 504,463
Allowance for indeterminants at 15%			$ 75,670
GRAND TOTAL			$ 580,133

QUESTION 5

In the SAMA study [1], the basis for the final SAMA screening and cost-benefit analysis is not clearly spelled out. For example, the screening analysis of SAMA 155, "Provide a centrifugal charging pump", is based on the risk impact analysis such that the charging pump failures have less than a 2.5 percent contribution to the internal events CDF. Please provide detailed description of the risk impact analysis, including the specific value of ΔCDF and Δperson-rem, for each of the final SAMA candidates.

Response to QUESTION 5:

Certain cases were evaluated based on the importance of the PSA model with a higher CDF of 6.12E-05/Yr. If the cost-benefit based on this scoping analysis warranted more refinement, the Level 3 model with the SAMA baseline CDF of 1.62E-.05/Yr was then used. SAMA 155 was evaluated using the SAMA baseline CDF and did not warrant a more detailed evaluation. Based on the SAMA baseline CDF contribution of less than 2.5%, the maximum benefit to be obtained from a centrifugal pump is less than $20.1K.

Other SAMAs were evaluated using the SAMA baseline model as described below. The benefits analysis results for each SAMA case using the baseline SAMA model is summarized in Table (4). The SAMA numbers associated with the SAMA cases are summarized in *Table F.2-2* of the Environmental Report (Ref. [1]). The cases listed in the table are summarized below:

Baseline SGCRABP2

DESCRIPTION: This baseline case was developed to account for several plant features that have significant impact on the benefit calculations, but were not included in the baseline plant risk model. This baseline model is used to evaluate SAMAs related to CCW performance, RCP seal LOCA, secondary heat removal, equipment ventilation, and credits the following features:

- Crosstie of the Unit 3 and Unit 4 Component Cooling Water (CCW) systems reducing the loss of CCW initiator and allowing recovery post-accident.
- Alternate feedwater sources for the steam generators, including opposite unit main feedwater and condensate.
- Revised dependency on Reactor Auxiliary Building ventilation, to reflect that only RHR pumps require the RAB fans.
- Revised common cause start and run failure beta factors for High Head Safety Injection (HHSI) pump, based on INEL-94/0064 Volume 6.
- Revised likelihood for RCP seal LOCA upon loss of seal cooling (partially due to the new O-ring for the Reactor Coolant Pumps).

This case represents the risk improvements already implemented at Turkey Point and is therefore not a SAMA alternative.

Case SGCRVLP2

DESCRIPTION: This case was used to determine the benefit to be obtained from a redundant, highly reliable, independent containment spray system. For the purposes of the analysis, a single bounding analysis was performed which assumed that the containment spray system would be perfectly reliable, thus eliminating those containment failures due to loss of sprays.

Case SGFCSF

DESCRIPTION: This case was used to determine the benefit to be obtained from elimination of secondary decay heat removal failures. For the purposes of the analysis, a single bounding analysis was performed which assumed that secondary decay heat removal does not fail.

Case OPERCSF

DESCRIPTION: This case was used to determine the benefit to be obtained from further increased operator training for critical human interactions.

Case RABCSF

DESCRIPTION: This case was used to determine the benefit to be obtained from improved ventilation in the Reactor Auxiliary Building (RAB). For the purposes of the analysis, it was assumed that equipment in the RAB requires no ventilation.

Case HHDDPCSF

DESCRIPTION: This case was used to determine the benefit to be obtained from a more diverse, redundant or independent high-head safety injection system. For the purposes of the analysis, a single analysis was performed which assumed the addition of two diesel-driven HHSI pumps (one for each Turkey Point unit).

Case SEALCSF

DESCRIPTION: This case was used to determine the benefit to be obtained from eliminating RCP Seal LOCAs. For the purposes of the analysis, a single analysis was performed which assumed that RCP Seal LOCA would not occur.

Case NO-ISLOCA

DESCRIPTION: This case was used to determine the benefit to be obtained from improved response to interfacing systems LOCA. For the purposes of the analysis, a single bounding analysis was performed which assumed interfacing systems LOCA would be eliminated.

Case NO-SGTR

DESCRIPTION: This case was used to determine the benefit to be obtained from improved response to steam generator tube rupture. For the purposes of the analysis, a single bounding analysis was performed which assumed SGTR would be eliminated.

Case CI OK

DESCRIPTION: This case was used to determine the benefit to be obtained from highly reliable containment isolation valves. For the purposes of the analysis, a single bounding analysis was performed which assumed that early containment failure (which includes containment isolation failure) would not occur.

Case No LOG

DESCRIPTION: This case was used to determine the benefit to be obtained from modifications that would improve plant response to loss of the offsite grid. For the purposes of the analysis, a single bounding analysis was performed which assumed perfect response to loss of grid initiators; i.e. that no sequences would result from a loss of the grid.

Case EDG5

DESCRIPTION: This case was used to determine the benefit to be obtained from modifications that would add another emergency diesel generator.

Case OperCSI

DESCRIPTION: This case was used to determine the benefit to be obtained from modifications that would provide the capability to automatically realign from injection mode to recirculation mode.

Table (4):
Results of Benefits Analysis for Considered SAMA Cases

Case->	sgcrabp2	sgcrvlp2	Sgfcsf	opercsf	rabcsf	hhddpscf	sealcsf	NO-ISLOCA	NO-SGTR	CIOK	No LOG	EDG5	OperCSI
Offsite Annual Dose (Rems)	10.88	7.91	9.89	10.17	10.64	9.37	10.37	10.60	10.87	10.87	10.16	9.83	10.31
Offsite Annual Property Loss ($)	$22,850	$16,315	$20,801	$21,480	$22,337	$19,816	$21,814	$22,057	$22,836	$22,834	$21,383	$20,671	$21,765
Reduction in CDF	NA	13%	10%	11%	1%	20%	3%	0%	0%	0%	5%	8%	10%
Reduction in Offsite Dose	NA	27%	9%	6%	2%	14%	5%	3%	0%	0%	7%	10%	5%
Total Benefit (Onsite + Repl Pwr + Offsite)	**$801,546**	**$176,980**	**$75,961**	**$66,464**	**$15,250**	**$130,588**	**$30,903**	**$15,761**	**$784**	**$664**	**$48,807**	**$71,370**	**$55,270**

QUESTION 6

The base-case CDF used in the SAMA evaluation, and the contribution of various release modes have changed significantly since the original IPE [2] was completed. For instance, based on the information presented in Reference [1] (e.g., Table F.1-2) one cannot determine if the changes in the risk contributions only result from changes in the estimated CDF (i.e., plant damage state frequencies), or changes in containment performance analyses. Therefore, to better assess the technical basis for the base-case, please provide the following:

a. *A list of all plant damage states, their definition where different from original IPE [2], their respective frequencies based on the latest PRA results used in the SAMA submittal.*

b. *A containment matrix based on the latest PRA (i.e., similar to Table 4.6-30 of Reference [2]), if different from the original IPE as reported in Reference [2]. In addition, please justify any changes in the estimated conditional probabilities associated with each release mode, given the plant damage states (i.e., the various end-state probabilities in the containment event trees) since the original IPE [2] was completed and reviewed by NRC [3, 4]. These changes should be supported by specific information on the advances in the state-of-the art, computer code calculations, experiments and any other relevant data.*

c. *A list of all changes to the level-2 PRA assumptions and/or models that could impact the level-2 results (e.g., item b above) should be provided.*

Response to QUESTION 6:

a. The PDSs used in the SAMA analysis are identical to those identified in the Turkey Point IPE document. However, due to model updates associated with the plant modifications and enhancements discussed previously, the PDS frequencies have changed. The baseline PDS frequencies that are used in the SAMA analysis are listed in Table (5) below.

Table (5):
SAMA Baseline PDS Frequencies

PDS	FREQUENCY
IC	2.10E-06
ID	1.54E-09
IE	9.54E-10
IF	5.81E-09
IH	2.35E-07
IIC	6.03E-08
IID	6.20E-08
IIE	7.87E-07
IIF	2.01E-10
IIH	7.26E-08
IIIC	6.18E-06
IIID	2.21E-08
IIIG	5.19E-08
IIIH	4.49E-08
IVC	2.99E-08
IVD	0
IVE	0
IVF	0
IVH	0
VA	7.35E-09
VB	2.64E-06
VD	1.27E-08
VE	9.54E-10
VF	7.98E-09
VH	1.15E-07
VIA	1.04E-06
VIB	2.44E-06
VID	1.62E-08
VIE	1.14E-07
VIF	1.61E-08
VIH	1.64E-08
SGTR	1.71E-08
ISLOCA	6.24E-08
CDF	**1.62E-05**

b. Updated Containment Matrixes are given in Tables (6) and (7) below. Any changes to the conditional probabilities associated with each release mode estimated in the Turkey Point IPE are discussed in the response to (c.) below.

Table (6):
CET Conditional Probabilities of Release Category for the PDSs

	IC	ID	IE	IF	IH	IIC	IID	IIE	IIF	IIH
A1	1.27E-02	1.69E-02	3.00E-02	3.01E-02	2.47E-02	1.27E-02	1.69E-02	3.00E-02	3.01E-02	2.47E-02
A2	5.81E-03	1.93E-02	2.29E-02	6.05E-03	2.82E-02	5.81E-03	1.93E-02	2.29E-02	6.05E-03	2.82E-02
B1	5.78E-02	3.99E-04	4.84E-04	7.02E-02	5.20E-04	5.78E-02	3.99E-04	4.83E-04	7.02E-02	5.20E-04
B2-L	1.32E-02	2.27E-04	1.85E-04	7.05E-03	5.91E-04	1.32E-02	2.27E-04	1.85E-04	7.05E-03	5.91E-04
B2-R	1.32E-02	2.27E-04	1.85E-04	7.05E-03	1.48E-06	1.32E-02	2.27E-04	1.85E-04	7.05E-03	1.48E-06
B3-L	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00
B3-R	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00
B4-L	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00
B4-R	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00
B5-L	1.49E-05	1.02E-07	1.26E-07	1.85E-05	2.03E-07	1.49E-05	1.02E-07	1.26E-07	1.85E-05	2.03E-07
B5-R	1.49E-05	1.02E-07	1.26E-07	1.85E-05	5.10E-10	1.49E-05	1.02E-07	1.26E-07	1.85E-05	5.10E-10
B6-L	6.80E-06	1.16E-07	9.64E-08	3.71E-06	2.32E-07	6.81E-06	1.16E-07	9.64E-08	3.71E-06	2.32E-07
B6-R	6.80E-06	1.16E-07	9.64E-08	3.71E-06	5.81E-10	6.81E-06	1.16E-07	9.64E-08	3.71E-06	5.81E-10
C1-L	6.66E-02	0.00E+00	8.95E-02	8.26E-02	0.00E+00	6.66E-02	7.32E-02	8.95E-02	8.26E-02	0.00E+00
C1-R	6.66E-02	0.00E+00	8.95E-02	8.26E-02	0.00E+00	6.66E-02	7.32E-02	8.95E-02	8.26E-02	0.00E+00
C2-L	3.03E-02	1.57E-01	6.84E-02	1.66E-02	3.15E-01	3.03E-02	8.34E-02	6.84E-02	1.66E-02	3.15E-01
C2-R	3.03E-02	1.57E-01	6.84E-02	1.66E-02	7.89E-04	3.03E-02	8.34E-02	6.84E-02	1.66E-02	7.89E-04
C3-L	6.85E-02	0.00E+00	7.29E-02	8.30E-02	0.00E+00	6.85E-02	6.01E-02	7.29E-02	8.30E-02	0.00E+00
C3-R	6.85E-02	0.00E+00	7.29E-02	8.30E-02	0.00E+00	6.85E-02	6.01E-02	7.29E-02	8.30E-02	0.00E+00
C4-L	3.12E-02	1.29E-01	5.57E-02	1.67E-02	2.57E-01	3.12E-02	6.85E-02	5.57E-02	1.67E-02	2.57E-01
C4-R	3.12E-02	1.29E-01	5.57E-02	1.67E-02	6.43E-04	3.12E-02	6.85E-02	5.57E-02	1.67E-02	6.43E-04
C5-L	1.83E-05	0.00E+00	2.79E-05	2.27E-05	0.00E+00	1.83E-05	2.25E-05	2.79E-05	2.27E-05	0.00E+00
C5-R	1.83E-05	0.00E+00	2.79E-05	2.27E-05	0.00E+00	1.83E-05	2.25E-05	2.79E-05	2.27E-05	0.00E+00
C6-L	8.35E-06	4.82E-05	2.13E-05	4.56E-06	9.62E-05	8.36E-06	2.57E-05	2.13E-05	4.56E-06	9.62E-05
C6-R	8.35E-06	4.82E-05	2.13E-05	4.56E-06	2.41E-07	8.36E-06	2.57E-05	2.13E-05	4.56E-06	2.41E-07
D1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	2.22E-05	1.48E-07	1.80E-07	2.69E-05	2.01E-07	2.22E-05	1.48E-07	1.78E-07	2.69E-05	2.01E-07
D2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	1.46E-05	2.12E-07	1.81E-07	9.85E-06	2.89E-07	1.46E-05	2.12E-07	1.79E-07	9.85E-06	2.89E-07
D3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	3.04E-07	2.04E-09	8.93E-10	1.33E-07	2.04E-09	3.05E-07	2.04E-09	8.92E-10	1.33E-07	2.04E-09
D4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	2.00E-07	2.92E-09	8.99E-10	4.88E-08	2.92E-09	2.00E-07	2.92E-09	8.98E-10	4.88E-08	2.92E-09
E1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	4.09E-04	2.22E-04	4.45E-04	4.09E-04	2.22E-04	4.09E-04	4.45E-04	4.45E-04	4.09E-04	2.22E-04
E2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	0.00E+00	2.23E-04	0.00E+00	0.00E+00	2.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-04
E3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	3.09E-04	1.54E-04	3.09E-04	3.09E-04	1.54E-04	3.09E-04	3.09E-04	3.09E-04	3.09E-04	1.54E-04
E4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	0.00E+00	1.55E-04	0.00E+00	0.00E+00	1.55E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-04
E5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	2.59E-06	1.54E-06	1.12E-06	9.37E-07	1.54E-06	2.59E-06	3.09E-06	1.12E-06	9.37E-07	1.54E-06
E6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	0.00E+00	1.55E-06	0.00E+00	0.00E+00	1.55E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-06
NCF	9.27E-02	5.68E-02	5.40E-02	8.80E-02	5.39E-02	9.27E-02	5.68E-02	5.40E-02	8.80E-02	5.39E-02
NCFA	3.53E-01	3.35E-01	3.18E-01	3.35E-01	3.18E-01	3.53E-01	3.35E-01	3.18E-01	3.35E-01	3.18E-01
NCFB	1.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NEG	5.04E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	IIIC	IIID	IIIG	IIIH	IVC	IVD	IVE	IVF	IVH	VA	VB
A1	1.27E-02	1.69E-02	1.26E-02	2.47E-02	1.27E-02	1.69E-02	3.00E-02	3.01E-02	2.47E-02	2.05E-02	1.54E-02
A2	5.81E-03	1.93E-02	5.73E-03	2.82E-02	5.81E-03	1.93E-02	2.29E-02	6.05E-03	2.82E-02	1.57E-02	3.10E-03
B1	5.78E-02	3.99E-04	4.34E-02	3.99E-04	5.78E-02	3.99E-04	1.05E-03	7.02E-02	5.20E-04	4.83E-04	7.01E-02
B2-L	1.32E-02	2.27E-04	9.89E-03	2.27E-04	1.32E-02	2.27E-04	4.02E-04	7.05E-03	5.91E-04	1.85E-04	7.04E-03
B2-R	1.32E-02	2.27E-04	9.89E-03	2.27E-04	1.32E-02	2.27E-04	4.02E-04	7.05E-03	1.48E-06	1.85E-04	7.04E-03
B3-L	1.99E-02	0.00E+00	1.49E-02	0.00E+00	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02
B3-R	1.99E-02	0.00E+00	1.49E-02	0.00E+00	1.99E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02
B4-L	9.05E-03	0.00E+00	6.79E-03	0.00E+00	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03
B4-R	9.05E-03	0.00E+00	6.79E-03	0.00E+00	9.05E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03
B5-L	1.79E-05	1.22E-07	1.34E-05	1.22E-07	1.49E-05	1.02E-07	1.42E-07	1.85E-05	2.03E-07	0.00E+00	0.00E+00
B5-R	1.79E-05	1.22E-07	1.34E-05	1.22E-07	1.49E-05	1.02E-07	1.42E-07	1.85E-05	5.10E-10	0.00E+00	0.00E+00
B6-L	8.14E-06	1.39E-07	6.11E-06	1.39E-07	6.81E-06	1.16E-07	1.08E-07	3.71E-06	2.32E-07	0.00E+00	0.00E+00
B6-R	8.14E-06	1.39E-07	6.11E-06	1.39E-07	6.81E-06	1.16E-07	1.08E-07	3.71E-06	5.81E-10	0.00E+00	0.00E+00
C1-L	6.66E-02	7.32E-02	6.66E-02	7.39E-02	6.66E-02	7.32E-02	6.75E-02	8.26E-02	0.00E+00	0.00E+00	8.07E-02
C1-R	6.66E-02	7.32E-02	6.66E-02	7.39E-02	6.66E-02	7.32E-02	6.75E-02	8.26E-02	0.00E+00	0.00E+00	8.07E-02
C2-L	3.03E-02	8.34E-02	3.03E-02	8.41E-02	3.03E-02	8.34E-02	5.16E-02	1.66E-02	3.15E-01	1.57E-01	1.62E-02
C2-R	3.03E-02	8.34E-02	3.03E-02	8.41E-02	3.03E-02	8.34E-02	5.16E-02	1.66E-02	7.89E-04	1.57E-01	1.62E-02
C3-L	6.84E-02	6.01E-02	6.84E-02	6.01E-02	6.85E-02	6.01E-02	7.29E-02	8.30E-02	0.00E+00	0.00E+00	8.30E-02
C3-R	6.84E-02	6.01E-02	6.84E-02	6.01E-02	6.85E-02	6.01E-02	7.29E-02	8.30E-02	0.00E+00	0.00E+00	8.30E-02
C4-L	3.12E-02	6.85E-02	3.12E-02	6.85E-02	3.12E-02	6.85E-02	5.57E-02	1.67E-02	2.57E-01	1.29E-01	1.67E-02
C4-R	3.12E-02	6.85E-02	3.12E-02	6.85E-02	3.12E-02	6.85E-02	5.57E-02	1.67E-02	6.43E-04	1.29E-01	1.67E-02
C5-L	2.19E-05	4.34E-05	2.19E-05	2.70E-05	1.83E-05	2.25E-05	2.82E-05	2.27E-05	0.00E+00	0.00E+00	0.00E+00
C5-R	2.19E-05	4.34E-05	2.19E-05	2.70E-05	1.83E-05	2.25E-05	2.82E-05	2.27E-05	0.00E+00	0.00E+00	0.00E+00
C6-L	1.00E-05	1.43E-05	1.00E-05	3.07E-05	8.36E-06	2.57E-05	2.15E-05	4.56E-06	9.62E-05	0.00E+00	0.00E+00
C6-R	1.00E-05	1.43E-05	1.00E-05	3.07E-05	8.36E-06	2.57E-05	2.15E-05	4.56E-06	2.41E-07	0.00E+00	0.00E+00
D1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	2.22E-05	1.48E-07	2.22E-05	1.47E-07	2.22E-05	1.47E-07	4.00E-07	2.69E-05	2.01E-07	1.78E-07	2.69E-05
D2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	1.46E-05	2.12E-07	1.46E-05	2.10E-07	1.46E-05	2.10E-07	4.02E-07	9.85E-06	2.89E-07	1.79E-07	9.85E-06
D3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	4.26E-07	2.44E-09	3.64E-07	2.44E-09	3.05E-07	2.04E-09	1.08E-10	1.33E-07	2.04E-09	0.00E+00	0.00E+00
D4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	1.77E-07	3.49E-09	2.39E-07	3.49E-09	2.00E-07	2.92E-09	1.08E-10	4.88E-08	2.92E-09	0.00E+00	0.00E+00
E1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	4.09E-04	4.45E-04	4.09E-04	4.45E-04	4.09E-04	4.45E-04	4.45E-04	4.09E-04	2.22E-04	2.22E-04	4.09E-04
E2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-04	2.23E-04	0.00E+00
E3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	3.09E-04	3.09E-04	3.09E-04	3.09E-04	3.09E-04	3.09E-04	3.09E-04	3.09E-04	1.54E-04	1.54E-04	3.09E-04
E4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-04	1.55E-04	0.00E+00
E5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	3.10E-06	3.70E-06	3.10E-06	3.70E-06	2.59E-06	3.09E-06	1.20E-07	9.37E-07	1.54E-06	0.00E+00	0.00E+00
E6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-06	0.00E+00	0.00E+00
NCF	9.26E-02	5.68E-02	9.27E-02	5.40E-02	9.27E-02	5.68E-02	1.31E-01	8.80E-02	5.39E-02	5.68E-02	9.27E-02
NCFA	3.53E-01	3.35E-01	3.53E-01	3.18E-01	3.53E-01	3.35E-01	3.18E-01	3.35E-01	3.18E-01	3.35E-01	3.53E-01
NCFB	1.42E-04	0.00E+00	3.56E-02	0.00E+00	1.42E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-04
NEG	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	VD	VE	VF	VH	VIA	VIB	VID	VIE	VIF	VIH
A1	1.69E-02	3.00E-02	3.01E-02	2.47E-02	2.05E-02	1.54E-02	1.69E-02	3.00E-02	3.01E-02	2.47E-02
A2	1.93E-02	2.29E-02	6.05E-03	2.82E-02	1.57E-02	3.10E-03	1.93E-02	2.29E-02	6.05E-03	2.82E-02
B1	3.99E-04	4.83E-04	7.02E-02	3.99E-04	4.83E-04	7.01E-02	5.20E-04	4.83E-04	7.02E-02	5.21E-04
B2-L	2.27E-04	1.85E-04	7.05E-03	2.27E-04	1.85E-04	7.04E-03	5.91E-04	1.85E-04	7.05E-03	5.92E-04
B2-R	2.27E-04	1.85E-04	7.05E-03	2.27E-04	1.85E-04	7.04E-03	1.48E-06	1.85E-04	7.05E-03	1.48E-06
B3-L	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00
B3-R	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	2.41E-02	0.00E+00
B4-L	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00
B4-R	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00	0.00E+00	4.84E-03	0.00E+00
B5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1-L	0.00E+00	8.95E-02	8.26E-02	0.00E+00	0.00E+00	8.07E-02	0.00E+00	8.95E-02	8.26E-02	0.00E+00
C1-R	0.00E+00	8.95E-02	8.26E-02	0.00E+00	0.00E+00	8.07E-02	0.00E+00	8.95E-02	8.26E-02	0.00E+00
C2-L	1.57E-01	6.85E-02	1.66E-02	1.58E-01	1.57E-01	1.62E-02	3.12E-01	6.85E-02	1.66E-02	3.15E-01
C2-R	1.57E-01	6.85E-02	1.66E-02	1.58E-01	1.57E-01	1.62E-02	7.82E-04	6.85E-02	1.66E-02	7.89E-04
C3-L	0.00E+00	7.29E-02	8.30E-02	0.00E+00	0.00E+00	8.30E-02	0.00E+00	7.29E-02	8.30E-02	0.00E+00
C3-R	0.00E+00	7.29E-02	8.30E-02	0.00E+00	0.00E+00	8.30E-02	0.00E+00	7.29E-02	8.30E-02	0.00E+00
C4-L	1.29E-01	5.57E-02	1.67E-02	1.29E-01	1.29E-01	1.67E-02	2.57E-01	5.57E-02	1.67E-02	2.57E-01
C4-R	1.29E-01	5.57E-02	1.67E-02	1.29E-01	1.29E-01	1.67E-02	6.43E-04	5.57E-02	1.67E-02	6.43E-04
C5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	1.80E-07	1.78E-07	2.69E-05	1.78E-07	1.78E-07	2.69E-05	2.01E-07	1.78E-07	2.69E-05	2.04E-07
D2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	1.81E-07	1.79E-07	9.85E-06	1.79E-07	1.79E-07	9.85E-06	2.89E-07	1.79E-07	9.85E-06	2.92E-07
D3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	2.22E-04	4.45E-04	4.09E-04	4.45E-04	2.22E-04	4.09E-04	2.22E-04	4.45E-04	4.09E-04	2.22E-04
E2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	2.23E-04	0.00E+00	0.00E+00	0.00E+00	2.23E-04	0.00E+00	2.23E-04	0.00E+00	0.00E+00	2.23E-04
E3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	1.54E-04	3.09E-04	3.09E-04	1.54E-04	1.54E-04	3.09E-04	1.54E-04	3.09E-04	3.09E-04	1.54E-04
E4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	1.55E-04	0.00E+00	0.00E+00	1.55E-04	1.55E-04	0.00E+00	1.55E-04	0.00E+00	0.00E+00	1.55E-04
E5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NCF	5.68E-02	5.40E-02	8.80E-02	5.40E-02	5.68E-02	9.27E-02	5.68E-02	5.40E-02	8.80E-02	5.39E-02
NCFA	3.35E-01	3.18E-01	3.35E-01	3.18E-01	3.35E-01	3.53E-01	3.35E-01	3.18E-01	3.35E-01	3.18E-01
NCFB	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NEG	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table (7):
CET Release Category Frequencies for All Considered PDSs

	IC	ID	IE	IF	IH	IIC	IID	IIE	IIF	IIH	IIIC	IIID	IIIG	IIIH	IVC
A1	2.67E-08	2.60E-11	2.86E-11	1.75E-10	5.80E-09	7.66E-10	1.05E-09	2.36E-08	6.05E-12	1.79E-09	7.85E-08	3.73E-10	6.54E-10	1.11E-09	3.80E-10
A2	1.22E-08	2.97E-11	2.18E-11	3.52E-11	6.63E-09	3.50E-10	1.20E-09	1.80E-08	1.22E-12	2.05E-09	3.59E-08	4.27E-10	2.97E-10	1.27E-09	1.74E-10
B1	1.21E-07	6.14E-13	4.62E-13	4.08E-10	1.22E-10	3.49E-09	2.47E-11	3.80E-10	1.41E-11	3.78E-11	3.57E-07	8.82E-12	2.25E-09	1.79E-11	1.73E-09
B2-L	2.77E-08	3.50E-13	1.76E-13	4.10E-11	1.39E-10	7.96E-10	1.41E-11	1.46E-10	1.42E-12	4.29E-11	8.16E-08	5.02E-12	5.13E-10	1.02E-11	3.95E-10
B2-R	2.77E-08	3.50E-13	1.76E-13	4.10E-11	3.48E-13	7.96E-10	1.41E-11	1.46E-10	1.42E-12	1.07E-13	8.16E-08	5.02E-12	5.13E-10	1.02E-11	3.95E-10
B3-L	4.18E-08	0.00E+00	0.00E+00	1.40E-10	0.00E+00	1.20E-09	0.00E+00	0.00E+00	4.84E-12	0.00E+00	1.23E-07	0.00E+00	7.73E-10	0.00E+00	5.95E-10
B3-R	4.18E-08	0.00E+00	0.00E+00	1.40E-10	0.00E+00	1.20E-09	0.00E+00	0.00E+00	4.84E-12	0.00E+00	1.23E-07	0.00E+00	7.73E-10	0.00E+00	5.95E-10
B4-L	1.90E-08	0.00E+00	0.00E+00	2.81E-11	0.00E+00	5.46E-10	0.00E+00	0.00E+00	9.73E-13	0.00E+00	5.59E-08	0.00E+00	3.52E-10	0.00E+00	2.71E-10
B4-R	1.90E-08	0.00E+00	0.00E+00	2.81E-11	0.00E+00	5.46E-10	0.00E+00	0.00E+00	9.73E-13	0.00E+00	5.59E-08	0.00E+00	3.52E-10	0.00E+00	2.71E-10
B5-L	3.13E-11	1.57E-16	1.20E-16	1.07E-13	4.77E-14	8.98E-13	6.32E-15	9.92E-14	3.72E-15	1.47E-14	1.11E-10	2.70E-15	6.95E-13	5.48E-15	4.46E-13
B5-R	3.13E-11	1.57E-16	1.20E-16	1.07E-13	1.20E-16	8.98E-13	6.32E-15	9.92E-14	3.72E-15	3.70E-17	1.11E-10	2.70E-15	6.95E-13	5.48E-15	4.46E-13
B6-L	1.43E-11	1.79E-16	9.20E-17	2.16E-14	5.45E-14	4.11E-13	7.19E-15	7.59E-14	7.46E-16	1.68E-14	5.03E-11	3.07E-15	3.17E-13	6.24E-15	2.04E-13
B6-R	1.43E-11	1.79E-16	9.20E-17	2.16E-14	1.37E-16	4.11E-13	7.19E-15	7.59E-14	7.46E-16	4.22E-17	5.03E-11	3.07E-15	3.17E-13	6.24E-15	2.04E-13
C1-L	1.40E-07	0.00E+00	8.54E-11	4.80E-10	0.00E+00	4.02E-09	4.54E-09	7.04E-08	1.66E-11	0.00E+00	4.12E-07	1.62E-09	3.46E-09	3.32E-09	1.99E-09
C1-R	1.40E-07	0.00E+00	8.54E-11	4.80E-10	0.00E+00	4.02E-09	4.54E-09	7.04E-08	1.66E-11	0.00E+00	4.12E-07	1.62E-09	3.46E-09	3.32E-09	1.99E-09
C2-L	6.36E-08	2.42E-10	6.53E-11	9.64E-11	7.40E-08	1.83E-09	5.17E-09	5.38E-08	3.34E-12	2.29E-08	1.87E-07	1.84E-09	1.57E-09	3.78E-09	9.06E-10
C2-R	6.36E-08	2.42E-10	6.53E-11	9.64E-11	1.85E-10	1.83E-09	5.17E-09	5.38E-08	3.34E-12	5.73E-11	1.87E-07	1.84E-09	1.57E-09	3.78E-09	9.06E-10
C3-L	1.44E-07	0.00E+00	6.95E-11	4.82E-10	0.00E+00	4.13E-09	3.73E-09	5.74E-08	1.67E-11	0.00E+00	4.23E-07	1.33E-09	3.55E-09	2.70E-09	2.05E-09
C3-R	1.44E-07	0.00E+00	6.95E-11	4.82E-10	0.00E+00	4.13E-09	3.73E-09	5.74E-08	1.67E-11	0.00E+00	4.23E-07	1.33E-09	3.55E-09	2.70E-09	2.05E-09
C4-L	6.55E-08	1.99E-10	5.31E-11	9.70E-11	6.04E-08	1.88E-09	4.25E-09	4.38E-08	3.36E-12	1.87E-08	1.93E-07	1.51E-09	1.62E-09	3.08E-09	9.33E-10
C4-R	6.55E-08	1.99E-10	5.31E-11	9.70E-11	1.51E-10	1.88E-09	4.25E-09	4.38E-08	3.36E-12	4.67E-11	1.93E-07	1.51E-09	1.62E-09	3.08E-09	9.33E-10
C5-L	3.84E-11	0.00E+00	2.66E-14	1.32E-13	0.00E+00	1.10E-12	1.40E-12	2.20E-11	4.56E-15	0.00E+00	1.35E-10	9.59E-13	1.14E-12	1.21E-12	5.47E-13
C5-R	3.84E-11	0.00E+00	2.66E-14	1.32E-13	0.00E+00	1.10E-12	1.40E-12	2.20E-11	4.56E-15	0.00E+00	1.35E-10	9.59E-13	1.14E-12	1.21E-12	5.47E-13
C6-L	1.75E-11	7.42E-14	2.03E-14	2.65E-14	2.26E-11	5.04E-13	1.59E-12	1.68E-11	9.17E-16	6.98E-12	6.18E-11	3.16E-13	5.19E-13	1.38E-12	2.50E-13
C6-R	1.75E-11	7.42E-14	2.03E-14	2.65E-14	5.66E-14	5.04E-13	1.59E-12	1.68E-11	9.17E-16	1.75E-14	6.18E-11	3.16E-13	5.19E-13	1.38E-12	2.50E-13
D1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	4.66E-11	2.28E-16	1.72E-16	1.56E-13	4.72E-14	1.34E-12	9.18E-15	1.40E-13	5.41E-15	1.46E-14	1.37E-10	3.27E-15	1.15E-12	6.60E-15	6.64E-13
D2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	3.07E-11	3.26E-16	1.73E-16	5.72E-14	6.79E-14	8.80E-13	1.31E-14	1.41E-13	1.98E-15	2.10E-14	9.02E-11	4.69E-15	7.58E-13	9.43E-15	4.37E-13
D3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	6.38E-13	3.14E-18	8.52E-19	7.73E-16	4.79E-16	1.84E-14	1.26E-16	7.02E-16	2.67E-17	1.48E-16	2.63E-12	5.39E-17	1.89E-14	1.10E-16	9.12E-15
D4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	4.20E-13	4.50E-18	8.58E-19	2.84E-16	6.86E-16	1.21E-14	1.81E-16	7.07E-16	9.81E-18	2.12E-16	1.09E-12	7.71E-17	1.24E-14	1.57E-16	5.98E-15
E1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	8.59E-10	3.42E-13	4.25E-13	2.38E-12	5.22E-11	2.47E-11	2.76E-11	3.50E-10	8.22E-14	1.61E-11	2.53E-09	9.83E-12	2.12E-11	2.00E-11	1.22E-11
E2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	0.00E+00	3.43E-13	0.00E+00	0.00E+00	5.24E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	6.49E-10	2.37E-13	2.95E-13	1.80E-12	3.62E-11	1.86E-11	1.92E-11	2.43E-10	6.21E-14	1.12E-11	1.91E-09	6.83E-12	1.60E-11	1.39E-11	9.24E-12
E4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	0.00E+00	2.39E-13	0.00E+00	0.00E+00	3.64E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	5.44E-12	2.37E-15	1.07E-15	5.44E-15	3.62E-13	1.56E-13	1.92E-13	8.81E-13	1.88E-16	1.12E-13	1.92E-11	8.18E-14	1.61E-13	1.66E-13	7.74E-14
E6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	0.00E+00	2.39E-15	0.00E+00	0.00E+00	3.64E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NCF	1.95E-07	8.75E-11	5.15E-11	5.11E-10	1.27E-08	5.59E-09	3.52E-09	4.25E-08	1.77E-11	3.91E-09	5.72E-07	1.26E-09	4.81E-09	2.42E-09	2.77E-09
NCFA	7.41E-07	5.16E-10	3.03E-10	1.95E-09	7.47E-08	2.13E-08	2.08E-08	2.50E-07	6.73E-11	2.31E-08	2.18E-06	7.40E-09	1.83E-08	1.43E-08	1.06E-08
NCFB	3.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.56E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.78E-10	0.00E+00	1.85E-09	0.00E+00	4.25E-12
NEG	1.06E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	IVD	IVE	IVF	IVH	VA	VB	VD	VE	VF	VH	VIA	VIB	VID	VIE	VIF	VIH
A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-10	4.07E-08	2.15E-10	2.86E-11	2.40E-10	2.84E-09	2.13E-08	3.76E-08	2.74E-10	3.42E-09	4.85E-10	4.05E-10
A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-10	8.18E-09	2.45E-10	2.18E-11	4.83E-11	3.24E-09	1.63E-08	7.56E-09	3.13E-10	2.61E-09	9.74E-11	4.62E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.55E-12	1.85E-07	5.07E-12	4.61E-13	5.60E-10	4.59E-11	5.02E-10	1.71E-07	8.42E-12	5.51E-11	1.13E-09	8.54E-12
B2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-12	1.86E-08	2.88E-12	1.76E-13	5.63E-11	2.61E-11	1.92E-10	1.72E-08	9.57E-12	2.11E-11	1.14E-10	9.71E-12
B2-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-12	1.86E-08	2.88E-12	1.76E-13	5.63E-11	2.61E-11	1.92E-10	1.72E-08	2.40E-14	2.11E-11	1.14E-10	2.43E-14
B3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.36E-08	0.00E+00	0.00E+00	1.92E-10	0.00E+00	0.00E+00	5.88E-08	0.00E+00	0.00E+00	3.88E-10	0.00E+00
B3-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.36E-08	0.00E+00	0.00E+00	1.92E-10	0.00E+00	0.00E+00	5.88E-08	0.00E+00	0.00E+00	3.88E-10	0.00E+00
B4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-08	0.00E+00	0.00E+00	3.86E-11	0.00E+00	0.00E+00	1.18E-08	0.00E+00	0.00E+00	7.79E-11	0.00E+00
B4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-08	0.00E+00	0.00E+00	3.86E-11	0.00E+00	0.00E+00	1.18E-08	0.00E+00	0.00E+00	7.79E-11	0.00E+00
B5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-07	0.00E+00	8.54E-11	6.59E-10	0.00E+00	0.00E+00	1.97E-07	0.00E+00	1.02E-08	1.33E-09	0.00E+00
C1-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-07	0.00E+00	8.54E-11	6.59E-10	0.00E+00	0.00E+00	1.97E-07	0.00E+00	1.02E-08	1.33E-09	0.00E+00
C2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-09	4.28E-08	1.99E-09	6.53E-11	1.32E-10	1.82E-08	1.63E-07	3.95E-08	5.05E-09	7.81E-09	2.67E-10	5.17E-09
C2-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-09	4.28E-08	1.99E-09	6.53E-11	1.32E-10	1.82E-08	1.63E-07	3.95E-08	1.27E-11	7.81E-09	2.67E-10	1.29E-11
C3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-07	0.00E+00	6.95E-11	6.62E-10	0.00E+00	0.00E+00	2.03E-07	0.00E+00	8.31E-09	1.34E-09	0.00E+00
C3-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-07	0.00E+00	6.95E-11	6.62E-10	0.00E+00	0.00E+00	2.03E-07	0.00E+00	8.31E-09	1.34E-09	0.00E+00
C4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.48E-10	4.41E-08	1.64E-09	5.31E-11	1.33E-10	1.48E-08	1.34E-07	4.07E-08	4.16E-09	6.35E-09	2.69E-10	4.21E-09
C4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.48E-10	4.41E-08	1.64E-09	5.31E-11	1.33E-10	1.48E-08	1.34E-07	4.07E-08	1.04E-11	6.35E-09	2.69E-10	1.05E-11
C5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-15	7.10E-11	2.29E-15	1.70E-16	2.15E-13	2.05E-14	1.85E-13	6.56E-11	3.26E-15	2.03E-14	4.33E-13	3.35E-15
D2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-15	2.60E-11	2.30E-15	1.71E-16	7.86E-14	2.06E-14	1.86E-13	2.40E-11	4.68E-15	2.04E-14	1.59E-13	4.79E-15
D3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.63E-12	1.08E-09	2.82E-12	4.25E-13	3.26E-12	5.12E-11	2.31E-10	9.98E-10	3.60E-12	5.07E-11	6.58E-12	3.64E-12
E2-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-12	0.00E+00	2.83E-12	0.00E+00	0.00E+00	0.00E+00	2.32E-10	0.00E+00	3.61E-12	0.00E+00	0.00E+00	3.66E-12
E3-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-12	8.16E-10	1.96E-12	2.95E-13	2.47E-12	1.77E-11	1.60E-10	7.54E-10	2.49E-12	3.52E-11	4.97E-12	2.53E-12
E4-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-12	0.00E+00	1.97E-12	0.00E+00	0.00E+00	1.78E-11	1.61E-10	0.00E+00	2.51E-12	0.00E+00	0.00E+00	2.54E-12
E5-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NCF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.17E-10	2.45E-07	7.21E-10	5.15E-11	7.02E-10	6.21E-09	5.91E-08	2.26E-07	9.20E-10	6.16E-09	1.42E-09	8.84E-10
NCFA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.46E-09	9.32E-07	4.25E-09	3.03E-10	2.67E-09	3.66E-08	3.48E-07	8.61E-07	5.43E-09	3.63E-08	5.39E-09	5.22E-09
NCFB	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.75E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NEG	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

i) c. Some basic event probabilities were altered for the update based on information discussed below.

1. Reference [6], based on the results and methods of References [7] and [8], has two findings regarding Direct Containment Heating (DCH) challenges to containment.

   a. Analyses indicate that natural circulation processes will result in hot leg or surge line failure long before melt relocation to the lower plenum and bottom head failure. These natural circulation processes will lead to spontaneous and complete depressurization of the RCS for core melt accidents that involve no operator intervention. There will be no DCH challenges for these circumstances.

   b. Recovery operations without depressurization could have various consequences. However, bounding analyses for such "splinter sequences" of loads versus containment strength using plant-specific information showed that all Westinghouse plants have a conditional containment failure frequency of less than 0.01. For Surry, Turkey Point, and most other Westinghouse plants, there is no intersection of the loads from DCH with the mean (best estimate) containment fragility curve. For Turkey Point, the largest predicted pressure is 0.713 MPa at a 99% probability. A containment failure pressure of 0.915 MPa at a probability of 1% is used. The Conditional Containment Failure Probability (CCFP) is given as zero (0), and this is stated to be less than 0.001.

   The probability of DCH-induced containment failure should be set at zero, or at most 1.0E-04, for a high or medium pressure sequence, because of hot leg/surge line failure causing early depressurization.

2. The SERG-2 group majority conclusion was that alpha-mode failure was a very low probability event and therefore resolved from a "risk perspective" to be of little or no significance to the overall risk. Theofanous (Ref. [9]) concluded that it is physically unreasonable for this alpha failure to occur with a frequency greater than 1.0E-04 per core melt.

   The probability of an alpha mode failure was set at zero, or at most 1.0E-04.

3. Reference [10] addresses the question of an induced SGTR for high-pressure melt sequences. For high-pressure sequences without operator intervention, analyses uniformly predict failure of some portion of the RCS pressure boundary before the formation of an in-core molten pool. In a typical SCDAP/RELAP5 analysis for Surry, the first formation of an in-core molten pool did not occur for roughly 70 minutes after the prediction of surge line failure. This is generally consistent with the earlier DCH–related analyses referred to above, performed at high pressure, which indicated the onset of the significant fuel melting after the heatup and failure of loop piping. However, the calculations indicate that a pressure or temperature-induced SGTR rupture may occur before a surge line or hot leg failure.

A representative analysis of Surry gives a base case containment bypass frequency of 3.9E-06/Yr for high reactor coolant system pressure with a dry secondary. This is based on a frequency of 1.6E-05/Yr for core damage with high RCS pressure and dry steam generators. The conditional containment bypass probability for the base case is 0.25.

The probability of an induced steam generator tube rupture for a high RCS pressure core melt sequence without operator intervention was set at 0.25. This assumes that Turkey Point thermal hydraulics resemble Surry during core melt. Pump seal LOCAs are to be included in this treatment.

PRSGOK = 0.75

4. The probability of the Rocket Failure Mode was set at zero, or at most 1.0E-04, for a high or medium RCS pressure sequence, because of hot leg/surge line failure causing early depressurization.

PRROCKET = 0.

CONCLUSION

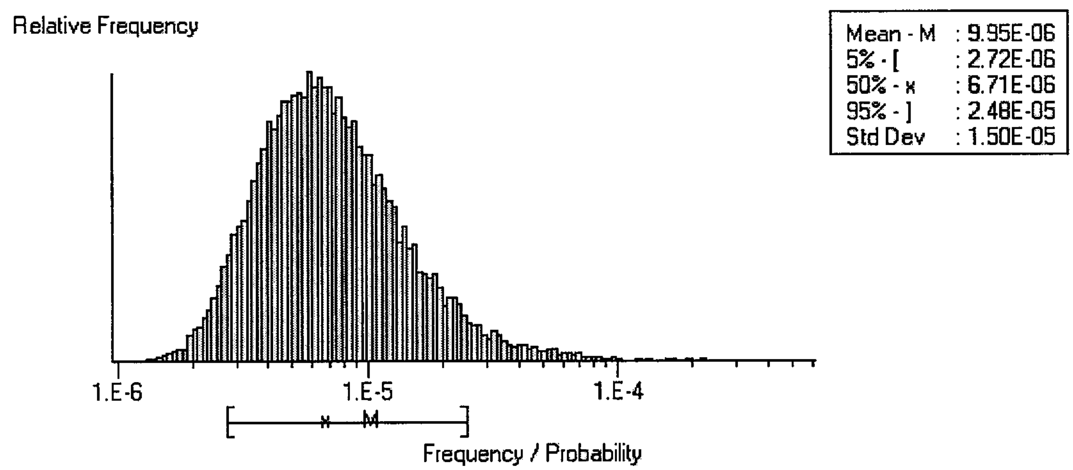
All changes to the assumptions as listed above are reasonable based on the references and justifications provided above.

QUESTION 7

Please provide the uncertainty range associated with the internal events CDF for the base-case PRA. Please show the impact of considering the uncertainties in the estimated CDF on the current SAMA cost-benefit conclusions. If the uncertainties in estimated CDF are not available, please determine the qualitative risk impact by considering the impact of uncertainty ranges as reported in typical level-1 PRA (e.g., NUREG-1150), on the estimated risk results.

Response to QUESTION 7:

In 2000, an update of the Turkey Point PSA was performed. A plot of the uncertainty distribution of the latest internal events CDF is shown below.



The 95th percentile associated with this distribution is 2.48E-05/Yr. The SAMA baseline CDF of 1.62E-05/Yr corresponds to the 88th percentile of the latest CDF distribution. Other factors that offset the higher CDF associated with higher failure rates include modeling uncertainties and cost estimates. For example, additional credit for severe accident guidance could have been taken to reduce the likelihood of containment failure and fission product release. Plant specific implementation of SAMA candidates may be complicated by space limitations, outage cost, regulatory requirements, seismic, fire and other considerations. These factors overestimate the benefit or underestimate the cost. It is concluded that the effect of considering these uncertainties associated with the SAMA cost-benefit estimate would, in effect, offset the uncertainties associated with the CDF estimates, thus making the conclusions robust. No SAMA candidates are considered cost-beneficial even when a higher-confidence CDF is used.

QUESTION 8:

On Page F.1-6 of Reference [1], it is stated that, "For all modes the RU, LA, CE, and BA fractions of the usual MACCS2 species are set to zero, as they were not reported in the Individual Plant Examination (IPE) submittal." Please perform a sensitivity calculation for several risk dominant release modes (e.g., based on the frequencies listed in Table F.1-2, and the consequences in Tables F.1-4 and F.1-5, the late containment failure release classes C4-L and C4-R appear to be among the risk dominant release modes for the base case analyses; however, other release modes that also have a major contribution to the total base case risk should be included also), by allowing for appropriate releases for these refractory species consistent with similar release categories in Surry NUREG-1150 or other published studies (e.g., Table 4.7-2 of Reference [2] provides examples of several applicable source term studies that contain releases for more complete set of radionuclide groups), to demonstrate that the risk impacts justify this assumption in Reference [1].

Response to QUESTION 8:

Similar release categories for the Surry plant evaluation given in NUREG-1150 were reviewed and examined for applicability in Turkey Point model release fractions of Ru, La, Ce, and Ba. The review indicated that the release fractions for these radionuclides are small and are more important for more likely scenarios associated with slow SBO, event V, and SGTRs Groups. Further, for these more likely bins, the release fractions range between {0.0E-00 – 7.5E-13}, {1.4E-02 – 7.8E-05}, and {0.0E-00 – 9.3E-10}, respectively in each considered group. A bounding sensitivity study was made assuming a release fraction of 1.0E-03 of these radionuclides in each considered group. Fractions of these radionuclides in other release modes are considered negligible (e.g., either 0.0E-00 or lower than 1.0E-12). Table (8) below provides a listing of radionuclide release fractions used for this sensitivity analysis. The shaded values are those varied in the sensitivity analysis. Table (9) provides the respective cost benefits. A review of the results indicates small differences with the baseline, and thus the conclusions do not change.

Table (8):
Radionuclide Release Fractions

Mode	XE/KR	I	CS	TE	SR	Ru	La	Ce	Ba
A1	9.50E-01	2.58E-05	2.57E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A2	9.50E-01	7.80E-02	7.80E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	9.50E-01	8.87E-04	4.88E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2-L	9.50E-01	9.24E-02	9.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2-R	9.50E-01	1.96E-01	2.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3-L	9.50E-01	8.87E-04	4.88E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3-R	9.50E-01	2.22E-03	1.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4-L	9.50E-01	9.24E-02	9.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4-R	9.50E-01	2.31E-01	2.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5-L	9.50E-01	1.33E-03	9.36E-04	0.00E+00	8.71E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5-R	9.50E-01	3.34E-03	2.34E-03	0.00E+00	4.36E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-L	9.50E-01	6.45E-02	6.40E-02	0.00E+00	2.64E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-R	9.50E-01	1.61E-01	9.12E-02	0.00E+00	1.32E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BP-V	1.00E+00	7.84E-01	7.84E-01	9.22E-04	1.46E-02	1.00E-03	1.00E-03	1.00E-03	1.00E-03
BP-SGTR	2.87E-01	1.20E-02	1.20E-02	0.00E+00	1.86E-05	1.00E-03	1.00E-03	1.00E-03	1.00E-03
C1-L	9.50E-01	8.87E-04	4.88E-04	1.58E-06	6.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1-R	9.50E-01	2.22E-03	1.22E-03	3.96E-06	3.30E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2-L	9.50E-01	9.24E-02	9.20E-02	1.58E-03	6.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2-R	9.50E-01	2.31E-01	2.30E-01	3.96E-03	3.30E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3-L	9.50E-01	8.87E-04	4.88E-04	1.58E-06	6.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3-R	9.50E-01	2.22E-03	1.22E-03	3.96E-06	3.30E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4-L	9.50E-01	9.24E-02	9.20E-02	1.58E-03	6.60E-05	1.00E-03	1.00E-03	1.00E-03	1.00E-03
C4-R	9.50E-01	2.31E-01	2.30E-01	3.96E-03	3.30E-04	1.00E-03	1.00E-03	1.00E-03	1.00E-03
C5-L	9.50E-01	1.33E-03	9.36E-04	1.58E-06	1.53E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C5-R	9.50E-01	3.34E-03	2.34E-03	3.96E-06	7.66E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-L	9.50E-01	6.45E-02	6.40E-02	1.58E-03	3.30E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C6-R	9.50E-01	1.61E-01	1.60E-01	3.96E-03	1.65E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-L	1.00E+00	5.15E-03	4.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D1-R	1.00E+00	1.29E-02	1.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-L	1.00E+00	1.44E-01	1.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D2-R	1.00E+00	3.61E-01	3.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-L	1.00E+00	2.12E-02	2.07E-02	7.44E-02	6.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D3-R	1.00E+00	5.29E-02	5.18E-02	1.86E-01	3.18E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-L	1.00E+00	8.85E-02	8.80E-02	7.44E-02	6.89E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D4-R	1.00E+00	2.21E-01	2.20E-01	1.86E-01	3.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-L	1.00E+00	5.15E-03	4.75E-03	1.58E-03	3.30E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E1-R	1.00E+00	1.29E-02	1.19E-02	3.96E-03	1.65E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-L	1.00E+00	1.44E-01	1.44E-01	4.80E-02	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E2-R	1.00E+00	3.61E-01	3.60E-01	1.20E-01	5.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-L	1.00E+00	5.15E-03	4.75E-03	1.58E-03	3.30E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E3-R	1.00E+00	1.29E-02	1.19E-02	3.96E-03	1.65E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-L	1.00E+00	1.44E-01	1.44E-01	4.80E-02	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E4-R	1.00E+00	3.61E-01	3.60E-01	1.20E-01	5.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-L	1.00E+00	2.12E-02	2.07E-02	7.56E-02	6.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E5-R	1.00E+00	5.29E-02	5.18E-02	1.89E-01	3.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-L	1.00E+00	8.85E-02	8.80E-02	1.11E-01	7.66E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E6-R	1.00E+00	2.21E-01	2.20E-01	2.78E-01	3.83E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table (9):
Cost Benefits Corresponding to Radionuclides Release Fractions Used in Question 8

Case->	Sgcrabp2 (Base Case)	sgcrvlp2	sgfcsf	opercsf	rabcsf	hhddpscf	sealcsf
Total Benefit (Onsite + Repl Pwr + Offsite)	$804,374	$177,851	$76,262	$66,617	$15,317	$130,918	$31,077
Baseline Total Benefit (Onsite + Repl Pwr + Offsite)	$801,546	$176,980	$75,961	$66,464	$15,250	$130,588	$30,903

QUESTION 9

Please list the contribution of each release mode (Table F.1-2), in terms of the percentage of the total annual risk of population dose and offsite economic cost in a tabular format similar to Tables F.1-2 and F.1-4). Also, please list the total annual risk of population dose (i.e., Sieverts per year) and offsite economic cost (i.e., dollars per year). In addition, for each release mode, please provide a table listing the release energy, release duration, the evacuation warning time, assumed shielding factors for buildings/shelters and justifications for these selections.

Response to QUESTION 9:

The Turkey Point Risk Model provided a Baseline Offsite Exposure of 10.88 person-REM/Yr, and a Baseline Offsite Property Damage of $22,850/Yr. These values were based on the Turkey Point Risk Model containment release fractions and the Off-site Dose factors. The offsite dose and property damage values were calculated in a 50-mile radius from the accident. The dose conversion factor associated with each release category was obtained from the MACCS. Table (10) provides the baseline exposures, and baseline offsite property damage values associated with each Containment Event Tree (CET) end-state (E.S.).

Table (10):
Offsite Exposure and Offsite Property Damage

CET E.S.	Base Annual Frequency	Cond'l Pop. Dose Offsite, Sieverts	Dose Conversion Factor	Offsite Economic Cost
A1	2.49E-07	5.46E+01	1.18E+07	$3
A2	1.18E-07	2.48E+04	4.48E+09	$528
B1	8.45E-07	8.46E+02	1.49E+07	$13
B2-L	1.48E-07	2.64E+04	5.11E+09	$754
B2-R	1.47E-07	3.73E+04	9.37E+09	$1,381
B3-L	2.90E-07	8.46E+02	1.49E+07	$4
B3-R	2.90E-07	1.92E+03	5.12E+07	$15
B4-L	1.01E-07	2.64E+04	5.11E+09	$515
B4-R	1.01E-07	3.78E+04	9.38E+09	$946
B5-L	1.44E-10	1.54E+03	2.74E+07	$0
B5-R	1.44E-10	3.28E+03	1.23E+08	$0
B6-L	6.57E-11	2.29E+04	3.84E+09	$0
B6-R	6.56E-11	2.74E+04	5.10E+09	$0
BY_EV V	6.24E-08	4.46E+04	1.27E+10	$792
BY-SGTR	1.71E-08	8.07E+03	7.99E+08	$14
C1-L	1.06E-06	8.46E+02	1.49E+07	$16
C1-R	1.06E-06	1.92E+03	5.12E+07	$54
C2-L	7.02E-07	2.65E+04	5.11E+09	$3,590
C2-R	5.96E-07	3.79E+04	9.38E+09	$5,587
C3-L	1.07E-06	8.46E+02	1.49E+07	$16
C3-R	1.07E-06	1.92E+03	5.12E+07	$55
C4-L	6.46E-07	2.65E+04	5.11E+09	$3,303
C4-R	5.59E-07	3.79E+04	9.38E+09	$5,246
C5-L	2.02E-10	1.54E+03	2.74E+07	$0
C5-R	2.02E-10	3.28E+03	1.23E+08	$0
C6-L	1.30E-10	2.29E+04	3.84E+09	$1
C6-R	1.01E-10	3.27E+04	7.56E+09	$1
D1-L	0.00E+00	5.63E+03	3.18E+08	$0

Table (10):
Offsite Exposure and Offsite Property Damage

CET E.S.	Base Annual Frequency	Cond'l Pop. Dose Offsite, Sieverts	Dose Conversion Factor	Offsite Economic Cost
D1-R	3.25E-10	8.20E+03	8.01E+08	$0
D2-L	0.00E+00	3.04E+04	6.98E+09	$0
D2-R	1.74E-10	2.87E+04	8.78E+09	$2
D3-L	0.00E+00	1.63E+04	1.77E+09	$0
D3-R	3.32E-12	1.89E+04	3.41E+09	$0
D4-L	0.00E+00	2.73E+04	5.23E+09	$0
D4-R	1.55E-12	2.69E+04	7.14E+09	$0
E1-L	0.00E+00	5.70E+03	3.18E+08	$0
E1-R	6.36E-09	8.38E+03	8.02E+08	$5
E2-L	0.00E+00	3.20E+04	6.98E+09	$0
E2-R	3.13E-10	3.05E+04	8.78E+09	$3
E3-L	0.00E+00	5.70E+03	3.18E+08	$0
E3-R	4.73E-09	8.38E+03	8.02E+08	$4
E4-L	0.00E+00	3.20E+04	6.98E+09	$0
E4-R	2.35E-10	3.05E+04	8.78E+09	$2
E5-L	0.00E+00	1.63E+04	1.77E+09	$0
E5-R	2.68E-11	1.89E+04	3.41E+09	$0
E6-L	0.00E+00	2.83E+04	5.26E+09	$0
E6-R	4.79E-13	2.83E+04	7.15E+09	$0

Release input parameters used in Level 3 quantification are defined below and listed in Table (11). They were assigned to each source term according to the "type". Each release plume was assumed to have only one segment. The early rupture and the bypass releases are essentially puff releases and the early leak and late failures are more continuous. The energy of releases was assigned by analogy with similar releases used in NUREG-1150 for Surry.

OALARM	Time after accident initiation when the accident reaches general emergency conditions (as defined in NUREG-0654), or when plant personnel can reliably predict that general emergency conditions will be attained
NUMREL	Number of plume segments that are released
MAXRIS	Selection of risk dominate plume
REFTIM	Reference time for dispersion and radioactive decay
PLHEAT	Heat content of the release segments (w) a value specified for each of the release modes
PLHITE	Height of the plume segments at release (m) a value specified for each of the release modes
PLUDUR	Duration of the plume segments (s) a value specified for each of the release modes
PDELAY	Time of release for each plume (seconds after Reactor Trip) specified for each of the release modes

Table (11):
Release input parameters used in Level 3 Analysis

Mode	OALARM	NUMREL	MAXRIS	REFTIM	PLHEAT	PLHITE	PLUDUR	PDELAY
A1	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
A2	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B1	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B2-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B2-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B3-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B3-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B4-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B4-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B5-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B5-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B6-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
B6-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
BP-V	7.20E+03	1.00E+00	1.00E+00	0.00E+00	1.00E+06	3.00E+01	3.60E+03	2.52E+04
BP-SGTR	3.60E+04	1.00E+00	1.00E+00	0.00E+00	1.00E+06	3.00E+01	1.40E+03	7.20E+04
C1-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C1-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C2-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C2-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C3-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C3-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C4-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C4-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C5-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C5-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C6-L	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
C6-R	1.76E+04	1.00E+00	1.00E+00	5.00E-01	9.20E+05	3.00E+01	5.40E+04	8.64E+04
D1-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
D1-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
D2-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
D2-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
D3-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
D3-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
D4-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
D4-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E1-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E1-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E2-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E2-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E3-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E3-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E4-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E4-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E5-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E5-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04
E6-L	1.11E+04	1.00E+00	1.00E+00	5.00E-01	1.80E+06	3.00E+01	8.64E+04	1.76E+04
E6-R	1.11E+04	1.00E+00	1.00E+00	0.00E+00	2.10E+06	3.00E+01	1.60E+03	1.76E+04

Evacuation Warning Time:

The emergency evacuation model has been modeled as a single evacuation zone extending out 10 miles from the plant. The average evacuation speed is estimated on the order of 35 mph (15.6 meters/s) with a starting time no longer than 30 minutes after the alarm. This is a high value compared to other plants. This estimate was made considering the wide streets in the evacuation area and population reaction. For the purposes of this analysis, an average evacuation speed of 12 meters/s is used with a 5130 second delay between the alarm and start of evacuation, with no sheltering.

A sensitivity analysis was performed where it was assumed that only 95 percent of the people within the emergency-planning zone would participate in the evacuation. The remaining 5 percent were assumed unable or unwilling to evacuate and were assumed to go about their normal activities. It was further assumed in this sensitivity that the evacuation speed was 1.0 m/s and that the evacuation delay time was 7200 seconds. The results were not significantly different on the whole from the complete evacuation case, for the purposes of the SAMA analyses. While the population doses increased and the evacuation costs decreased, the overall population exposure and accident mitigation costs are governed mainly by the long term effects over the whole 50 mile zone, and so the net changes were small, under one percent, which is not considered significant.

Shield Factors for Building/Shelters:

Shield factors for building/shelters were conservatively adopted using NUREG-4551, Page 3-10, as 1, 0.75, and 0.70 for evacuees while moving, normal activity in the sheltering and evacuation zone, and sheltered activity, respectively.

QUESTION 10

Table F.1-2 lists the core inventory for the uprated power of 2300 MW(t) for Turkey Point based on the scaling of the MACCS end-of-cycle inventory for a 3412 MW(t) plant. Please justify (i.e., by providing plant-specific data or ORIGEN or other equivalent plant-specific computer code calculated burn-up results) that the power-scaled standard MACCS core inventory as used in Reference [1] is applicable to the present-day Turkey Point fuel burn-up histories for typical Turkey Point end-of-cycle conditions.

Response to QUESTION 10:

A typical 18-month cycle burn-up associated with Turkey Point was reviewed. At the beginning of the cycle, approximately one-third of the fuel assemblies are fresh fuel, the other one-third are the fuel assemblies with 18-months exposure, and the other one-third with a 36-months exposure. At the beginning of the cycle, the weighted burn-up is approximately 19,000 MWD/MTU. The end-of-cycle weighted burn-up is approximately 35,000 MWD/MTU. Although this may be slightly higher than the 33,000 MWD/MTU that is purportedly associated with the MACCS end-of-cycle inventory for a 3,412 MW(t) plant, the average cycle burn-up is approximately 27,000 MWD/MTU. A comparison of the major core inventory reported in the MACCS end-of-cycle inventory for a 3,412 MW(t) plant was made with that estimated by Westinghouse for the Turkey Point Power Uprate project. A sensitivity study was also performed by using the core inventory based on a representative end of cycle estimate. Results indicate an increase of less than 25% of estimated benefits of SAMA candidates. This increase is well offset by other factors that overestimate the risk. The risk assessment considering the higher burn-up does not change the conclusions.

REFERENCES FOR ATTACHMENT 1

1. "*Applicant's Environmental Report Operating License Renewal Stage*" Turkey Point Units 3 & 4, Florida Power and Light, Docket Nos. 50-250 and 50-251, Revision 1.

2. "*Turkey Point Plant Units 3 & 4 Probabilistic Risk Assessment - Individual Plant Examination,*" Final Report, L-91-184, June 25, 1991.

3. "*Staff Evaluation of Turkey Point Individual Plant Examination (IPE) (Internal Events Only),*" Enclosure 1 to letter from L. Raghavan (NRC) to J. H. Goldberg, Florida Power and Light, October 15, 1992.

4. *"Turkey Point Plant Units 3 & 4 Individual Plant Examination of External Events"* (IPEEE), L-94-157, June 24, 1994

5. R. T. Sewell, et al., "*Technical Evaluation Report on the "Submittal-Only" Review of the Individual Plant Examination of External Events at Turkey Point Nuclear Plant, Units 3 and 4,*" Energy Research, Inc. ERI/NRC 95-507, January 1998.

6. M. M. Pilch, et al., *"Resolution of the Direct Containment Heating Issue for all Westinghouse Plants with Large Dry Containments or Subatmospheric Containments,"* NUREG/CR-6338, Feb. 1996.

7. M. M. Pilch, et al., "*The Probability of Containment Failure by Direct Containment Heating in Zion,*" NUREG/CR-6075 and NUREG/CR-6075, Supplement 1, 1994

8. M. M. Pilch, et al., "*The Probability of Containment Failure by Direct Containment Heating in Surry,*" NUREG/CR-6109, 1995.

9. Theofanous, T. G., et al., "*An Assessment of Steam Explosion Induced Containment Failure,*" NUREG/CR-5030, Feb. 1989.

10. USNRC SGTR Severe Accident Working Group, "*Risk Assessment of Severe Accident-Induced Steam Generator Tube Rupture,*" NUREG-1570, March 1998.

TABLE 9.1-1
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT TURKEY POINT UNITS 3 & 4 OPERATIONS

Agency	Authority	Requirement	Number	Expiration or Consultation Date	Activity Covered
		Federal Prerequisites to License Renewal			
U.S. Nuclear Regulatory Commission	Atomic Energy Act [42 USC 2011, et seq.], 10 CFR 50.10	License to operate	DPR-31 (Unit 3); DPR-41 (Unit 4)	7/19/12 (Unit 3); 4/10/13 (Unit 4)	Operation of Units 3 & 4
DEP	Clean Water Act Section 401 [33 USC 1341]	Certification of compliance with State water quality standards	FL0001562 (Section I.E.15)	1/6/05	Discharges during license renewal term (Appendix E)
U.S. District Court	Clean Water Act	Consent Decree	70-328-CA	None	Recirculating condenser cooling water system (canals)
U.S. Fish and Wildlife Service	Migratory Bird Treaty Act [16 USC 703 – 712]	Permit	PRT-697722	12/31/00 Renewal In Progress	Carcass salvage and injured bird transport
		State and Local Authorizations			
South Florida Water Management District	Florida Statutes § 120.54(5)	Agreement	4-FPL-22 8046/306	None	Interceptor ditch operation, groundwater monitoring
DEP	Florida Statutes Clean Water Act Section 402 (33 USC 1342); § 403	Discharge permit	FL0001562	1/6/05	Closed-loop cooling canal and 2 solids settling basins (fossil). State implementation of National Pollutant Discharge Elimination System (Appendix E)

TABLE 9.1-1 (cont'd)
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT TURKEY POINT UNITS 3 & 4 OPERATIONS

Agency	Authority	Requirement	Number	Expiration or Consultation Date	Activity Covered
DEP	Florida Statutes § 403.087	Wastewater treatment permit	FLA013612-001	1/24/06	Sewage treatment facility
DEP	Florida Statutes Chapter 376	Annual storage tank registration	Facility ID 8622249, Placard No. 129320	06/30/01	Operation of above-ground storage tanks. Seven for petroleum products and one for sulfuric acid
DEP	Florida Statutes Chapter 376	Annual storage tank registration	Facility ID 8622251, Placard No. 125644	06/30/01	Operation of three above-ground and two underground petroleum storage tanks
DEP	Florida Statutes Chapter 403	Air permit	0250003-002-AV	12/31/03	Emissions from nine diesel emergency generators, miscellaneous diesel engines, and miscellaneous unregulated and insignificant emissions units and/or activities
DEP	Florida Statutes Chapter 403	Underground injection control permit	U013-277655	11/5/00 Renewal In Progress	Sanitary wastewater disposal to well
FWCC	Florida Administrative Code Chapter 39	Scientific collecting permit	WS00278	7/30/03	Salvaging carcasses of protected wildlife

TABLE 9.1-1 (cont'd)
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT TURKEY POINT UNITS 3 & 4 OPERATIONS

Agency	Authority	Requirement	Number	Expiration or Consultation Date	Activity Covered
FWCC	Florida Administrative Code Chapter 39	Special purpose permit	WX01041	12/31/03	Live-capturing crocodiles, alligators, and Eastern indigo snakes
DERM	Code of Miami-Dade County Chapter 24	Multiple source annual operating permit	MSP-00010-2000	9/30/01	Boiler makeup water treatment system, fleet operations, two underground storage tanks, barge slip operations, and refrigerant use and recovery
DERM	Code of Miami-Dade County Chapter 24	Domestic wastewater annual operating permit	DWO-00010-2000/2001	4/14/01	Sewage treatment facility
Miami-Dade County, Florida Fire Rescue Department		Burning permit	8201	3/7/01 Renewal In Progress	

CFR = Code of Federal Regulations
DEP = (Florida) Department of Environmental Protection
DERM = (Miami-Dade County, Florida) Department of Environmental Resources Management
FWCC = (Florida) Fish and Wildlife Conservation Commission