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JUN 0 1 2007

U. S. Nuclear Regulatory Commission
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SUSQUEHANNA STEAM ELECTRIC STATION
PROPOSED LICENSE AMENDMENT NO. 285
FOR UNIT 1 OPERATING LICENSE NO. NPF-14
AND PROPOSED LICENSE AMENDMENT NO. 253
FOR UNIT 2 OPERATING LICENSE NO. NPF-22
EXTENDED POWER UPRATE APPLICATION
RE: PROBABILISTIC RISK ASSESSMENT LICENSING
REVIEW REQUEST FOR ADDITIONAL INFORMATION
RESPONSES
PLA-6201

Docket Nos. 50-387
and 50-388

References:

1) *PPL Letter PLA-6076, B. T. McKinney (PPL) to USNRC, "Proposed License Amendment Numbers 285 for Unit 1 Operating License No. NPF-14 and 253 for Unit 2 Operating License No. NPF-22 Constant Pressure Power Uprate," dated October 11, 2006.*

2) *Letter, R. V. Guzman (NRC) to B. T. McKinney (PPL), "Request for Additional Information (RAI) - Susquehanna Steam Electric Station, Units 1 and 2 (SSES 1 and 2) - - Extended Power Uprate Application Re: Probabilistic Risk Assessment Licensing Review (TAC Nos. MD3309 and MD3310)," dated April 27, 2007.*

3) *PLA-6189, B. T. McKinney (PPL) to USNRC, "Proposed License Amendment Numbers 285 for Unit 1 Operating License No. NPF-14 and 253 and for Unit 2 Operating License No. NPF-22 Extended Power Uprate Application Re: Operator Licensing and Human Performance Technical Review Request for Additional Information Responses," dated May 8, 2007.*

4) *PLA-6200, B. T. McKinney (PPL) to USNRC, "Proposed License Amendment Numbers 285 for Unit 1 Operating License No. NPF-14 and 253 and for Unit 2 Operating License No. NPF-22 Extended Power Uprate Application Re: Mechanical and Civil Engineering Technical Review Request for Additional Information Responses."*

Pursuant to 10 CFR 50.90, PPL Susquehanna LLC (PPL) requested in Reference 1 approval of amendments to the Susquehanna Steam Electric Station (SSES) Unit 1 and Unit 2 Operating Licenses (OLs) and Technical Specifications (TS) to increase the

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maximum power level authorized from 3489 Megawatts Thermal (MWt) to 3952 MWt, an approximate 13% increase in thermal power. The proposed Constant Pressure Power Uprate (CPPU) represents an increase of approximately 20% above the Original Licensed Thermal Power (OLTP).

The purpose of this letter is to provide responses to the "Request for Additional Information" transmitted to PPL in Reference 2.

The Enclosure contains the PPL responses.

There are no new regulatory commitments associated with this submittal.

PPL has reviewed the "No Significant Hazards Consideration" and the "Environmental Consideration" submitted with Reference 1 relative to the Enclosure. We have determined that there are no changes required to either of these documents.

If you have any questions or require additional information, please contact Mr. Michael H. Crowthers at (610) 774-7766.

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

Executed on: 6-1-07

B. T. McKinney

B. T. McKinney

Enclosure: Request for Additional Information Responses

Copy: NRC Region I
Mr. A. J. Blamey, NRC Sr. Resident Inspector
Mr. R. V. Guzman, NRC Sr. Project Manager
Mr. R. R. Janati, DEP/BRP

Enclosure to PLA-6201

PPL EPU

Request for Additional Information Responses

NRC Question 1:

Constant Pressure Power Uprate (CPPU) Safety Analysis Report (SAR) Section 10.5, Page 10-10: The section indicates that the changes to emergency operating plans/severe accident management guides as a result of the CPPU were not available prior to completion of the PRA evaluation and it is assumed that the procedural changes have a minor impact on the PRA results. Please describe the status of these procedural changes and if they have been developed sufficiently (e.g., in draft form) to confirm that the PRA results would only be minimally impacted.

PPL Response:

The PPL risk model does not credit operator actions that are not explicitly incorporated in SSES plant procedures. Changes to the procedures required by CPPU do not involve changes to the format or actions required, but only incorporate changes to setpoints and curves affected by the increased power level and the plant modifications required to support the power increase. The major changes to the EOPs are described in PPL Response to NRC Question 1a of Reference 3.

Status of EOPs CPPU Revisions:

1. Calculations that determine CPPU specific parameters for incorporation into the EOPs are complete except for the heat capacity temperature limit (HCTL) calculation which is drafted.

2. Unit 2 procedural modifications are complete in support of the SLC and condensate pump modifications. This includes revision to the EOPs.

Based on the above, the EOP changes for CPPU have been sufficiently developed to allow confirmation that the PRA results described in Section 10.5 of the Power Uprate Safety Analysis Report are insignificantly impacted.

NRC Question 2:

CPPU SAR Section 10.5.3, Page 10-14: The section discusses the operator response evaluation, but does not explicitly identify the human reliability analysis (HRA) methods used. Please describe the SSES HRA methods employed in these analyses.

PPL Response:

For operator actions that have the potential to significantly impact the PRA, a detailed HRA analysis was performed. This analysis is based on the EPRI Caused Based approach (EPRI TR-100259, June 1992). ASEP Time Reliability Correlation HEPs (NUREG/CR-4772) are added when the response time is short (i.e., less than 1 hour). THERP HEP data (from NUREG/CR-1278) is used in the EPRI approach as needed. For actions that did not significantly impact the PRA results, values based on industry Simulator Data from Gertman and Blackman (Human Reliability & Safety Analysis Data Handbook, 1994) were generally used.

NRC Question 3:

CPPU SAR Section 10.5.3, Page 10-14, and Table 10-5, Pages 10-43 - 10-46, and Table 10-6, Page 10-47: This section states that about 100 independent and 20 dependent operator actions were not impacted by the CPPU and lists in Tables 10-5 and 10-6 those actions that were impacted. Please identify the operator actions (including the values) that have a risk achievement worth (RAW) greater than 2.0 or Fussel-Vessely (FV) importance greater than 0.005, as determined from the CPPU CDF calculation. (Note: The staff will use this information to support the appropriate amount of review to perform in accordance with NUREG/CR-1764, "Guidance for the Review of Changes to Human Actions").

PPL Response:

The operator actions that have a risk achievement worth (RAW) greater than 2.0 or Fussel Vessely (FV) importance greater than 0.005 were determined from the CPPU CDF cutset file. The results are given in Table 3-1.

During the course of response preparation for these NRC questions, minor enhancements were made to the ATWS portion of the model. In addition, Loss of Instrument Air and Loss of Service Water initiating event fault trees were incorporated into the model. (See PPL Response 17 for more detail). The ATWS enhancements resulted in identification of one additional Operator Action that met the RAW and/or FV criteria, 183-N-N-ADS_INH_10-O.

Table 3 – 1 CPPU Operator Actions with RAW ≥2.0 or Fussel-Vessely ≥0.005

Event Name	Probability	Fus Ves (FV)	Ach W (RAW)	Description
002-N-N-BMS-O	2.93E-02	**0.1130**	**4.73**	OPERATOR ERROR FOR ALIGNING THE STATION PORTABLE DIESEL GENERATOR
016-N-N-VENT-O	9.90E-03	**0.0208**	**3.08**	OPERATOR FAILS TO OPEN DOORS AND DAMPERS IN ESW PUMP HOUSE 9.9E-3
RCVSPC_INJ_L-O	6.00E-04	**0.0466**	**78.69**	OPERATOR FAILS TO REPOSITION VALVE MANUALLY
Z-BMAX-EDG-O	1.63E-02	**0.1470**	**9.88**	DEPENDENT HEP FOR BLUE MAX AND E DG
Z-SPC2-CST-CTRL-VENT-O	5.00E-07	**0.0040**	**7.84E+03**	FAILURE OF DEPENDENT OPERATOR ACTIONS FOR SPC CST MAKEUP LEVEL CONTROL AND CONT VENT
Z-VENT-CVLOC-O	5.43E-04	**0.0011**	**2.94**	JHEP OPERATOR FAILS TO VENTILATE RHRSW AND LOCALLY VENT CONTAINMENT
024-N-N-DGE-O	1.15E-01	**0.0656**	**1.5**	OPERATOR FAILS TO ALIGN DGE
116-10A-O	1.00E+00	**0.0106**	**1**	OPERATOR FAILS TO OPEN HV11210A MANUALLY
116-10B_CLOSE-O	1.00E+00	**0.0086**	**1**	OPERATOR FAILS TO CLOSE HV11210B MANUALLY
116-10B-O	1.00E+00	**0.0094**	**1**	OPERATOR FAILS TO OPEN HV11210B MANUALLY
116-15A-O	1.00E+00	**0.0106**	**1**	OPERATOR FAILS TO OPEN HV11215A MANUALLY
116-15B_CLOSE-O	1.00E+00	**0.0086**	**1**	OPERATOR FAILS TO CLOSE HV11215B MANUALLY
116-15B-O	1.00E+00	**0.0094**	**1**	OPERATOR FAILS TO OPEN HV11215B MANUALLY
116-F073/075-O	1.00E+00	**0.0206**	**1**	OPERATOR FAILS TO OPEN HV112F073A/B OR HV112F075A/B MANUALLY
125-N-N-FXTIACIG-O	2.20E-01	**0.0544**	**1.19**	OPERATOR FAILS TO OPEN IA-CIG CROSSTIE VALVES
145-N-N-REDFW-O	1.00E+00	**0.0528**	**1**	OPERATOR FAILS TO RUN BACK FEEDWATER IN 3.5 MINUTES FOLLOWING AN ATWS .15
149-F024A-O	1.00E+00	**0.0107**	**1**	OPERATOR FAILS TO OPEN HV151F024A MANUALLY
149-F024B-O	1.00E+00	**0.0137**	**1**	OPERATOR FAILS TO OPEN HV151F024B MANUALLY
149-F048A-O	1.00E+00	**0.0107**	**1**	OPERATOR FAILS TO CLOSE HV151F048A MANUALLY
149-F048B-O	1.00E+00	**0.0137**	**1**	OPERATOR FAILS TO CLOSE HV151F048A MANUALLY
149-N-N-F017AB_EARLY-O	1.00E+00	**0.0069**	**1**	OPERATOR FAILS TO ISOLATE BREAK WITH F017 EARLY

Event Name	Probability	Fus Ves (FV)	Ach W (RAW)	Description
149-N-N-F017AB_LATE-O	5.00E-01	**0.0069**	**1.01**	OPERATOR FAILS TO ISOLATE BREAK WITH F017 LATE
151-N-N-F005-O	1.00E+00	**0.0171**	**1**	OPERATOR FAILS TO OPEN HV152F005A/B MANUALLY
153-N-N-SLCS12-O	1.60E-02	**0.0067**	**1.41**	OPERATOR FAILS TO INITIATE SLCS IN 12 MINUTES IN ATWS
153-N-N-SLCS7-O	4.50E-02	**0.0452**	**1.96**	OPERATOR FAILS TO INITIATE SLCS IN 7 MINUTES IN ATWS
183LEVELCTRL-O	2.00E-01	**0.0127**	**1.05**	OPERATOR FAILS TO CONTROL LEVEL ABOVE -129
183-N-N-ADS_INH_10-O	4.70E-02	**0.0062**	**1.12**	OPERATOR FAILS TO INHIBIT ADS WITHIN 9 MINUTES DURING ATWS
183-N-N-MSIVCLOSE-O	1.00E+00	**0.0528**	**1**	OPERATOR FAILS TO CLOSE MSIVs FOLLOWING A HIGH RAD IN MAIN STEAM LINE ALARM 7.3e-2
183RXLEVELSIG-O	1.00E+00	**0.0127**	**1**	OPERATOR FAILS TO BYPASS REACTOR LOW LOW LOW LEVEL SIGNAL
1CLPIA-O	2.30E-01	**0.0113**	**1.04**	OPERATOR FAILS TO CONTROL LOW PRESSURE INJECTION DURING ATWS
216-10B_CLOSE-O	1.00E+00	**0.0171**	**1**	OPERATOR FAILS TO CLOSE HV21210B MANUALLY
216-15B_CLOSE-O	1.00E+00	**0.0171**	**1**	OPERATOR FAILS TO CLOSE HV21215B MANUALLY

NRC Question 4:

CPPU SAR Section 10.5.3, Page 10-14, and Table 10-5, Pages 10-43 - 10-46, and Table 10-6, Page 10-47: Please confirm that, as a result of the CPPU, all previously modeled operator actions can be physically achieved within their CPPU times and describe the basis for this determination (e.g., procedural walk-throughs, simulator exercises).

PPL Response:

The total time for an operator to take action to successfully deal with an event is divided into two components:

- The diagnosis time in which the operator evaluates the situation and determines the correct course of action, and
- The time required to complete the action.

With the implementation of CPPU, this total time is assumed to be reduced due to the increase in the initial reactor power level. The impact of this power level increase has been evaluated for all operator actions included in the PRA. For those actions with long operator response times (e.g., Operations aligning the station portable diesel generator), there is no impact on the HEP and, therefore, those actions are not listed in Tables 10-5 or 10-6. For shorter term actions (e.g., Operator fails to transfer water to CST within 18 minutes), the HEPs are re-evaluated for CPPU by increasing the probability of failure because the total time available for both diagnosing and completing the action is reduced.

The time required to complete the actions in the plant is not affected by the power level. An increase in the time required to complete the action would only occur if there were changes in the plant or control room design that inhibited an operator action. No plant changes were made that inhibited an operator action in the PRA; thus, there is no change in the time required to complete the various operator actions.

For the HEP analysis, the total time available for both diagnosing and completing the action was reduced commensurate with the increase in rated power. For those actions analyzed with the EPRI CBDT methodology, this reduction was applied to the diagnosis time since the time to complete the action did not change (note that the time to complete the action for events in this category was typically 1 minute and the actions are simple and not affected by the increase in reactor power). For those actions analyzed using the Gertman and Blackman data, the diagnosis and action times are not segregated, so the total time (diagnosis plus action time) was reduced commensurate with the increase in rated power. The revised HEPs appearing in Tables 10-5 and 10-6 were re-calculated based on this reduced time. No additional procedural walk-throughs or simulator exercises were required to support this analysis.

NRC Question 5:

CPPU SAR Section 10.5.3, Page 10-14, and Table 10-5, Pages 10-43 - 10-46, and Table 10-6, Page 10-47: There are numerous human error probabilities (HEP) for similar actions with very slight differences in timing. For example, the failure of the operator to initiate standby liquid control system (SLCS) after an anticipated transient without scram (ATWS) has 5 different HEPs, addressing CPPU times of 3.2 minutes, 5 minutes, 6 minutes, 9.5 minutes, and 16 minutes. The NRC staff is aware that there are success criteria considerations (e.g., ability to use one SLCS pump as opposed to two), that might warrant different operator actions, but this is typically limited to 2 HEPs (in the SLCS example, an early initiation is the latest time at which 1 SLCS pump provides success, while a late initiation establishes the latest time at which 2 SLCS pumps provide success). For each of the multiple HEP operator actions, please explain why multiple HEPs are necessary.

PPL Response:

In general, the required response times are determined by the specific accident scenario (initiating event, equipment unavailable, etc.). This fact inherently gives rise to the different required response times for similar actions that are contained in the SSES PRA; thus, multiple HEP operator actions are necessary.

Regarding the SLCS initiation HEPs, four HEPs are necessary for the pre-CPPU model and two HEPs are necessary for the CPPU model.

The event tree structure is the same for pre-CPPU and CPPU except that the times to complete the required actions are different. The event trees also reflect a difference in Stand-by Liquid Control (SLC) pump logic. In the pre-CPPU case, when SLC is initiated, two pumps are started. However, for the CPPU case, a modification changed this scheme to only start one pump and only allow one pump to operate at a time (NRC approved Technical Specification Amendments 240 and 217 for Unit 1 and 2 respectively). Hence, each SLC branch of the pre-CPPU event tree requires two operator action times (one for two SLC pump success and one for one SLC pump success).

The pre-CPPU and CPPU ATWS event trees both contain two different branches (main condenser available or unavailable). Each branch requires different SLC initiation times. Therefore, for the pre-CPPU case, four operator action times are required.

Due to the SLC modification that only allows one pump operation, the CPPU model only requires two operator action times (main condenser available or unavailable). The number of operator actions required is summarized in the table below:

Status of Main Condenser	Number of SLC Pump Successes	Operator Action Pre-CPPU	Operator Action CPPU
Available	1	153-N-N-SLCS5-O	153-N-N-SLCS7-O
Available	2	153-N-N-SLCS8-O	NA
Unavailable	1	153-N-N-SLCS7-O	153-N-N-SLCS12-O
Unavailable	2	153-N-N-SLCS12-O	NA

NRC Question 6:

CPPU SAR Section 10.5.3, Page 10-14 and Table 10-11, Pages 10-51 - 10-52: Two of the facts and observations (F&Os) identified are related to missing pre-initiator HEPs. Please describe the type of pre-initiators not included (the subject of the F&O) and the rationale for why these events would not appreciably impact risk.

PPL Response:

Twenty-one pre-initiator human errors are currently documented in the HRA Notebook and are included in the plant PRA model. Pre-initiators have been evaluated for the diesel generators, LPCI, RCIC, HPCI, Core Spray, SLC, and CRD. In the model quantification, the pre-initiators contribute about 5% of the CDF with more than half of the contribution coming from the A and B diesel generators. The pre-initiator contribution is fairly consistent with other industry BWR models.

The subject F&Os listed in Table 10-11 refer to the following: (1) a lack of explicit incorporation of potential common cause pre-initiators (e.g., LPCI/LPCS low RPV pressure permissive mis-calibration), and (2) to a lack of a detailed systematic approach to incorporating pre-initiators in the system model development. Since the modeled pre-initiator contribution for SSES is in-line with expected results and since the addition of any new common cause pre-initiators would only represent constant additive terms to both the pre-CPPU and CPPU results, a more formal resolution of the subject F&Os would not result in any measurable impact on the delta-risk associated with the CPPU risk assessment.

NRC Question 7:

CPPU SAR Section 10.5.4, Pages 10-14 - 10-17: The discussion on success criteria does not identify if a specific unit was used in determining the appropriate success criteria for both units or if there are any differences in the plant designs that might impact success criteria. Please identify any significant plant differences and how these differences are addressed within the CPPU PRA.

PPL Response:

The SSES success criteria were determined using a single model to represent both units. Based on satisfactory results obtained from SSES transient model development and benchmarking it was determined that the SSES units were similar enough to not warrant separate modeling of the reactors.

The SSES units have the same number of major components with similar performance characteristics. Each unit has the following major components: three feedwater heater strings, three turbine driven feedwater pumps, two reactor recirculation pumps, one reactor core isolation cooling pump, sixteen safety relief valves, and two main steam isolation valves per each of the four main steam lines. Each unit also has the same number and type of pumps in the ECCS including one HPCI pump, four core spray pumps, and four residual heat removal pumps. Both units also have Siemens main turbines. Therefore, the system performance of both units is similar.

The normal operating conditions with respect to flow, pressure, and level setpoint are the same for both units. Both units operate using the same pressure regulator and level setpoints. Current steam flow for both units is approximately 14.4 Mlb/hr at their current rated core powers of 3489 MWt. Under CPPU conditions, it is anticipated that both units will continue to have similar steam flows and have the same pressure regulation and level setpoints. Currently, both SSES cores consist of full cores of ATRIUM-10 fuel with scatter loading.

There are minor differences in support systems between the two units (for example, the emergency switchgear rooms for the two units are cooled by different means). Any differences in support systems are modeled directly in the PRA fault tree.

Based on the above discussion, the success criteria (that is, the systems or actions required to prevent core damage, RPV or containment failure and radioactivity release) are essentially unit independent.

NRC Question 8:

CPPU SAR Section 10.5.4, Page 10-15: The inventory makeup success criteria discussion states that control rod drive (CRD) injection as an independent makeup source during the initial stages of an accident is deemed marginal for both pre-CPPU and CPPU conditions, but that it is viable as a late injection source. Please describe the scenarios/ sequences and timing in which CRD is modeled as an injection source in the pre-CPPU PRA and the CPPU PRA.

PPL Response:

CRD is modeled as an injection source for extended high pressure makeup (late injection). Extended high pressure makeup is credited after four hours from the initiating event. The four hour time period was chosen to correspond to the battery depletion time of four hours. CRD is a viable extended high pressure makeup source due to the lower decay heat greater than four hours after event occurrence.

CRD is not credited at less than four hours due to the higher decay heat loads.

The sequences which use extended high pressure makeup are the same for the pre-CPPU and CPPU models. These sequences would start with a transient and success of high pressure makeup, and then test for the availability of extended high pressure makeup. The success criterion of CRD injection is adequate at four hours to prevent core damage for both pre-CPPU and CPPU conditions was confirmed with representative MAAP4 runs.

NRC Question 9:

CPPU SAR Section 10.5.4, Page 10-15: The pool heat load discussion addresses non-ATWS scenarios, but does not address ATWS scenarios. Please describe the impact of ATWS scenarios on pool heat load.

PPL Response:

The ATWS success criteria and timing requirements for SLCS injection are based on avoiding a rapid increase to 260°F in the suppression pool. Hydrodynamic loads associated with SRV discharges and rapid pool heatup are assumed to lead to containment failure if SLCS injection is not initiated in a timely fashion. Note that for CPPU conditions, the use of enriched boron is anticipated to increase the time available to initiate SLC since the shutdown time will be shorter.

To account for the expected increase in pool heat loads for events initiated from CPPU conditions, the required SLCS initiation times have been reduced based on the CPPU power level compared to the current licensed thermal power. The changes to the human error probabilities associated with SLCS injection are indicated in Tables 10-5 and 10-6 of the PUSAR report. Also, see the PPL Response to NRC Question 5 herein.

NRC Question 10:

CPPU SAR Section 10.5.4, Page 10-16: The overpressure margin discussion states that for an isolation ATWS scenario, having four safety relief valves (SRVs) out of service is acceptable to prevent over pressurizing the reactor pressure vessel (RPV) for CPPU conditions. Please clarify for the pre-CPPU and CPPU conditions what is the success criterion for SRVs for these isolation ATWS scenarios and what is the success criterion for non-isolation ATWS scenarios.

PPL Response:

The success criterion for isolation ATWS events is no more than four SRVs failed based on the GE analysis. Since no event tree paths result in core damage for a non-isolation ATWS event, changes to the success criterion for number of SRVs available would have an insignificant impact on CDF and LERF results. The same success criterion is used for non-isolation ATWS events even-though the pressure rise for non-isolation events would be less than for isolation events. Therefore, the success criterion for number of SRVs available has minimal impact on the calculated CDF and LERF. Also note that the probability of failure of more than four SRVs is extremely small.

NRC Question 11:

CPPU SAR Section 10.5.4, Page 10-16: The SRV actuation discussion does not identify the number of SRVs expected to open following the various initiating events that must subsequently reclose and if this number increases with the CPPU (or if this aspect is conservatively modeled in the SSES PRA). Please clarify how the pre-CPPU and CPPU PRA models address the number of SRVs that open (and must subsequently reclose) for each of the initiating event groups.

PPL Response:

Initiating event groups are not relevant as to whether or not SRVs lift in the pre-CPPU and CPPU PRA models. At most, three SRVs are expected to lift. However, after the initial lift, the SRVs are expected to cycle more for CPPU conditions. The original CPPU SORV probability was derived using a non-informative prior with no evidence of SRV reseat failures for all plant trips experienced in the life of the SSES units. The CPPU model reflects the increased cycling by increasing the probability of failure to reclose. The increased failure probability was assumed to be directly proportional to the increase in power.

NRC Question 12:

CPPU SAR Section 10.5.4, Pages 10-18 - 10-21: The Level 2 PRA discussion states that release categories are defined based on the percentage of cesium iodine (CsI) released to the environment, but does not identify the percentage used to define a large release. Please provide the percentage of CsI used to define a large release, in the context of the large early release frequency (LERF) metric.

PPL Response:

The percentage of CsI used to define a large release is greater than 10%.

NRC Question 13:

CPPU SAR Section 10.5.5, Pages 10-21 - 10-24: The staff understands that the fire and other external events were evaluated using the analyses of the SSES Individual Plant Examination of External Events (IPEEE). Please confirm that the changes made to the internal events PRA logic model since the IPEEE was submitted would not significantly affect the IPEEE conclusions concerning internal fire and other external event risks. Specifically, please confirm for the internal fires assessment that no previously screened areas would be unscreened at the pre-CPPU or CPPU conditions.

PPL Response:

The IPEEE screening criteria credited CRD as a valid source of high pressure makeup from the time of the initiating event. The current PRA model only credits CRD as a valid high pressure makeup source four hours after the initiating event as described in PPL Response to NRC Question 8 herein.

To re-screen the fire zones, the IPEEE screening criteria was applied but no credit was given for CRD in the first four hours of the event. The re-screening effort also used the latest cable and raceway database information to determine the equipment lost in each fire zone due to a large fire in that zone.

The IPEEE employed a two- step screening process. The first step was to assess the amount of combustibles in a fire zone and if it was deemed insignificant, the fire zone screened out. If the combustibles were not insignificant, the equipment lost due a fire was determined and, if the remaining equipment available met the Defense-in-Depth (DID) criteria, the fire zone screened out. So, if a zone was assessed to have insignificant combustibles, the DID assessment was not performed. In the IPEEE column in the below Table, "Yes" means the fire zone screened out due to DID or lack of significant combustibles and a "No" means the fire zone did not screen out.

The IPEEE two- step screening process was not used for this response. Instead a modified approach was used. Specifically, only the DID criteria for each fire zone was assessed. In the Response column, a "Yes" means the fire zone screened out due to DID, a "No" means the fire zone did not screen out.

Screening Results		
Fire Zone	IPEEE	RAI Response
1-1A	Yes	No
1-1F	Yes	No
1-1G	Yes	No
1-2A	Yes	No
1-2C	Yes	Yes
1-3A	No	No
1-3B-N	Yes	No
1-3B-S	Yes	No
1-3B-W	No	No
1-3C-N	No Combustibles	No
1-3C-S	Yes	No
1-3C-W	Yes	No
1-4A-N	No	No
1-4A-S	No	No
1-4A-W	No	Yes
1-4B	No Combustibles	No
1-4E	No Combustibles	Yes
1-4G	Yes	No
1-5A-N	Yes	No
1-5A-S	No	No
1-5A-W	No	Yes
1-5E	Yes	Yes
1-5H	No Combustibles	Yes
1-6B	Yes	Yes
1-6C	Yes	Yes
1-6D	Yes	Yes
1-6E	No Combustibles	Yes
1-6F	No Combustibles	Yes
1-7A	Yes	Yes
1-7B	No Combustibles	Yes
0-6G	No Combustibles	Yes
0-6H	No Combustibles	Yes
0-8A	Yes	Yes
1-1B	Yes	No
1-1C	Yes	No
1-1D	Yes	No
1-1E	Yes	No
1-1I	No Combustibles	Yes
1-1J	No Combustibles	Yes
1-2B	No	No

Screening Results		
Fire Zone	IPEEE	RAI Response
1-2D	Yes	No
1-3B-N	No	No
1-3C-N	No Combustibles	No
1-4A-N	No	No
1-4B	No Combustibles	No
1-4G	Yes	No
1-5A-N	Yes	No
1-5C	Yes	No
1-5D	Yes	Yes
1-6A	Yes	No
1-6I	No Combustibles	No
1-1H	No Combustibles	Yes*
1-4F	No Combustibles	Yes*
1-5B	Yes	No
1-4C	Yes	No
1-4D	Yes	No
1-5F	Yes	No
1-5G	Yes	Yes
0-21B	No Combustibles	Yes
0-29A	No Combustibles	Yes
0-22B	No Combustibles	Yes
0-29C	No Combustibles	Yes
0-21A	Yes	Yes
0-22A	Yes	Yes
0-22C	No Combustibles	Yes
0-23	No Combustibles	Yes
0-24A	Yes	Yes
0-24B	Yes	Yes
0-24C	Yes	Yes
0-24F	No Combustibles	Yes
0-24I	No Combustibles	Yes
0-24K	No Combustibles	Yes
0-28S	No Combustibles	Yes
0-29B	No	Yes
0-29D	No Combustibles	Yes
0-30A	No	Yes
0-30B	No Combustibles	Yes
0-24G	No	Yes
0-24J	No Combustibles	Yes
0-25B	No Combustibles	Yes
0-26B	No Combustibles	Yes
0-27F	No Combustibles	Yes
0-28P	No Combustibles	Yes
0-26S	No Combustibles	Yes
0-24L	No Combustibles	Yes
0-24M	No Combustibles	Yes
0-25C	No Combustibles	Yes

Screening Results		
Fire Zone	IPEEE	RAI Response
0-25D	No Combustibles	Yes
0-26C	No Combustibles	No
0-26D	No Combustibles	No
0-26T	No Combustibles	No
0-26V	No Combustibles	No
0-27G	No Combustibles	No
0-27H	No Combustibles	No
0-28Q	No Combustibles	Yes
0-28R	No Combustibles	Yes
0-24E	Yes	Yes
0-26A	Yes	Yes
0-26E	No Combustibles	Yes
0-26F	No Combustibles	Yes
0-26G	Yes	Yes
0-26H	No	No
0-26I	Yes	Yes
0-26J	No Combustibles	Yes
0-26K	Yes	Yes
0-26L	Yes	Yes
0-26M	No Combustibles	No
0-26N	No Combustibles	Yes
0-26P	No Combustibles	Yes
0-26R	No Combustibles	Yes
0-27C	No Combustibles	No
0-27D	Yes	Yes
0-28A-I	No	Yes
0-28C	Yes	Yes
0-28E	Yes	Yes
0-28G	Yes	Yes
0-28H	Yes	No
0-28J	No	No
0-28B-I	No	No
0-28M	Yes	Yes
0-28N	Yes	Yes
0-28A-II	No	No
0-28T	Yes	Yes
0-28D	Yes	Yes
0-28F	No	Yes
0-28B-II	No	No
0-28I	No	No
0-28K	Yes	Yes
0-28L	Yes	Yes
0-24D	No	No
0-25A	No Combustibles	Yes
0-25E	No Combustibles	No
0-27A	No	Yes
0-27B	No Combustibles	No

Screening Results		
Fire Zone	IPEEE	RAI Response
0-27E	No	No

* Screened due to fire zone being inerted (Drywell and Suppression Chamber)

Given that several fire zones previously screened out in the IPEEE ("Yes" in the IPEEE column) now do not screen out ("No" in the Response column), a new fire frequency was developed considering a large fire in each of these zones, i.e. all cables in that zone are damaged by the fire. All fire zones that did not screen out ("No" in the Response column) had their fire core damage frequency calculated. This calculation did not credit balance of plant (BOP) equipment since the cable and raceway database was not developed to assess the functionality of this equipment. Not crediting the BOP equipment is conservative since some of it may be functional after a fire.

The fire induced equipment failures for each fire zone were derived from the current cable raceway database. The conditional core damage probability was obtained by using our current PRA risk model. The probability of non-suppression is consistent with NEI 00-01, Nuclear Power Plant Fire Protection. The fire frequencies were obtained from the IPEEE. The results of the re-quantification are in the table below. Two sensitivities are also provided, one for not crediting suppression and the other for only crediting manual suppression.

Fire CDF			
Case	Auto and Manual Suppression	Only Manual Suppression	No Suppression
CPPU	9.24E-07	2.67E-06	2.67E-05
Pre-CPPU	9.24E-07	2.67E-06	2.67E-05
Delta	4.19E-10	-1.78E-09	-1.78E-08

Intuitively, the CPPU fire CDF should be higher than the Pre-CPPU fire CDF. However, the CPPU model has a redundant spray pond bypass valve that can be closed if the motor operated bypass valve fails to close. This additional valve has been added to the plant design to accommodate the CPPU spray pond thermal analysis. This additional valve would not normally be expected to influence the base model quantification. However, in this case, it does influence the results since a division of RHR is failed due to the fire. Thus, for CPPU, failure of both valves to close would be required for the flow to bypass the spray pond array. Hence, depending on the amount of other equipment failed due to the fire, the CPPU fire CDF can be lower than the Pre-CPPU fire CDF due the additional spray pond bypass valve.

<u>NRC Question 14</u>:

CPPU SAR Section 10.5.5, Pages 10-21 - 10-23: The IPEEE staff evaluation indicated that SSES fire analysis contained a significant weakness involving the assumption that the severity of a fire and probability of failure of fire suppression were independent, resulting in low core damage frequencies (CDFs). It does not appear that the SSES fire analysis has been updated since the IPEEE. Please address this specifically identified weakness in the SSES fire analysis and, if necessary, supplement the internal fire analyses to address this issue.

<u>PPL Response</u>:

The impact of the identified weakness has been bounded in our response to Question 13. This response recalculates the fire CDF for all fire zones that do not screen out using our current success criteria. Three cases are provided: (1) full credit for suppression, (2) limited credit for suppression, and (3) no credit for suppression.

Note that the results of this analysis represent a conservative approach since all scenarios are assumed to damage all components physically located in the fire zone as well as all components associated with the cables in the area. The full range of less severe fires is not considered in this analysis. Regardless of which of the three cases presented in Response 13 is chosen as representative of the fire risk, the CPPU results indicate a reduction in the fire CDF due to the addition of a redundant spray pond bypass valve.

<u>NRC Question 15</u>:

CPPU SAR Section 10.5.5, Pages 10-23 - 10-24: The seismic discussion indicates that a number of seismic-related issues were closed out, but that there is an ongoing process to monitor seismic issues at the plant. Please describe the remaining seismic issues at the plant and the potential impact of these issues on plant seismic risk.

<u>PPL Response</u>:

The Seismic Margins Assessment (SMA) identified seismic interaction concerns as part of the equipment walkdowns. All of the identified deficiencies were corrected shortly after the IPEEE report was issued as part of the SSES Modification or Deficiency Management Programs. There are no open seismic issues associated with the SMA performed in 1993/1994. PPL Response to NRC Question 23 of Reference 4 discusses the SMA in more detail.

System Engineers at the SSES routinely walk down systems during which they can identify items that could affect the dynamic qualification of safety-related equipment. These walkdowns are documented in the System Journals. Issues that have the potential for adversely affecting seismic qualification are addressed through the Corrective Action Program. Guidelines for seismic walkdowns (including discussions and examples of the detrimental effects of loose and unsecured items, the need to have doors closed tightly, and the need for having all fasteners present in good working condition, etc.) are used for these walkdowns.

In addition, a seismic module on missing hardware, housekeeping, transient materials, etc., was added to SSES Plant Access Training as part of the IPEEE audit response.

NRC Question 16:

CPPU SAR Section 10.5.6, Pages 10-24 - 10-27: The section states that the time to core uncovery for CPPU conditions is 8 hours compared to 9.1 hours at pre-CPPU conditions at 1-day into an outage with the RPV level at the flange. Please provide the time for boildown (core uncovery) at 1 hour and 8 hours into an outage for pre-CPPU and CPPU conditions.

PPL Response:

For shutdown times of 8 hours or less from all rods in, it is assumed that the reactor vessel head is still in place. For the 1-hour shutdown case, it is assumed that the reactor vessel is still pressurized with the level in the reactor vessel increased to +90". For the 8-hour shutdown case, it is assumed that the reactor is depressurized and remains depressurized throughout the boil down transient. MAAP4 cases were run for both pre-CPPU and CPPU conditions. The results showed that the time to core uncovery for these cases are:

Time After Shutdown (hours)	Time to Core Uncovery Pre-CPPU (Hours)	Time to Core Uncovery CPPU (Hours)
1 hour	1.27 hours	1.07 hours
8 hours	4.42 hours	3.83 hours

The ratio in core uncovery times is slightly greater than the ratio of initial power levels (3952/3489 = 1.13) because the liquid inventory in the reactor at boil-off initiation is slightly less at CPPU power level than at current power level. The difference in inventory results from the greater steam flow and hence lower average density (caused by the larger decay heat) for the CPPU cases.

NRC Question 17:

CPPU SAR Table 10-3, Page 10-40, and Table 10-4, Page 10-41: The loss of service water and loss of instrument air initiating event frequency is set at 5E-3/year. Please provide the justification and data source for using this value for these initiating events.

PPL Response:

At the time of preparation of the Susquehanna CPPU SAR, loss of Instrument Air and Service Water initiating event models were not utilized in the PRA model. Instead, the PRA modeled the loss of Instrument Air and Service Water frequencies as basic events (with an assigned frequency). Based on engineering judgment, a value of 5E-3/year was assigned to the loss of Instrument Air and Service Water initiating events for the preparation of the CPPU SAR. This value, assigned to both Instrument Air and Service Water systems, is consistent with the range of values presented in NUREG/CR-5750, Appendix G, Table G-2.

Since the submittal of the Susquehanna CPPU SAR, the PRA has been enhanced with the addition of loss of Instrument Air and Service Water initiating event models. The initiating event frequencies calculated by these models are as follows:

Initiating Event	Updated Frequency/Year	CPPU SAR Frequency/Year
Instrument Air	6.75E-03	5E-03
Service Water	7.11E-04	5E-03

NRC Question 18:

CPPU SAR Section 10.5.8, Pages 10-29 - 10-30 and Table 10-3, Page 10-40, and Table 10-4, Page 10-41: The Sensitivity Cases use a "long-term" data period of 10 years to provide a projected average increase in risk as a result of the CPPU. However, the majority of the risk increase will occur within the first year after implementation of CPPU. To provide a perspective of the potential maximum risk increase in the first year following implementation of the CPPU, please re-perform the sensitivity calculations for this first year only (i.e., increase the turbine trip with bypass frequency from 0.894/year to 2.894/year and increase the isolation initiator frequency from 0.136/year to 1.136/year). In addition, include a sensitivity case that incorporates into the current Sensitivity Case #4 (the combined sensitivity cases) the inclusion of the loss of instrument air and service water initiators and reflects any changes resulting from the SSES response to the following comment.

PPL Response:

PUSAR Tables 10-3 and 10-4 were revised and provided below. These use the initiating event frequencies requested in the NRC Question. The models used to obtain the listed results have been updated from the models used for the initial submittal by including initiating event fault trees for Loss of Instrument Air and Loss of Service Water along with the correction of a minor discrepancy discovered in the ATWS sequences.

PUSAR Table 10-3 (Revised)

Results of Unit 1 PRA Sensitivity Cases

Parameter	CLTP	CPPU	Case #1	Case #2	Case #3	Case #4
Post-Initiator HEPs	Base CLTP values	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings
SORV Probabilities	Base CLTP values	Increased 13%	Increased 13%	Increased 13%	Increased 13%	Increased 13%
Turbine Trip w/Bypass (%1NONISO, with units of 1/yr)	Base CLTP (0.894)	Base CLTP value	2.894	Base CLTP value	Base CLTP value	2.894
MSIV Closure Initiator (%1ISO, with units of 1/yr)	Base CLTP (0.136)	Base CLTP value	Base CLTP value	1.136	Base CLTP value	1.136
LOCA Initiators and internal flooding due to feedwater	Base CLTP values	Base CLTP values	Base CLTP values	Base CLTP values	Increased 2x	Increased 2x
Unit 1 CDF (1/yr):	1.76E-06	1.86E-06	2.29E-06	2.19E-06	1.94E-06	2.70E-06
Unit 1 delta CDF:	-	1.03E-07	5.30E-07	4.36E-07	1.84E-07	9.44E-07
Unit 1 LERF (1/yr):	1.72E-07	1.73E-07	1.77E-07	1.79E-07	1.91E-07	2.01E-07
Unit 1 delta LERF:	-	8.20E-10	5.30E-09	6.99E-09	1.90E-08	2.97E-08

Note: The CLTP and CPPU models used to obtain the listed results include Instrument Air and Service Water Initiating Event Fault Trees. See response to Question 17 for the frequencies of these two initiators. All results were obtained by quantifying the model.

Table 10-4 (Revised)

Results of Unit 2 PRA Sensitivity Cases

Parameter	CLTP	CPPU	Case #1	Case #2	Case #3	Case #4
Post-Initiator HEPs	Base CLTP values	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings	Calculated using CPPU Timings
SORV Probabilities	Base CLTP values	Increased 13%	Increased 13%	Increased 13%	Increased 13%	Increased 13%
Turbine Trip w/Bypass (%2NONISO, with units of 1/yr)	Base CLTP (0.894)	Base CLTP value	2.894	Base CLTP value	Base CLTP value	2.894
MSIV Closure Initiator (%2ISO, with units of 1/yr)	Base CLTP (0.136)	Base CLTP value	Base CLTP value	1.136	Base CLTP value	1.136
LOCA Initiators and internal flooding due to feedwater	Base CLTP values	Base CLTP values	Base CLTP values	Base CLTP values	Increased 2x	Increased 2x
Unit 2 CDF (1/yr):	1.74E-06	1.84E-06	2.26E-06	2.17E-06	1.92E-06	2.68E-06
Unit 2 delta CDF:	-	1.04E-07	5.28E-07	4.35E-07	1.85E-07	9.39E-07
Unit 2 LERF (1/yr):	1.72E-07	1.72E-07	1.77E-07	1.79E-07	1.91E-07	2.01E-07
Unit 2 delta LERF:		8.20E-10	5.31E-09	6.98E-09	1.90E-08	2.97E-08

Note: The CLTP and CPPU models used to obtain the listed results include Instrument Air and Service Water Initiating Event Fault Trees. See response to Question 17 for the frequencies of these two initiators. All results were obtained by quantifying the model.

NRC Question 19:

CPPU SAR Section 10.5.8, Pages 10-29 - 10-30 and Table 10-3, Page 10-40, and Table 10-4, Page 10-41: The combination of sensitivity cases in Sensitivity Case #4 is to determine if there are synergistic effects that would not be revealed in individual sensitivity cases. However, the sum of deltas of the individual sensitivity cases is actually greater than the delta for the combined sensitivity case. Please explain why the sum of the deltas of the individual sensitivity cases is greater than the combined sensitivity case.

PPL Response:

The sum of the deltas reported for Cases 1, 2 and 3 should not equal the delta reported for Case 4. Case 4 aggregates the sensitivities of Cases 1, 2 and 3; however, the deltas are the difference between the individual cases and the CLTP base case. So, if the deltas from Cases 1, 2 and 3 are added together, their sum will be larger than the reported Case 4 delta. This sum is larger because the difference between the CLTP and CPPU cases is included in each of the deltas.

If a test for synergism is desired, it is more appropriate to sum the differences between sensitivity cases (Cases 1, 2 and 3) and the base CPPU case. To this sum, add the difference between the CPPU and the CLTP base cases. This result can then be compared to the Case 4 delta (Case 4 CDF minus CLTP base case). This methodology is applied to the original version of Table 10-3 for Unit 1 and to the original version of Table 10-4 for Unit 2 and the result is shown below:

Unit 1

Parameter	CLTP	CPPU	Case #1	Case #2	Case #3	Case #4
Unit 1 CDF (1/yr)	1.65E-06	1.71E-06	1.75E-06	1.76E-06	1.79E-06	1.88E-06
Unit 1 delta CDF (datum CLTP)		6.00E-08	1.00E-07	1.10E-07	1.40E-07	**2.30E-07**
Unit 1 delta CDF (datum CPPU)			4.00E-08	5.00E-08	8.00E-08	
Unit 1 LERF (1/yr)	1.75E-07	1.76E-07	1.77E-07	1.77E-07	1.95E-07	1.96E-07
Unit 1 delta LERF (datum CLTP)		1.00E-09	2.00E-09	2.00E-09	2.00E-08	**2.10E-08**
Unit 1 delta LERF (datum CPPU)			1.00E-09	1.00E-09	1.90E-08	
Sum of delta CDF using a datum of CPPU	1.70E-07					
Delta CDF (CPPU-CLTP)	6.00E-08					
Aggregate increase of Sensitivity Cases 1, 2 and 3 from CLTP (CDF)	2.30E-07					
Sum of delta LERF using a datum of CPPU	2.10E-08					
Delta LERF (CPPU-CLTP)	1.00E-09					
Aggregate increase of Sensitivity Cases 1, 2 and 3 from CLTP (LERF)	2.20E-08	The difference between 2.1E-8 and 2.2E-8 is due to rounding off the numbers. If the more significant figures were used, the comparable values are 2.09E-8 and 2.08E-8.				

Unit 2

Parameter	CLTP	CPPU	Case #1	Case #2	Case #3	Case #4
Unit 2 CDF (1/yr)	1.63E-06	1.70E-06	1.73E-06	1.75E-06	1.78E-06	1.86E-06
Unit 2 delta CDF (datum CLTP)		7.00E-08	1.00E-07	1.20E-07	1.50E-07	**2.30E-07**
Unit 2 delta CDF (datum CPPU)			3.00E-08	5.00E-08	8.00E-08	
Unit 2 LERF (1/yr)	1.75E-07	1.76E-07	1.77E-07	1.77E-07	1.95E-07	1.96E-07
Unit 2 delta LERF (datum CLTP)		1.00E-09	2.00E-09	2.00E-09	2.00E-08	**2.10E-08**
Unit 2 delta LERF (datum CPPU)			1.00E-09	1.00E-09	1.90E-08	
Sum of delta CDF using a datum of CPPU	1.60E-07					
Delta CDF (CPPU-CLTP)	7.00E-08					
Aggregate increase of Sensitivity Cases 1, 2 and 3 from CLTP (CDF)	2.30E-07	The difference between 2.3E-7 and 2.2E-7 is due to rounding off the numbers. If the more significant figures were used, the comparable values are 2.28E-8 and 2.28E-8.				
Sum of delta LERF using a datum of CPPU	2.10E-08					
Delta LERF (CPPU-CLTP)	1.00E-09					
Aggregate increase of Sensitivity Cases 1, 2 and 3 from CLTP (LERF)	2.20E-08	The difference between 2.1E-8 and 2.2E-8 is due to rounding off the numbers. If the more significant figures were used, the comparable values are 2.09E-8 and 2.10E-8.				

Hence, due to the good agreement between the delta CDF/LERF from Case 4 compared to the aggregate increase of Sensitivity Cases 1, 2 and 3 from CLTP, there are no synergistic effects from the three sensitivity cases. This result is expected; since the sensitivity cases only varied the initiating event frequencies, the cutsets without the varied initiator would be unaffected.

<u>NRC Question 20</u>:

Provide a summary of the LERF results for both the pre-CPPU and CPPU conditions similar to Tables 10-12 and 10-13.

<u>PPL Response</u>:

A summary of the LERF results for both the pre-CPPU and CPPU conditions similar to the Tables 10-12 and 10-13 is given in the attached Table 10-12A and Table 10-13A.

Since the submittal of the Susquehanna CPPU SAR, the PRA has been enhanced with the addition of Loss of Instrument Air and Loss of Service Water initiating event models. These enhancements also included slight changes to the ATWS tree. To maintain consistency, the revised model summary results for both the pre-CPPU and CPPU CDF conditions are also provided and are given in the attached Table 10-12B and Table 10-13B.

Table 10-12A
Comparison of CLTP LERF vs. CPPU LERF by Initiator

Event Name	Unit 1 CLTP Value (1/yr)	Unit 1 CPPU Value (1/yr)	Unit 1 % Increase by Initiator	Unit 1 Relative % of LERF Increase	Unit 2 CLTP Value (1/yr)	Unit 2 CPPU Value (1/yr)	Unit 2 % Increase by Initiator	Unit 2 Relative % of LERF Increase
Loss of Offsite Power (%LOOP-FLAG)	2.21E-08	2.28E-08	2.7%	86.8%	2.21E-08	2.28E-08	2.8%	86.76%
Reactor Trip without MSIV Closure (%1(2)NONISO)	1.54E-09	1.65E-09	6.9%	15.9%	1.53E-09	1.65E-09	7.3%	15.67%
Inadvertent MSIV Isolation (%1(2)ISO)	5.12E-10	5.45E-10	6.1%	4.7%	5.11E-10	5.45E-10	6.5%	4.66%
Other Initiators Contributing <0.5% to ΔLERF (#)	1.48E-07	1.48E-07	-2.5%	-7.4%	1.47E-07	1.47E-07	-1.6%	-7.1%
TOTALS	1.72E-07	1.73E-07	13.20%	100%*	1.71E-07	1.72E-07	15.00%	100%*

* Total may not be exactly 100% due to round off error.
Note 1: Data sort based on greater than 1% Increase by Initiator
Note 2: Negative sign indicates virtually no change between CLTP and CPPU on an individual initiating event basis.

Table 10-12B
Comparison of CLTP CDF vs. CPPU CDF by Initiator

Event Name	Unit 1 CLTP Value (1/yr)	Unit 1 CPPU Value (1/yr)	Unit 1 % Increase by Initiator	Unit 1 Relative % of CDF Increase	Unit 2 CLTP Value (1/yr)	Unit 2 CPPU Value (1/yr)	Unit 2 % Increase by Initiator	Unit 2 Relative % of CDF Increase
Reactor Trip without MSIV Closure (%1(2)NONISO)	1.45E-07	1.88E-07	29.4%	49.9%	1.43E-07	1.86E-07	30.3%	42.8%
Loss of Offsite Power (%LOOP-FLAG)	1.21E-06	1.25E-06	3.1%	43.8%	1.19E-06	1.24E-06	4.1%	48.5%
Inadvertent MSIV Isolation (%1(2)ISO)	3.87E-08	4.37E-08	12.9%	5.9%	3.83E-08	4.36E-08	13.9%	5.3%
Inadvertent Opening of a relief Valve (%1IORV)	3.90E-09	5.71E-09	46.2%	2.1%	3.88E-09	5.71E-09	47.1%	1.8%
Room I-500 Flood (%FLD-1(2)-749FLOODSW)	3.35E-09	4.55E-09	35.8%	1.4%	3.32E-09	4.57E-09	37.4%	1.2%
Other Initiators Contributing <0.5% to ΔCDF	3.71E-07	3.68E-07	16.7%	-3.1%	3.62E-07	3.63E-07	35.4%	0.4%
TOTALS	1.77E-06	1.86E-06	144.1%	100%*	1.74E-06	1.48E-06	168.3%	100%*

* Total may not be exactly 100% due to round off error.
Note 1: Data sort based on greater than 1% Unit Relative % of CDF Increase.
Note 2: Negative sign indicates virtually no change between CLTP and CPPU on an individual initiating event basis.

Table 10-13A
Comparison of CLTP LERF vs. CPPU LERF by Sequence

Sequence Designator	Description	Unit 1 CLTP Value (1/yr)	Unit 1 CPPU Value (1/yr)	Unit 1 Relative % of LERF Increase	Unit 2 CLTP Value (1/yr)	Unit 2 CPPU Value (1/yr)	Unit 2 Relative % of LERF Increase
RCVSEQ1TR-7-013	Loss of extended high pressure makeup and energetic containment failure ex vessel at high vessel pressure.	2.40E-08	2.47E-08	107%	2.39E-08	2.47E-08	107.8%
RCVSEQ1TR-6AH-001	Isolation ATWS with success of high pressure makeup, failure of SLC and failure to manually depressurize.	5.03E-11	9.92E-11	8.3	5.03E-11	9.93E-11	6.6%
RCVSEQ1IS-1-003	Interfacing system LOCA for RHR pump discharge, failure to isolate the break.	1.29E-08	1.29E-08	1.7	1.29E-08	1.29E-08	-.98%
RCVSEQ1TR-6AH-009	Isolation ATWS, failure to de-pressurize with Energetic containment failure.	0.0+	2.36394E-11	4.0%	0.0+	2.3627E-11	3.2
Other	Other Sequences that Contribute <1% to ΔLERF	1.35E-07	1.35E-07	-20.98%	1.35E-07	1.35E-07	-16.6%
	TOTALS	1.718E-07	1.724E-07	100%	1.716E-07	1.724E-07	100%

Note 1: Table represents CPPU values greater than 1% relative % of LERF increase
Note 2: Negative sign represents virtually no change between CLTP and CPPU.
+ Frequency was below the quantification truncation value 1.00E-11

Table 10-13B
Comparison of CLTP CDF vs. CPPU CDF by Sequence

Sequence Designator	Description	Unit 1 CLTP Value (1/yr)	Unit 1 CPPU Value (1/yr)	Unit 1 Relative % of LERF Increase	Unit 2 CLTP Value (1/yr)	Unit 2 CPPU Value (1/yr)	Unit 2 Relative % of LERF Increase
RCVSEQ1TR-6-017CD	Non-isolation ATWS, with failure to reduce Rx level and failure to inject SLC.	6.35E-08	9.89E-08	41.7%	6.29E-08	9.89E-08	34.0%
RCVSEQ1TR-1-005CD	Loss of injection after successful containment venting (core damage at 25.6 hours).	3.60E-07	3.79E-07	22.4%	3.63E-07	3.88E-07	24.0%
RCVSEQ1TR-7-001CD	Loss of extended high pressure makeup and depressurization (core damage at 5.9 hrs).	9.19E-07	9.37E-07	21.0%	9.09E-07	9.37E-07	27.1%
RCVSEQ1TR-6-036CD	Isolation ATWS, with success of high pressure makeup and the failure of SLC.	1.32E-08	2.14E-08	9.6%	1.30E-08	2.14E-08	7.8%
RCVSEQ1TR-6-030CD	Isolation ATWS with success of high pressure makeup and the failure of SLC and MRI.	1.53E-08	1.79E-08	3.0%	1.51E-08	1.79E-08	2.6%
RCVSEQ1TR-6-038CD	Isolation ATWS with loss of high pressure makeup, success of SLC, and failure to depressurize.	4.91E-09	7.08E-09	2.6%	4.86E-09	7.09E-09	2.1%
Other	Other Sequences that Contribute <1% to ΔLERF	3.98E-07	3.98E-07	-0.4%	3.69E-07	3.71E-07	2.3%
	TOTALS	1.77E-06	1.86E-06	100%	1.74E-06	1.84E-06	100%

Note 1: Table represents CPPU values greater than 1% of Unit relative % o f LERF increase
Note 2: Negative sign represents virtually no change between CLTP and CPPU.

NRC Question 21:

Provide a parametric uncertainty analysis of the pre-CPPU and CPPU CDF and LERF.

PPL Response:

A parametric uncertainty analysis of the Pre-CPPU and CPPU models for both CDF and LERF is shown below. The uncertainty analysis was performed using the Monte Carlo method with a sample size of 1000.

Unit 1

	Pre-CPPU		CPPU	
	1CDF	1LERF	1CDF	1LERF
Mean	2.01E-06	1.94E-07	2.33E-06	1.93E-07
5%	1.25E-06	1.47E-07	1.32E-06	1.47E-07
50%	1.67E-06	1.66E-07	1.77E-06	1.65E-07
95%	3.57E-06	3.15E-07	3.98E-06	3.14E-07
Std. Dev.	2.08E-06	1.54E-07	4.21E-06	1.34E-07

Unit 2

	Pre-CPPU		CPPU	
	2CDF	2LERF	2CDF	2LERF
Mean	1.92E-06	2.84E-07	2.20E-06	2.01E-07
5%	1.19E-06	1.47E-07	1.32E-06	1.48E-07
50%	1.60E-06	1.68E-07	1.73E-06	1.66E-07
95%	3.62E-06	3.04E-07	3.77E-06	3.16E-07
Std. Dev.	1.26E-06	2.79E-06	3.46E-06	1.76E-07