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**SUSQUEHANNA STEAM ELECTRIC STATION**
**APPLICATION FOR RENEWED OPERATING LICENSES**
**NUMBERS NPF-14 AND NPF-22 FOLLOW-UP INFORMATION**
**TO PPL's SAMA RAI RESPONSE** **Docket Nos. 50-387**
**PLA-6217** **and 50-388**

*References:*

1) *PLA-6110, Mr. B. T. McKinney (PPL) to Document Control Desk (USNRC), "Application for Renewed Operating License Numbers NPF-14 and NPF-22," dated September 13, 2006.*

2) *Letter from Ms. A. J. Mullins (USNRC) to Mr. B. T. McKinney (PPL), "Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Susquehanna Steam Electric Station, Units 1 and 2 (TAC NOS. MD3021 and MD3022)," dated January 16, 2007.*

3) *PLA-6154, Mr. B. T. McKinney (PPL) to Document Control Desk (USNRC), "Application for Renewed Operating License Numbers NPF-14 and NPF-22, Response to SAMA RAI's," dated April 12, 2007.*

In accordance with the requirements of 10 CFR 50, 51, and 54, PPL requested the renewal of the operating licenses for the Susquehanna Steam Electric Station (SSES) Units 1 and 2 in Reference 1.

Reference 3 provided PPL's responses to the NRC's Request for Additional Information (RAI) transmitted to PPL Susquehanna LLC, (PPL) in Reference 2.

The enclosure to this letter provides additional information related to PPL's Reference 3 responses, as discussed during a teleconference on May 1, 2007 in response to questions by NRC reviewers. These responses are numbered consistently with the RAI questions in References 2 and 3.

There are no new regulatory commitments contained herein as a result of the additional information provided in these responses.

A120

If you have any questions, please contact Mr. Duane L Filchner at (610) 774-7819.

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

Executed on: 7-3-07

B. T. McKinney

Enclosure: PPL Follow-up Responses to NRC's Request for Additional Information (RAI)

Copy: NRC Region I
Ms. Y. K. Diaz-Sanabria, NRC Project Manager, License Renewal, Safety
Mr. A. L. Stuyvenberg, NRC Project Manager, License Renewal, Environmental
Mr. A. J. Blamey, NRC Sr. Resident Inspector
Mr. R. V. Guzman, NRC Sr. Project Manager
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# Enclosure to PLA-6217
# PPL Follow-up Responses to NRC's Request for Additional Information (RAI)

**NRC RAI 1c(1):**

The response to this RAI provides the reasoning for the higher SBO contributions for Unit 1 compared to Unit 2 as a result of the failure of the diesel generators to start, which in turn, is due to the failure of the necessary 125 VDC from Unit 1 batteries. It is not obvious why this would impact Unit 1 more than Unit 2 since the diesel generators are shared between units. Explain this.

**PPL Response:**

The diesel generators are shared between units to supply 4kV power. The control power for all four of the diesels is normally supplied from the Unit 1 125Vdc batteries (Diesel A control power is 1D610, Diesel B control power is 1D620, Diesel C control power is 1D630 and Diesel D control power is 1D640). The diesels are cooled by Division I or Division II of ESW. The breaker control power for ESW pumps A and C (Division I) is normally from the Unit 1 125Vdc battery 1D610. The breaker control power for ESW pumps B and D (Division II) is normally from the Unit 1 125Vdc battery 1D620. Transfer to the Unit 2 batteries for common loads (ESW and diesels) is not credited in the event of Unit 1 battery failure since the transfer activity can take 30 minutes.

Difference in SBO Contributions Between Units 1 and 2:

Unit 1

Given a loss of off-site power (LOOP), and the failure of 125Vdc batteries 1D610 and 1D620, Diesel Generators A and B will not start. The DC loads supplied by 1D610 and 1D620 will not have power. Without this DC power, Unit 1 HPCI and RCIC will not initiate and ADS is also lost. Feedwater is lost due to the MSIVs closing on the LOOP. Hence, there is no high pressure makeup and no means to depressurize, leading to high pressure boil off and core damage.

This discussion demonstrates that Unit 1 is calculated to have core damage given a LOOP with coincident failure of batteries 1D610 and 1D620. Although not necessary for Unit 1 to result in core damage, but a consequence of a LOOP with failure of batteries 1D610 and 1D620, is the failure of all of the ESW pumps to start. Without cooling, the C and D diesels also fail in this scenario; hence, a station blackout (SBO) condition exists. Therefore, this group of failures results in Unit 1 core damage and SBO.

Unit 2

Given a LOOP and the failure of 125Vdc batteries 2D610 and 2D620, Diesel Generators A, B, C and D will start as well as the ESW pumps. However, the Unit 2 125 VDC battery chargers do not have the capacity to supply the initial load following a LOOP and battery failure. Therefore, the DC loads supplied by 2D610 and 2D620 will not have power. Without this DC power, Unit 2 HPCI and RCIC will not initiate and ADS fails. Feedwater makeup capability is lost due to MSIV closure from the LOOP. Hence, there is no high pressure makeup capability and no way to depressurize. This results in high pressure boil off and core damage.

This discussion demonstrates that Unit 2 will have core damage given a LOOP and the failure of batteries 2D610 and 2D620; however, these conditions do not result in an SBO because the diesel generators remain capable of supplying the 4 kV buses.

Conclusion:

From the discussions 125 VDC battery failures on both units, core damage will result in both units but only the Unit 1 failures will also produce an SBO. Based on the shared diesel generators having more of a reliance from the Unit 1 125 VDC batteries and buses, Unit 1 will report a higher SBO contribution than Unit 2.

**NRC RAI 1c(2):**

It is noted in the ER submittal that the LOOP contributions to both units are the same. Explain this in light of the 4% difference in SBO contribution.

**PPL Response:**

The difference in contribution to CDF from an SBO as reported in response to Question 1c of PLA-6154 is 4.3% (17.1%-12.8%). The following table lists the Fussell-Vesely (FV) values for the combined failure of 1D610 (A battery) 1D620 (B battery) along with an SBO Flag (a recovery item inserted into the cutset to indicate an SBO exists) for Unit 1 and failure of 2D610 (A battery) 2D620 (B battery) along with an SBO Flag for Unit 2. The non-SBO contributions concurrent with a loss of off-site power are also provided for comparison.

| Event | U1 FV (SBO) | U1 FV (non-SBO) | U2 FV (SBO) | U2 FV (non-SBO) |
|---|---|---|---|---|
| FV for Common Cause Factor (CCF) 2 of 4 A, B 125V dc | 1.68E-02 | 0 | 0 | 1.69E-02 |
| FV for CCF 3 of 4 with A,B,C 125V dc | 6.59E-03 | 0 | 0 | 6.66E-03 |
| FV for CCF 3 of 4 with A,B,D 125V dc | 6.59E-03 | 0 | 0 | 6.66E-03 |
| FV for CCF 4 of 4 125V dc | 5.72E-03 | 0 | 0 | 5.78E-03 |
| FV for 125V dc A, B individual batteries | 5.43E-03 | 0 | 0 | 5.49E-03 |
| Total FV for CCF with A, B batteries | 4.11E-02 | 0 | 0 | 4.15E-02 |

The total FV for all combinations of A and B battery failures are similar for both units. However, as described in Response 1c (1) above, those failures result in SBO conditions in Unit 1, but do not cause an SBO in Unit 2.

It is concluded that Unit 1 has a higher reported contribution from SBO to CDF but the "extra 4.3%" difference compared to Unit 2 was not necessary for core damage. The model inserts an SBO Flag in a cutset during the recovery phase of quantification if that cutset would cause an SBO, regardless of whether or not the SBO is necessary for core damage.

**NRC RAI 1d:**

The response addresses the reasons the loss of a 4 kV safety-related bus does not make a significant contribution to CDF. Discuss the loss of a 13.8 kV bus initiator.

**PPL Response**:

The loss of the 13.8 kV buses are included in the initiating event frequency calculation for isolation events and non-isolation events. Unit 2 experienced a dead 13.8 kV auxiliary bus and then tripped. This event is included in the initiating event frequency calculation.

**NRC RAI 1g:**

The response to this RAI indicates that SSES does not have a hard containment vent. Discuss the costs and benefits of adding either an active or a passive (no operator action required) hard vent, based on consideration of both internal and external events.

**PPL Response:**

The estimated cost of implementing an unfiltered hardened vent is based on the Calvert Cliffs License Renewal application of $3.1M [Reference 1] on a per unit basis. For both SSES units, this would result in an estimated cost of $6.2M. This far exceeds the Modified Maximum Averted Cost Risk (MMACR) for SSES of $1.1M (which includes both internal and external events) used in the SAMA analysis. This modification would have screened out in Phase I and a therefore a detailed Phase II analysis would not have been performed. Similarly, the implementation of a hardened vent would have screened out in Phase I if the 95$^{th}$ percentile MMACR of $2.3M was used for SSES. In any event, a bounding cost-benefit analysis using the same methodology that was utilized in the Calvert Cliffs license renewal application (including a factor of two adjustments on the internal events results to account for the potential impact from external events) was performed by making the changes listed below to the Unit 1 and Unit 2 base case results at EPU conditions:

1. All containment overpressure failure (COPF) or containment vented sequences with subsequent core damage were assumed to go to OK (no core damage) end states (this assumes that the hardened vent is perfectly reliable and that an injection source can be maintained after venting to avoid core damage).

2. All early core damage sequences with later COPF were assumed to result in no larger than a low magnitude release with the same timing assumed to be applicable. This would predict larger than expected risk benefit since the opening of the containment vent would, by definition, occur earlier than the expected COPF time. Additionally, if a low or low-low release magnitude was already assigned, then the release was assumed to be a low-low release.

3. All early core damage sequences with later containment over-temperature failures (COTF) were also assumed to lead to reduced source terms of no larger than a low magnitude release even though the presence of the hardened vent would not completely eliminate this containment failure mode.

   Implementation of this potential SAMA yields a reduction in the CDF, dose-risk, and offsite economic cost-risk (OECR). The results are summarized in the following table for Unit 1 and for Unit 2 for post-EPU conditions:

| | Post-EPU | | |
|---|---|---|---|
| | CDF | Dose-Risk | OECR |
| Unit $1_{Base}$ | 1.97E-06 | 1.90 | $11,151 |
| Unit $1_{SAMA}$ | 1.61E-06 | 0.82 | $3,257 |
| Unit 1 Percent Change | 18.1% | 56.8% | 70.8% |
| Unit $2_{Base}$ | 1.94E-06 | 1.86 | $10,845 |
| Unit $2_{SAMA}$ | 1.58E-06 | 0.80 | $3,232 |
| Unit 2 Percent Change | 18.6% | 57.0% | 70.2% |

A further breakdown of the dose-risk and OECR information is provided below according to release category.

## SAMA for Implementation of a Perfect Hardened Vent, Unit 1 Results by Release Category (Post-EPU)

| Release Category* | H/E | H/I | H/L | M/E | M/I | M/L | L/E | L/I | L/L | LL/I | LL/L | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Frequency_{BASE}$ | 1.72E-07 | 1.59E-07 | 1.31E-10 | 0.00E+00 | 5.38E-07 | 1.51E-07 | 1.08E-07 | 4.87E-07 | 9.46E-09 | 1.56E-09 | 2.22E-08 | **1.65E-06** |
| $Frequency_{SAMA}$ | 1.72E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.06E-07 | 6.90E-07 | 1.43E-07 | 4.87E-08 | 3.08E-08 | **1.19E-06** |
| $Dose\text{-}Risk_{BASE}$ | 0.50 | 0.25 | 0.00 | 0.00 | 0.79 | 0.18 | 0.02 | 0.16 | 0.00 | 0.00 | 0.00 | **1.90** |
| $Dose\text{-}Risk_{SAMA}$ | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.23 | 0.06 | 0.01 | 0.00 | **0.82** |
| $OECR_{BASE}$ | $2,632 | $2,099 | $4 | $0 | $5,057 | $995 | $18 | $337 | $9 | $0 | $0 | **$11,151** |
| $OECR_{SAMA}$ | $2,628 | $0 | $0 | $0 | $0 | $0 | $18 | $478 | $129 | $3 | $1 | **$3,257** |

## SAMA for Implementation of a Perfect Hardened Vent, Unit 2 Results by Release Category (Post-EPU)

| Release Category* | H/E | H/I | H/L | M/E | M/I | M/L | L/E | L/I | L/L | LL/I | LL/L | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Frequency_{BASE}$ | 1.72E-07 | 1.39E-07 | 1.17E-10 | 0.00E+00 | 5.50E-07 | 1.30E-07 | 1.08E-07 | 4.73E-07 | 3.42E-09 | 6.87E-10 | 2.11E-08 | **1.60E-06** |
| $Frequency_{SAMA}$ | 1.72E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.06E-07 | 6.82E-07 | 1.25E-07 | 2.07E-08 | 2.40E-08 | 1.13E-06 |
| $Dose\text{-}Risk_{BASE}$ | 0.50 | 0.22 | 0.00 | 0.00 | 0.80 | 0.16 | 0.02 | 0.16 | 0.00 | 0.00 | 0.00 | **1.86** |
| $Dose\text{-}Risk_{SAMA}$ | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.23 | 0.05 | 0.00 | 0.00 | **0.80** |
| $OECR_{BASE}$ | $2,632 | $1,835 | $3 | $0 | $5,170 | $857 | $18 | $327 | $3 | $0 | $0 | **$10,845** |
| $OECR_{SAMA}$ | $2,628 | $0 | $0 | $0 | $0 | $0 | $18 | $472 | $113 | $1 | $0 | **$3,232** |

* H/E – High – Early
H/I – High – Intermediate
H/L – High – Late
M/E – Medium – Early
M/I - Medium – Intermediate
M/L – Medium – Late
L/E – Low – Early
L/I – Low – Intermediate
L/l – Low – Late
LL/I – Low – Low – Intermediate
LL/L – Low – Low – Late

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

**SAMA for Implementation of a Perfect Hardened Vent Net Value**

| Unit | Base Case Cost-Risk (Post-EPU) | Revised Cost-Risk (Post-EPU) | Averted Cost-Risk (Post-EPU) |
|---|---|---|---|
| Unit 1 | $550,000 | $229,648 | $320,352 |
| Unit 2 | $538,000 | $227,111 | $310,889 |
| Total | $1,088,000 | $456,759 | $631,241 |

Based on the $6.2M cost of implementation, the Post-EPU net value for this SAMA is -$5.6M (.6M - $6.2M = -$5.6M), which implies that this SAMA is not cost beneficial. If the 95th percentile values are applied, the implementation of this SAMA would not be cost-beneficial. A separate sensitivity was also explored in which no credit for the hardened containment vent in reducing the COTF sequences from M/I or H/I to L/I was taken. This assumption change is more likely to represent a realistic measure of the actual benefit that could be obtained from the implementation of the hardened vent. In this case, the averted cost risk was reduced to $43,443 for Unit 1 and to $42,642 for Unit 2 for a total averted cost risk of $86,085.

[1] Baltimore Gas and Electric Company, Applicant's Environmental Report - Operating License Renewal Stage; Calvert Cliffs Nuclear Power Plant Units 1 & 2. Appendix F - Severe Accident Mitigation Alternatives Analysis. April 1998. Available on U.S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/calvert-cliffs/ccv3.pdf.

**NRC RAI 2a(1):**

It would appear from the description of the event trees provided in response to this RAI that there are a very large number of unique individual sequence endpoints. These appear to be grouped or binned into one of the 12 release categories. While the information in the event tree provides the timing input to the release categories, release magnitude category assignment is stated to have been established by reference to MAAP case results. Unless MAAP cases were run for all unique sequences, some grouping or binning based on information in the event tree is needed to establish the release magnitude category assignment. Discuss this.

**PPL Response:**

Unique MAAP cases were not run for every event tree end state, but reference to a representative MAAP case was made for each of the event tree end states. The assignment of the release category magnitude was based on the binning strategy outlined below:

1. All ISLOCA or Break-Outside-Containment sequences were assigned to a high release magnitude category.
2. All LOCAs with vapor suppression failures were assigned to a high release magnitude category.
3. All energetic containment failures near the time of vessel failure were assigned to a high release magnitude category.
4. For all other cases, the following characteristics were examined in choosing a representative MAAP case for the release magnitude assignment.
    a. The status of the containment failure (or vent) location,
        i. in the drywell region,
        ii. in the wetwell above the water line, or
        iii. in the wetwell below the water line,
    b. The status of whether the suppression pool has been bypassed or not (pool bypass cases were assumed to be approximately equivalent to drywell region failures),
    c. The status of containment sprays or late injection to provide a long term source of water after containment failure (or vent), and
    d. The accident sequence progression and approximate time of core damage and vessel failure with respect to the time of containment breach.
5. The CSI release fraction from the representative MAAP case was then used to determine the release magnitude assignment (i.e., high, medium, low, or low-low) as shown in Table E.2-1 of the License Renewal application.

**NRC RAI 2a(2):**

Identify the version of MAAP utilized for the Level 2 analysis, and the version of the PRA in which the MAAP calculations were most recently updated.

**PPL Response:**

MAAP, Version 4.05 was utilized for the Level 1 and Level 2 analysis for the FEB06 version of the PRA models. MAAP cases were not needed for the subsequent PRA model revisions.

**NRC RAI 2a(3):**

A number of the CSI release timings provided in Tables 2a-1 and 2a-2, particularly those for early release categories for EPU conditions have extended end-of-release times (48 hours) that are greater than Pre-EPU conditions. Explain this and describe how the timing and rate of fission product releases were modeled in the Level 3 analyses.

**PPL Response:**

The Level 3 Pre-EPU and EPU analysis utilized the release timings and fractions from the Level 2 information provided in Table E.2-4a and E.2-4b of the License Renewal application that was reproduced in Tables 2a-1 and 2a-2 of the initial RAI response. To incorporate the data from these tables into MACCS2 for the Level 3 analysis, some manipulation is required given the following MACCS2 v.1.12 limitations:

1. Maximum of three (3) plumes allowed for proper MACCS2 operation.

2. Maximum of ten (10) hour plume durations.

Plume segments are modeled for each release category based on judgment given the MACCS2 v.1.12 limitations and the data provided from the Level 2 analysis. The plume definition process involves interpreting the data provided in the tables, as well as the graphical output for each of the releases to define up to three (3) plume segments that are judged to be representative for MACCS2 modeling that are generally consistent with the release time and fraction of each individual fission product group.

The table below provides a comparison of the Pre-EPU and EPU early release categories CSI plume release timings and fractions modeled in the Level 3 analysis.

**Comparison of Pre-EPU and EPU Early Release Category CSI Plume Modeling**

| Source Term | Plume | Plume Timing | | | | Release Fraction | |
|---|---|---|---|---|---|---|---|
| | | Release Time | | Plume Duration | | CSI | |
| | | Pre-EPU | EPU | Pre-EPU | EPU | Pre-EPU | EPU |
| 1 (H/E) | Plume 1 | 0.75 | 0.80 | 2.25 | 3.00 | n/a | n/a |
| | Plume 2 | 3.80 | 3.40 | 1.20 | 1.00 | 6.0E-1 | 5.8E-1 |
| 4 (M/E) | Plume 1 | 2.00 | 1.30 | 2.00 | 4.70 | n/a | n/a |
| | Plume 2 | 4.00 | 5.80 | 4.00 | 10.00 | n/a | 5.6E-2 |
| | Plume 3 | 8.00 | n/a | 8.00 | n/a | 6.0E-2 | n/a |
| 7 (L/E) | Plume 1 | 2.00 | 1.30 | 2.00 | 3.00 | 1.0E-3 | 1.1E-3 |

As indicated by the table, the plume segments are modeled fairly consistently for the Pre-EPU and EPU conditions given the differences in the Level 2 results.

<u>NRC RAI 2b</u>:

Expand on the form or nature of the input provided by industry consultants that is mentioned in the third sentence of the last paragraph of the response to this RAI. Provide information such as if the consultants performed a review of the analysis, if PPL asked specific questions, and if this input was formalized in any way.

**PPL Response:**

Two documents were prepared and reviewed by consultants in support of the Level 2 model development. The first document included recommendations for expanding the existing event trees to consider the multiple release categories as currently included in the model. The final version of this document was prepared in conjunction with support and input from PPL. The second document provided an initial set of MAAP case results in support of the Level 2 analysis. A formal record of the consultants internal review comments and the resolution of comments are included as appendices to each document. PPL performed an acceptance review of both documents.

One consultant was utilized to modify the event tree notebooks. Formal reviews of the event tree notebook revisions (one for pre-EPU and one for EPU conditions) were performed by PPL personnel. The event tree notebooks and resolution of comments were finalized using the PPL procedures and processes. Additionally, PPL personnel performed a complete set of Level 1 (and some additional Level 2) MAAP case runs to support both the pre-EPU and EPU revisions to the event tree notebooks. A consultant was utilized to formally review the MAAP case run documents. The other PRA supporting notebooks that were updated as part of this effort were formally reviewed and documented by PPL personnel utilizing the same process as outlined in the initial response to this RAI.

**NRC RAI 3a:**

With regard to this RAI, confirm that the revised IPEEE fire results (i.e., the audit response results cited in the ER) utilized the revised internal events IPE model upon which the August 11, 1998 NRC SER was based (i.e., with a total internal events CDF of 5.6E-7 per year).

**PPL Response:**

The revised IPEEE fire results used the original IPE data. In lieu of trying to recreate the IPEEE based on the revised IPE model upon which the August 11, 1998 NRC SER was based, fire core damage frequencies were developed. These fire core damage frequencies are based on the current cable and raceway database and the current risk model. These results are not based on a fire PRA. However, they are considered acceptable because the approach used produces results that are bounding fire CDF's since the entire fire zone is assumed to be affected.

As described in PLA-6201, 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 the current Level 1 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 Credit for 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 modifications include the installation of a redundant spray pond bypass valve that can be closed if the motor-operated bypass valve fails to close. This additional valve was put in to accommodate the spray pond thermal analysis. This additional valve normally does not influence the base model CDF results but can influence the results when 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.

**NRC RAI 3b:**

The response to this RAI does not discuss the issue causing the three order of magnitude increase in fire CDF mentioned in the SER. In addition, this increase is relative to the original IPEEE fire CDF. If applied to the fire CDF updated in the audit response and used in the ER, the fire CDF would be significantly larger than the internal events CDF. Discuss the technical issue causing the increase in fire CDF and its applicability to the other fire zones and the updated fire results.

**PPL Response:**

The response to RAI 3a (above) shows that the fire core damage frequency has been recalculated using our current cable and raceway database and current PRA model. Although the results shown are not from a fire PRA, they are a "first approximation" to a fire PRA. Since the equipment to cable to fire zone relationships are known for the Appendix R credited systems, an impact vector for a fire zone could be established. The impact vector assumed that all the relevant cables in the zone are damaged. Without mapping the actual location of the cables, it was assumed that a large fire would need to occur in order to have the relevant cables damaged. Given that each fire zone was assumed to have a large fire, further discussion of suppression is necessary. Since many of the fire zones have automatic suppression, the most reasonable way to have a large fire is due to a failure of automatic suppression. Failing all suppression (automatic and manual) is the other extreme. Given a fire starts, detection is available and the fire brigade will be dispatched to extinguish the fire.

The following assumptions are used:

- all cables in the zone are damaged due to a large fire;
- no fire modeling is used;
- Balance of Plant (BOP) systems are assumed to be unavailable (limitations of the cable and raceway database results in the conservative assumption that BOP systems were unavailable);
- partial credit for suppression is most appropriate.

Another conservative assumption is that in the most vulnerable fire zones, off-site power was modeled as failed. Investigating this input further revealed that only the off-site power to the safety-related buses would be lost. In all cases, at least one startup source of off-site power is available. This means that power would be available to the BOP systems and the fire CDF would not approach the bounding "No Suppression" case. Therefore, the current fire core damage frequency is considered to be best represented by the "Only Manual Suppression" case which is predicted to be 2.67E-6. This fire CDF value is consistent with the assumption utilized in the SAMA analysis that the fire CDF is approximately consistent with the Internal Events CDF. The slightly higher value reported here is encompassed within the 95$^{th}$ percentile sensitivity case values utilized in the cost-benefit analysis.

**NRC RAI 5c:**

The response to this RAI cites the Wolf Creek license renewal SAMA estimate of $350,000 for protecting cables in a fire zone. This estimate is based on protecting all the cables in specific Wolf Creek fire zones. Presumably, the cost of protecting only a few critical cables in a zone would be considerably less. Discuss if the SSES fire risk can be reduced by protection of only a few critical cables and, if appropriate, provide a cost-benefit analysis.

**PPL Response:**

The estimated cost for protecting cables is approximately $2,000 per linear foot. Thus, the estimate of $350,000 is not totally unreasonable for protecting a limited set of cables in a fire zone. Additionally, to further define a minimal set of cables to be wrapped, the first action would be to update the revised IPEEE analysis of fire risk to determine which cables need to be protected to eliminate or greatly reduce the fire risk in the area. Based on industry experience, this update would be between $250,000 and $500,000 for a reduced scope set of areas and the entire plant update would be nearly $1,000,000 or more. Since the highest averted cost risk using the 95$^{th}$ percentile maximum averted cost risk in the initial response to RAI 5c was less than $130,000, there would be no one area that would show a cost-benefit from the performance of this analysis in the context of the SAMA analysis.

**NRC RAI 6d:**

The response to this RAI does not address why the impact of venting, either with the existing procedures or the SAMA 12 procedures, is so low. As indicated in the RAI, the impact of venting would be expected to eliminate drywell overpressure failures and reduce the resulting releases. Therefore, explain why the frequencies of the H/I, M/I and M/L release categories, indicated in Table 2a-1 of the RAI responses to include drywell overpressure failures, are not reduced more significantly.

**PPL Response:**

Table 2a-1 in the RAI response was using the term "overpressure" in the general sense of exceeding the pressure/temperature containment failure threshold. The actual containment failure mode in the H/I, M/I, and M/L representative cases is better characterized as containment over-temperature failure (COTF). Since all injection and containment sprays are unavailable either for the duration of the scenario or at least up until near the time of containment failure, and it is assumed that not all of the core debris is transported into the wetwell.

Containment venting is assumed ineffective in COTF scenarios and is not credited in the event tree sequence model since the high temperature conditions will lead to separate containment failure modes (e.g., seal degradation). The scenarios where venting is credited would be those cases with injection or containment sprays available that lead to high containment pressures but relatively low containment temperatures (i.e., generally near saturated conditions). The availability of injection or sprays after core damage and vessel failure already tends to result in lower source terms. However, as shown in the SAMA 12 discussion within the license renewal submittal, there are some cases where credit for containment vent in the wetwell results in a source term reduction from a high or medium release category to a low or low-low release category, but the frequency of these contributors is much lower than the COTF contributions to the high and medium release category. In summary, the overall impact of providing more credit for containment venting when viable has a relatively small impact in reducing the source terms and associated cost benefit.