FPL.

May 15, 2013
10 CFR 50.90
L-2013-164

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Re: Turkey Point Nuclear Generating Station Units 3 and 4
Docket Nos. 50-250 and 50-251
Response to Request for Additional Information Regarding License Amendment Request No. 216 - Transition to 10 CFR 50.48(c) - NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Generating Plants (2001 Edition)

By Florida Power and Light Company (FPL) letter L-2012-092 dated June 28, 2012, in accordance with the provisions of 10 CFR 50.90, "Application of License or Construction Permit," FPL requested an amendment to the Renewed Facility Operating License (RFOL) for Turkey Point Nuclear Generating Station Units 3 and 4. The license Amendment Request (LAR) will enable FPL to adopt a new fire protection licensing basis which complies with the requirements in 10 CFR 50.48(a) and (c) and the guidance in Revision 1 of Regulatory Guide (RG) 1.205.

On September 5, 2012, the NRC Staff requested supplemental information regarding the LAR. By FPL letter L-2012-354 dated September 19, 2012, the supplemental information was provided.

On March 15, 2013, the NRC Staff requested additional information regarding the LAR. Based on discussions with the NRC Staff, the additional information requested was prioritized and the response to the request for additional information is to be provided in three separate submittals. The attachment to this letter provides the 120-day response to the request for additional information.

Please note that credit for the conditional probabilities for electrical panel factors have been eliminated and is discussed in response to RAI PRA 01.t. Work is in process for additional refinements related to the impact of the removal of the electrical panel factors credit. Further, credit for the incipient detection (very early warning fire detection system (VEWFDS) in the main control room has been eliminated and is discussed in response to RAI PRA 01.r. This approach is consistent with the latest NRC comments on FAQ 13-0001 for VEWFDS which does not provide any additional credit beyond that of a standard in cabinet detection system. The attached responses contain several sensitivity analyses to show the impact of the specific concern. As with Duane Arnold [Electronic Communication, ME6818 - DAEC Adoption of NFPA-805 - Request for Additional Information (revised), dated April 4, 2013 (ML 13098B072)] it is expected that the staff will request a final risk analysis combining the effects

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of all the agreed RAI responses. Several of the attached responses refer to that combined risk analysis and the additional refinements will be included in that combined analysis.

The supplemental information does not impact the 10 CFR 50.92 evaluation of "No Significant Hazards Consideration" previously provided in FPL letter L-2012-092.

This letter makes no new commitments; however, there is a change to an existing commitment. Items 3 and 4 of Table S-2 in Attachment S is changed with all references to "incipient detection" becoming "in cabinet detection" to reflect the analysis in RAI PRA 01.r response.

If you should have any questions regarding this application, please contact Robert Tomonto, Licensing Manager, at 305-246-7327.

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

Executed on May 15, 2013.

Michael Kiley
Vice President
Turkey Point Nuclear Generating Station

Attachment

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point
USNRC Project Manager for Turkey Point
Ms. Cindy Becker, Florida Department of Health

L-2013-164 Attachment

Response to Request for Additional Information Regarding License Amendment Request No. 216 120-Day Response

Florida Power and Light Company
Turkey Point Nuclear Generating Station Units 3 and 4
Transition to 10 CFR 50.48(c) - NFPA 805
Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition

PTN RAI PRA 01.a

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

a) F&O 1-10 against IGN-A9: The response to this F&O states that a sensitivity evaluation was performed that increased the transient fire weighting factor for occupancy and storage from "low" to "medium" and found that the Core Damage Frequency (CDF) impact was less than 1E-7 for each unit. It is not clear whether this sensitivity analysis bounds the deviations from the NUREG/CR-6850, "EPRI [Electrical Power Research Institute]/NRC-RES [Nuclear Regulatory Commission (NRC) Office of Nuclear Regulatory Research] Fire PRA Methodology for Nuclear Power Facilities," April 2005, approach for transient fire apportionment that are identified in this F&O (e.g., areas were weighted as zero for maintenance, occupancy, and storage even though entrance to the areas is physically possible, and areas used a weighting factor of "1" for maintenance, occupancy, and storage, even though activities were not prohibited by plant procedure). Re-perform the sensitivity study using the NUREG/CR-6850 or the National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition (NFPA 805), frequently asked question (FAQ) 12-0064 (Accession No. ML12346A488) approach for transient fire apportionment.

   Note the following expectations of applying the NUREG/CR-6850 approach (and as appropriate the draft FAQ 12-0064): 1) the influence factor for each location bin associated with transient or hot work fires will utilize a range of influence factors about the rating "3," including the maximum 10 (or 50 for maintenance) and, if appropriate, even the rating "0," 2) no physical analysis unit (PAU) may have a combined weight of zero unless it is physically inaccessible, administrative controls notwithstanding, and 3) in assigning influence factor ratings, those factors for the Control/Auxiliary/Reactor Building are distinct from the Turbine Building; thus, the influence factor ratings for each location bin are to be viewed according to the bin itself.

RESPONSE:

The transient weighting factors have been updated to consider the guidance specified in FAQ 12-0064. The impact of this change to the CDF and LERF quantification for PTN Units 3 and 4 are summarized below:

Risk Impact of Revision of Transient Weighting Factors to address FAQ 12-0064 guidance (original (transient portion of fire risk)/new (transient portion of fire risk)/percent increase in total baseline fire risk)

	Unit 3	**Unit 4**
CDF	1.94E-05/2.47E-05/7.2%	1.89E-05/2.23E-05/5.0%
LERF	9.51E-07/1.18E-06/3.8%	5.42E-07/4.93E-07/-1.0%

The impact on delta risk for this change is expected to be on the same order as the percent increase to the base risk.

PTN RAI PRA 01.i - Documentation of Circuit Analysis for Hot Short Probabilities

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

i) F&O 4-17 against CF-B1: Appendix D of the Fire Scenario report presents application of various hot short probabilities to specific scenario events listed in Appendices D and F. However, the link to circuit failure analysis and the circuit failure analysis itself does not appear to be documented. Determination of circuit failure probabilities does not appear to be included as part of the Cable Selection or other reports. Identify where description of the circuit analysis task resides, where the results are documented and how the two efforts were linked.

RESPONSE:

A sensitivity analysis was performed to determine the increase in risk by removing the hot short-induced spurious operation probabilities. To perform this sensitivity, the rule file was used with QRecover32 to find every hot short-induced spurious operation probability and replace its value with 1.0 in the aggregate cutset. An importance run was then generated using CAFTA for the altered aggregate cutset and the Fussel Vesley/Brinbaum (Birnbaum provides the maximum impact on risk since the current value has the BE equal to 1.0 and Birnbaum equals this current CDF minus total CDF with BE set to zero) was examined to determine the benefit of each hot short-induced spurious operation probability value being applied. For basic events with a hot short-induced spurious operation probability that led to an increase in risk greater than 1E-07 (from importance run Birnbaum value, as noted above) in the total CDF, the circuit analysis basis has been confirmed. Hot short-induced spurious operation probabilities were assigned using guidelines from Task 10 in NUREG/CR-6850. All components that were not subject to a circuit analysis will have corresponding hot short-induced spurious operation credit removed in a future revision of the Fire PRA documentation. Documentation of the basis for the remaining hot short-induced spurious operation probabilities will be incorporated into the Scenario Report. The sensitivity of the Fire PRA results to the values specified in NUREG/CR-6850 related to control power transformers is addressed in RAI PRA 12.

PTN RAI PRA 01.j - Uncertainty in Quantification Results

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

j) F&O 6-9 against QU-A3: Confirm that the risk estimates reported in Attachment W of the LAR are derived from the calculated means based on propagation of parametric data uncertainty (as opposed to being derived from point estimates). Also, confirm that the state-of-knowledge correlation (SOKC) was evaluated as part of the parametric data uncertainty analysis for initiating events, basic events, and human error. If the risk results were based on point estimates, provide them (i.e., fire area and total CDF, LERF, Δ CDF, and Δ LERF) based on calculated mean values that include consideration of SOKC.

RESPONSE:

The UNCERT quantification resulted in CDF/LERF mean values which were no more than 1% above the corresponding point value CDF/LERF quantification. Therefore, the use of the CDF/LERF point values is considered appropriate and the resulting Δ CDF and Δ LERF values are also considered appropriate. Uncertainty intervals associated with FPRA unique parameters were correlated to ensure consistency in application of these uncertainties.

PTN RAI PRA 01.k

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

k. F&O 6-16 against FQ-C1, HRA-C1 and QU-C2: Cited in Table V-3 as closed by the focused scope peer review, this F&O is discussed in detail in Attachment 1 of the response to the request for supplemental information regarding the LAR, dated September 19, 2012 (Accession No. ML12278A106). However, it is not clear that establishing minimum joint HEPs floors was performed because it appears not to have been performed for the internal events PRA (IEPRA) on which the fire PRA is based. If establishing minimum joint HEPs floors was not performed, then provide the results (e.g., CDF, LERF, ΔCDF, ΔLERF) of a sensitivity study performed on the FPRA utilizing guidance provided in NUREG-1921, "Fire Human Reliability Analysis Guidelines," to establish minimum acceptable values for joint HEPs. Ensure that HEPS screened by the IEPRA is reevaluated by the FPRA.

RESPONSE:

A sensitivity analysis has been performed for the total plant Fire CDF and LERF for both PTN U3 and U4 using an HEP floor value of 1E-05. This was done using a two-step process. The first step was to ensure that all internal events had a corrected floor value of 1E-05. A further review of the resulting cutset file was performed to adjust cutsets containing screening HEPs to ensure that the effective total HEP adjustment, including screening HEPs, was no less than 1E-05. The results of the sensitivity evaluation are provided in Table 1 below.

Table 1: Percent increase using floor value

	LAR Value (per reactor year)	Corrected LAR CDF and LERF incorporating effect of 1E-05 HEP Floor Value (per reactor year)	Percent Increase
U3 CDF	7.28E-05	9.06E-05	24
U3 LERF	6.17E-06	7.98E-06	29
U4 CDF	6.75E-05	7.02E-05	4
U4 LERF	5.13E-06	7.45E-06	45

The sensitivity has shown that all totals are still within the acceptance criteria of 1E-04 and 1E-05 for total CDF and LERF respectively (margin in the above numbers to allow for addition of internal events risk, as shown in LAR Attachment V, remains to ensure that the total will be below 1E-04/1E-05 for CDF/LERF). While delta CDF and LERF were not considered as part of this analysis, it is expected that the percentage increase in delta CDF will be a fraction of that determined above. The impact on delta risk will be evaluated in conjunction with an evaluation of the synergistic effects of all RAIs which impact Fire PRA risk quantification.

PTN RAI PRA 01.l - Basis for HEP Screening Values

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

l) F&O 7-6 against HRA-A2, HRA-A4, HRA-B2, HRA-B3, HRA-D2, HRA-E1, PRM-B11, HR-E1, HR-E2, HR-E4, HR-H2, HR-I1, HR-I2, HR-I3: It appears that a detailed fire-specific Human Reliability Analysis (HRA) was not performed for the FPRA because the fire response procedures are not sufficiently developed, and so as a result several SRs are not met or only Capability Category CC-I (i.e., HRA-A2, HRA-A4, HRA-B2, HRA-B3, HRA-D2, HRA-E1, PRM-B11, HR-E1, HR-E2, HR-E4, HR-H2, HR-I1, HR-I2, HR-I3). Provide PRA results and risk estimates by-area for total CDF and LERF and Δ CDF and Δ LERF, in which these SRs are met or achieve Capability Category II, or show quantitatively how use of conservative values does not lead to under prediction of the CDF, LERF, Δ CDF, and Δ LERF.

RESPONSE:

The Turkey Point (PTN) Fire PRA (FPRA) model is based on the full power internal events PRA (FPIE) model. Operator actions applied to the FPRA use the corresponding FPIE model Human Error Probability (HEP) with a multiplier applied based on the time available to complete the action, location of the action and whether the cue/instrumentation is impacted from a potential fire.

(FPRA OA HEP Value) = (FPIE OA HEP Value) x (Multiplier)

Multiplier values are determined by flow charts. One flowchart is applicable to In-Control Room (in-CR) actions and a second flowchart is applicable for Ex-Control Room (ex-CR) actions. These flowcharts can be found in the Turkey Point Human Failure Evaluation Report Rev. 3 in Section 4.

All Operator Actions in the FPIE PRA model were reviewed and evaluated for the FPRA model. For each PRA model operator action, the HRA Calculator data associated with the action was reviewed and the appropriate multiplier applied to the HEP per the flow charts. The HRA Calculator provided the FPIE HEP value for each event, the location of the action, and the time available to complete the action.

The HFE failure probabilities were modified as follows in the HRA Calculator to obtain the values used in the FPRA Recovery Rule file:

1. The non-recovery probability for each HFE was set to the value adjusted by the appropriate multiplier (i.e., base value times the multiplier),

2. All combination event non-recovery probabilities were re-calculated using the new fire-related HFE values from (1.) above.

The above approach for adjusting the values of the FPIE HFEs for fire is similar to that discussed in NUREG-1921 Section 5.2 in that flow chart logic is used to develop a fire-related value for the HFEs. The flow charts in Section 5.2 of NUREG-1921 lead the analyst to lookup tables that provide revised HFE values, where the PTN FPRA flow charts determine a multiplier to be applied to the FPIE HFE similar to NUREG-1921 Section 5.1.

In order to support this functionality, each operator action credited in the model was reviewed to identify the safe shutdown related instrumentation that should normally be available to support the action (one train of instrumentation is protected for fire to support the deterministic post fire shutdown analysis). It was assumed that if no safe shutdown instruments were available to provide a cue for the specific HFE, then the HFE would be failed. Credit is taken for the fact that the fire procedures identify post-fire shutdown instruments that could be impacted by fires for each fire area, and also for the general fire training that prepares the operators for the fact that fire events can impact instrumentation.

An analysis was also performed to identify the fire zone(s) where the ex-CR actions are taken and the fire zones that are in the operator's path to take the action(s). For FPRA quantification, in order to account for fire locations that could impact performance of the action or the pathway to the action, the ex-CR actions were failed in the fire zones where the action is taken and in the fire zones in the pathway to the action.

The HEP values were linked to the FPRA Risk Model by modifying the Recovery Rule file to reflect the fire-related values discussed above. Each HFE and combination (dependent) event is set to the value calculated by the HRA Calculator based on the adjusted values from applying the flow chart's multipliers.

After review of FPRA quantification results, for fire-related failures that are judged to be recoverable by a new operator action (an action not present in the FPIE model), a screening value (typically 0.1 for an ex-CR action and 0.01 for an in-CR action) was used for the new HFEs in lieu of performing a detailed HRA analysis. The approach used is similar to NUREG-1921 Section 5.1 in that a screening value is determined in lieu of a more detailed analysis. These screening values are judged to be conservative and consistent with the PTN FPRA screening flow charts discussed above. Based on the estimated timing of these screening HFEs compared to similar FPIE HFEs, the screening values used are consistent with the values that would be obtained by using the more detailed analysis discussed in NUREG-1921 Section 5.2. The addition of these HFEs was based on cutest review and thus their use is scenario-specific. Screening HFEs that are determined to be significant to risk will be included in a revision to the post-fire shutdown procedures.

Since a detailed HRA analysis was not performed for screening HFEs added after quantification, it was conservatively assumed that all the screening HFEs were completely dependent on one another. This means that failing one action would fail the rest. To ensure that probabilities from multiple screening HFEs were not combined in a single cutset, the Recovery Rule file used for FPRA quantification adds a combination multiplier to the cutset whenever multiple screening HFEs were in the same cutset. For example, a cutset with two screening HFEs, each with a 0.1 failure probability, would get a multiplier with a value of 10. The 10 would effectively remove credit for one of the 0.1 screening HFEs. See RAI PRA 01.k for additional discussion of the review of the minimum combination HEP value used in the PTN Fire PRA.

The feasibility assessment is not explicitly prescribed in the PTN FPRA HFE screening process, but the process used is considered to yield results that are consistent with NUREG-1921. For the in-CR actions, the cue availability was assessed to confirm that adequate personnel would be available to carry out the proceduralized actions. Both of those conditions were required for feasibility in both processes. Beyond these issues, the NUREG-1921 feasibility requirements were considered to be met in the PTN process by the work done for the FPIE HFE assessments and no additional work was required to demonstrate feasibility. For PTN ex-CR actions, an assessment was performed to determine if the pathway to take the action was impacted by the fire. If it was determined that the fire impacted access to the action location, the HFE was set to 1.0. NUREG-1921 allows credit for ex-MCR actions if it can be shown that the fire does not impact the action.

The discussion provided below compares the PTN HRA method to that specified in NUREG-1921.

NUREG-1921 requires an assessment to be made for each fire scenario to identify whether or not safety-related equipment is impacted, and if so, whether the impacts are limited to a single division/train of equipment. Credit for an action is determined based on the types of failures that are present for each scenario. The PTN approach is based on the identification of failures that impact the equipment explicitly required to perform the action that is being evaluated. The fault tree model is constructed to ensure the actions are failed when required equipment is failed by the fire.

The impact of time is conceptually the same in the two methodologies, but practical implementation may yield some differences, depending on the analysts' assumptions. Both methodologies are designed to show a reduced impact of the fire on the HEP when the fire effects are no longer dynamic, but NUREG-1921 does not provide concrete guidance on when the dynamic changes are no longer occurring. For PTN it is assumed most fires are out by 60 minutes and thus has different multipliers for actions that are taken within 60 minutes and those taken between 60 and 120 minutes. No multiplier is applied for actions after 120 minutes.

Table 1 below summarizes the approaches used for determining the PTN FPRA related HFEs and provides a comparison to the criteria found in NUREG-1921 Section 5.1. Comparison to Section 5.1 of NUREG-1921 was used since it incorporates an approach where a screening value which could incorporate a multiplier to the FPIE HFE is addressed.

Table 1
PTN FPRA Related HFEs Comparison

	NUREG-1921 Screening	**Turkey Point Screening for new HFEs**	**Turkey Point FPIE HFE Adjustments (using FPRA Flow Charts)**
Feasibility (e.g., instrument availability, adequate timing, procedure availability, etc.)[1]	Infeasible actions set to 1.0.	Infeasible actions set to 1.0.	Infeasible actions set to 1.0.
Set 1 Action (HFEs from the internal events analysis)	Actions taken when fire impacts may still be evolving (within first hour): 10x FPIE HEP Long term actions where the fire impacts are stable (after first hour): use FPIE HEP	NA - adjustments to FPIE HFEs based on flow charts (see the discussion in the column to the right)	Ex-CR Actions: Actions that must be taken in less than 60 minutes: If complex 30x FPIE HEP, If not complex 10x FPIE HEP Actions that must be taken between 60 and 120 minutes: If complex 6x FPIE HEP, If not complex 2x FPIE HEP Actions that must be taken after 2 hours: Use FPIE HEP In-CR Actions: Actions that must be taken in less than 60 minutes: 10x FPIE HEP Actions that must be taken between 60 and 120 minutes: 2x FPIE HEP Actions that must be taken after 2 hours: use FPIE HEP

Table 1
PTN FPRA Related HFEs Comparison

	NUREG-1921 Screening	Turkey Point Screening for new HFEs	Turkey Point FPIE HFE Adjustments (using FPRA Flow Charts)
Set 1 Action: Specific Criteria Comparison	Crit1: No significant damage to safe shutdown equipment being credited for the performance of an HFE.		Crit1: No specific rules about safe shutdown equipment, in general. Equipment used for the HFE must not be impacted (instrumentation failures are OK as long as 1 train OK).
	Crit2: No spurious instrument behavior related to the critical safety functions. No spurious behavior the operators can't clearly attribute to a fire. No spurious events allowed that require immediate responses.		Crit2: Spurious actuations that impact the equipment being used in the HFE are not allowed. At least one train of non-impacted instrumentation must be available.
	Crit3: On train/div of safe shutdown equipment and instrumentation must be completely free of any spurious events.		Crit3: No requirements about safe shutdown equipment unless it is used as part of the HFE.
	Crit4: The MCR crew most responsible for safe shutdown must not have any significant additional responsibilities for a fire.		Crit4: A general assessment of staffing in fire events is made as part of the fire HRA to identify any potential task loading issues.
	Crit5: No significant environmental impact or threat to MCR crew may be present.		Crit5: Unless MCR abandonment is required, no environmental issues are assumed to impact the HFEs.
	Crit6: There must be no reason to believe the action timing is different.		Crit6: The timing is assumed to be similar to the FPIE cases.
	Crit7: Show the conditions of the local action and the travel path to the location are not impacted by the fire; otherwise, set to 1.0.		Crit7: For quantification, the ex-CR actions were failed in the fire-impacted fire zone(s) where the action is taken and in fire zones in the pathway to the zone(s) to take the action.

Table 1
PTN FPRA Related HFEs Comparison

	NUREG-1921 Screening	Turkey Point Screening for new HFEs	Turkey Point FPIE HFE Adjustments (using FPRA Flow Charts)
Set 2 Action (FPIE actions, like Set 1, but with spurious electrical effects impacting one safety-related train only).	Actions taken when fire impacts may still be evolving (within first hour): The greater of 10x FPIE HEP or 0.1. Long term actions where the fire impacts are stable (after first hour): The smaller of 10x FPIE HEP or 0.1.		Ex-CR Actions: Actions that must be taken in less than 60 minutes: If complex 30x FPIE HEP, If not complex 10x FPIE HEP Actions that must be taken between 60 and 120 minutes: If complex 6x FPIE HEP, If not complex 2x FPIE HEP Actions that must be taken after 2 hours: Use FPIE HEP In-CR Actions: Actions that must be taken in less than 60 minutes: 10x FPIE HEP Actions that must be taken between 60 and 120 minutes: 2x FPIE HEP Actions that must be taken after 2 hours: use FPIE HEP
Set 3: Actions added for the fire model (not in FPIE), or FPIE HFEs that are significantly altered for fire.	Actions to be performed within 1 hour of the fire: Set to 1.0. Actions taken after 1 hour and there is "plenty" of time for diagnosis: Set to 0.1 or 10x the FPIE, whichever is smaller.	In-CR: Set to 0.01 unless compelling conditions indicate an alternate value should be used. Ex-CR: Set to 0.1 unless compelling conditions indicate an alternate value should be used.	NA – screening values used (see discussion to the column to the left)
Set 4: MCR abandonment	Set to 1.0.	Not specifically part of the screening process, but set to 0.1 for PTN.	Not specifically part of the screening process, but set to 0.1 for PTN.

Notes:
[1]The feasibility check is considered to be consistent for each method.

PTN RAI PRA 01.m - Treatment of joint HEPs

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

m) F&O 7-8 against HR-H3 and HR-I2 via HRA-D2 and PRM-B1: Clarify whether dependency analysis was performed for HFEs that appear in the same cutset. If dependency analysis has not been performed and a joint HEP has not been developed that reflects dependency for factors including timing, instrumentation, common procedures, increased stress, and availability of resources, then perform an HFE dependency analysis to provide new risk estimates by-area for total CDF and LERF and Δ CDF and Δ LERF, or show quantitatively how use of conservative values does not lead to under prediction of the CDF, LERF, Δ CDF, and Δ LERF.

RESPONSE:

All Full Power Internal Events (FPIE) PRA combination (dependent) event non-recovery probabilities were re-calculated by the Human Reliability Analysis (HRA) Calculator after the FPIE Human Failure Evaluation (HFE) values were adjusted for fire using the multipliers determined from use of the PTN FPRA screening HFE flow chart logic. The results of this dependency analysis were then incorporated in the Recovery Rule file used for FPRA quantification.

Since a detailed HRA analysis was not performed for screening HFEs added after quantification, it was conservatively assumed that all the screening HFEs were completely dependent on each other. To ensure that probabilities from multiple screening HFEs were not combined in a single cutset, the Recovery Rule file used for FPRA quantification added a combination multiplier to the cutset whenever multiple screening HFEs were in the same cutset. For example, a cutset with two screening HFEs, each with a 0.1 failure probability, would be assigned a multiplier with a value of 10. The multiplier would effectively remove credit for one of the 0.1 screening HFEs.

The use of conservative HEPs will result in conservative CDF, LERF, Δ CDF, and Δ LERF results. For Δ CDF and Δ LERF if the HEP is associated with a VFDR the delta is conservative and if the HEP is not associated with a VFDR the impact on the risk in both variant and compliant cases is the same and so the impact on the delta risk will cancel out.

PTN RAI PRA 01.o - Quantify Rather than Screen HGL Scenarios

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

o) F&O 9-1 and 9-4 against FSS-G2, FSS-G3, FSS-G4, FSS-G5,and FSS-G6: Table 3-1 of the Hot Gas Layer (HGL) and Multi-Compartment Analysis (MCA) report presents a large number of scenarios screened out because the frequency of forming an HGL was determined to be somewhere between 1E-7/yr and 4.37E-7/yr. As a result of applying this and other screening criteria, no MCA scenarios were quantified. F&O 9-4 points out that assuming a bounding value of 7.4E-3 for active barrier elements may not be bounding (NUREG/CR-6850 Section 11.5.4.4 suggests using a screening value of 0.1). Given the large number of screened scenarios, screening assumptions, and frequencies exceeding 1E-7/yr, it is not clear whether the contribution to risk from MCA scenarios is "insignificant". Provide quantitative justification for screening out the contribution of MCA to CDF and LERF and Δ CDF and Δ LERF.

RESPONSE:

The Hot Gas Layer and Multi-Compartment Analysis report was updated to remove the use of the screening criteria. The updated Hot Gas Layer and Multi-Compartment Analysis report provides details of the process used in generating the updated analysis. The result of removing the screening criteria from the analysis resulted in additional MCA scenarios being incorporated into the quantification model. The contribution of these MCA scenarios to the U3 CDF and U4 CDF is 1.02E-07 /year and 8.87E-08/year, respectively. The corresponding contribution for LERF is 8.65E-09/year and 9.88E-09/year for U3 and U4 respectively.

Given that 13 of 57 fire areas have multiple PAUs and that the majority of these 13 fire areas (A, B, C, F, G, O, HH, MM, WW, XX, AAA, BBB and OD) are relatively low risk fire areas, the impact on the Δ CDF and Δ LERF is expected to be significantly less than the impact on the total CDF and LERF.

The use of the 7.4E-03 barrier failure probability is considered a bounding value since the barrier failure probabilities specified in NUREG/CR-6850 are not demand failures and therefore represent the probability of a pre-existing failure with the door failure probability being the highest value for the various barrier features specified.

PTN RAI PRA 01.p - Additional Basis for HGL/MCA Methodology

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

p) F&O 9-5 against FSS-G2: Clarify that the standard generic fire scenario used in multi-compartment analysis (MCA) represents or bounds actual conditions in the fire zones addressed. Include discussion of how the potential for high energy arcing fault (HEAF) is represented or bounded in the areas where it exists. If the standard scenario does represent or bound actual scenarios that can occur in fire zones addressed in MCA (e.g., HEAF where there may be 0 minute delay for ignition), provide a quantitative estimate of the total fire area CDF and LERF and Δ CDF and Δ LERF of using the standard fire scenario.

RESPONSE:

The HEAF fire has the potential to directly damage targets without being able to credit time to suppress the initial fire. The MCA evaluation is analyzing the time to suppress the fire before the multiple enclosure volumes reach a damage temperature. Analyzing the HEAF fire in MCA terms means that after the initial fire occurs, the fire that remains is a typical medium voltage switchgear fire (237 kW fire, per NUREG/CR-6850, Appendix G, Table G-1, 3rd row, bounding value for 98th percentile fire). By evaluating the switchgear rooms using an electrical cabinet fire (464 kW fire, per NUREG/CR-6850, Appendix G, Table G-1, 4th row, bounding value for 98th percentile fire) in combination with the bounding secondary combustible configuration, a bounding fire scenario is produced for physical analysis units (PAUs) where a HEAF can occur. A similar approach is implemented in PAUs without the potential for a HEAF fire and the scenario generated is also a bounding fire scenario. The bounding fire scenario is used to generate a time to damage and equivalently a non-suppression value based on that time to damage. The bounding fire scenario non-suppression value is applied to the total PAU ignition frequency along with a barrier failure probability to generate a probability of multi-compartment damage. By applying the most bounding ignition source fire and secondary combustible fire to the entire PAU ignition frequency, the calculated MCA probability is a conservative and bounding probability.

PTN RAI PRA 01.r - Incipient Detection Credit

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

r) F&O 9-10 against FSS-A6 and FSS-H7): The F&O clarifies that per discussion with the licensee non-suppression credit that could be obtained by using NUREG/CR-6850 Appendix L guidance was not applied, but rather incipient detection (very early warning fire detection system (VEWFDS)) was credited for preventing damage in the cabinets monitored. The F&O also clarifies that propagation of fire to other cabinets is precluded. F&O 10-13 indicates that FAQ-08-0046 (Accession No. ML093220426) rather than NUREG/CR-6850 Appendix L was applied for cabinets with incipient detection. Staff notes an 0.02 non-suppression probability (NSP) factor was applied in Appendix H of the Fire Scenario report to represent full credit for VEWFDS. Application of FAQ-08-0046 to credit success of VEWFDS does not preclude consideration of fire damage in a cabinet but rather fire damage to adjacent cabinets. Also, use of FAQ-08-0046 is not meant for continuously occupied locations such as the main control room (MCR) where significant non-suppression credit could already be realized by applying NUREG/CR-6850 Appendix L. Credit by VEWFDS for preventing damage in the cabinets monitored should be removed, propagation of fire to adjacent cabinets should be explicitly added to the modeling (or its low risk contribution quantitatively justified), and a sensitivity study performed that calculates new total CDF and LERF and Δ CDF and Δ LERF. Note that, although the response to NRC Question 4 presented in the LAR supplement dated September 19, 2012 (Accession No. ML12278A106), removes a factor of 50 over-credit from the original risk reduction estimates presented in the LAR, the revised risk reduction values still appear to credit VEWFDS installed in MCR panels (delta-CDFs of 1.3E-5/yr for Unit 3 and 1.8E-5/yr for Unit 4).

RESPONSE:

The credit for incipient detection of 2E-02 has been removed from all scenarios in the Control Room and the factor has been replaced with a 0.19 non-suppression probability credit. This non-suppression probability is based on the FAQ 08-0050 non-suppression probability Tables (Table 1, at 5 minutes, for Control Room fires). The use of this factor is based on NUREG/CR-6850 Section P.1.3 where incipient credit of 5 minutes can be taken for a panel with in-cabinet smoke detection. The in-cabinet smoke detection to be employed may be an incipient detection system or a standard smoke detector. A decision regarding the type of detector will be made once further guidance on incipient detection credit is finalized (FAQ 13-0001 is being developed to provide this additional guidance, the use of the 0.19 non-suppression probability is consistent with the draft FAQ).

Table P-3 allows for a five minute deduction to the detection time in the control room resulting in a 0.19 NSP, which is the factor for fires that will cause damage to the panel that is impacted by the fire. All other fires will be suppressed before any damage in the associated panel. For the Main Control Board (MCB) Appendix L allows additional credit based on the damage distance in the MCB. The Control Room analysis for Turkey Point has conservatively assumed a zero damage distance for a credit of 9E-03 in the MCB scenarios (from Figure L-1 of Appendix L of NUREG/CR-6850), which can be credited for all MCB fire scenarios. A total NSP factor of 1.71E-03 (9E-03*0.19) is used for MCB scenarios 3C01 through 3C06 and 4C01 through 4C06. Removing incipient detection and crediting smoke detection and the Appendix L factor is a refinement of the overall Control Room analysis and leads to a net reduction to the CDF, LERF and deltas. Incipient credit for non-MCB panels does not credit the Appendix L factor, however, the net result of incorporation of the 0.19 factor and the Appendix L factor on the MCB panels outweighs the increase in risk for substitution of the 0.19 factor for the 0.02 incipient detection factor for non-MCB panels. However, the Control Room analysis will also be impacted by RAI PTN 01.z ii and RAI PRA 08. For the net impact on CDF, LERF, Delta CDF and Delta LERF of these three RAIs see the response to RAI PRA 08.

PTN RAI PRA 01.t - Electrical Cabinet Fire Propagation

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

t) F&O 10-3 against FSS-C4: Section V-2 of the LAR and the LAR supplement provide sensitivity analysis results of using this method of applying conditional probabilities for propagation of fire from electrical cabinets against using guidance in NUREG/CR-6850. The sensitivity results show an increase of 15 to 35% in CDF and LERF, and an increase of 20 to 90% for Δ CDF and Δ LERF for affected fire zones. This results in exceeding Regulatory Guide (RG) 1.174 guidelines for Δ CDF and Δ LERF. The response to this F&O indicates that credit for defense-in-depth (DID) may be taken to compensate for the increased Δ risk. Discuss what refinements in the sensitivity analysis or DID credit are being used to address or compensate for this excessive risk.

RESPONSE:

The PTN Fire PRA was updated to remove conditional probabilities for propagation of fire from electrical cabinets. This included removing credit in the Hot Gas Layer and Multi-Compartment Analysis and removing credit on individual electrical cabinet scenarios in the quantification. The credit for conditional probabilities for propagation was replaced by computing a non-suppression probability value based on heat flux damage at a target distance. For further details, see the updated Hot Gas Layer and Multi-Compartment Analysis report which provides the individual calculation for each scenario. The resulting total U3 and U4 Fire CDF totals are 1.06E-04/year and 1.03E-04/year, respectively. The corresponding LERF totals are 1.34E-05/year and 1.09E-05/year for U3 and U4 respectively.

Further potential refinements to the analysis include additional scenario target partitioning and scenario-specific fire modeling of secondary combustibles.

In addition, the current CDF/LERF values are based on NUREG/CR-6850 baseline ignition frequencies. The use of the NUREG/CR-6850 Supplement 1 ignition frequencies is expected to result in a significant reduction in total risk with the above results as a bounding value for the required sensitivity analysis when using the Supplement 1 ignition frequency data.

The additional refinement and possible use of NUREG/CR-6850, Supplement 1 ignition frequencies will be addressed in conjunction with an evaluation of synergistic effects or RAI responses. This provides reasonable assurance that the final results will remain within Region II of R.G. 1.74 Revision 2. This analysis is expected to be performed subsequent to NRC review of the first round RAI responses as part of the incorporation of the final RAI results into the baseline analysis based on the agreed upon resolution of all the RAIs that impact the risk estimates.

PTN RAI PRA 01.v - Basis for NSP Credit in HGL/MCA Evaluation

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

v) F&O 10-9 against FSS-D8: This F&O and response indicates that non-suppression credit was taken in the MCA without explicitly considering time to detect and suppress a fire and time to form a HGL for individual scenarios. The F&O also states that fire detection and suppression system compliance to codes and standards is not taken into account. Staff notes a range of different non-suppression values presented in Appendices A, B, C, D, and F of the MCA report. Provide justification of the non-suppression values used in the MCA. Clarify whether instances exist in which the time-to-a-HGL could be less than the time-to-suppress the fire. If such instances exist provide the quantitative impact of including such scenarios on CDF and LERF and Δ CDF and Δ LERF.

RESPONSE:

The time to detect and suppress a fire was accounted for where credit was taken for automatic suppression or for detection in support of manual suppression. The specific approach taken is detailed below.

Non-suppression credit for automatic suppression systems in the Hot Gas Layer and Multi-Compartment Analysis was only credited in physical analysis units (PAUs) where the automatic suppression system is actuated by smoke detection. The smoke detection is credited with detecting the fire at an early stage where damage is expected to be minimal and no time lag is evaluated. For these fire zones, a non-severe fire (a fire impacting targets up to a specified distance from the ignition source with an associated split fraction based on NUREG/CR-6850 heat release rate distributions) is evaluated which does not credit automatic fire suppression.

Evaluation of manual non-suppression credit in the Hot Gas Layer and Multi-Compartment Analysis credits detection at time equal to zero for PAUs with automatic detection installed. For PAUs without automatic detection installed, detection is assumed 15 minutes after the fire initiates per NUREG/CR-6850 Appendix P, page P-14. In the case where the time to HGL is less than 15 minutes, no credit for non-suppression is taken. The Generic Fire Modeling Treatments report and its Supplement 2 report document times to HGL for various heat release rate (HRR) and volume combinations. The Hot Gas Layer and Multi-Compartment Analysis report uses the scenario ignition source and PAU volume to assign a time to HGL, taking into account whether there is an area wide automatic detection system. The assigned time to HGL is considered as the time to suppress the fire before an HGL is reached. The time to suppress is input into the non-suppression distribution to generate a manual non-suppression value.

The Fire PRA has no instances where the time-to-a-HGL could be less than the time-to-suppress the fire for automatic suppression systems, as discussed above. For manual suppression systems the manual non-suppression probability distribution, as specified in NUREG/CR-6850 Appendix P, is applied to the time to HGL to determine the manual non-suppression probability. Therefore, the approach used is consistent with NUREG/CR-6850 and there is no impact to the reported CDF and LERF and Δ CDF and Δ LERF.

PTN RAI PRA 01.w - Smoke Damage

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

w) F&O 10-12 against FSS-D9: Staff sees that assessment of smoke damage impact is provided in Section 6.2 of the Fire Scenario report. The licensee argues that only an abandonment scenario would produce smoke exposure conditions in the MCR sufficient to have negative impact on electronics not already directly affected by fire damage. No credit is taken for electronics surviving fire in the same cabinet. In addition, it is argued that high voltage components reside in enclosures that limit smoke density and that smoke removal capacity exists in areas of concern such as the switchgear rooms.

Based on this discussion it appears that smoke damage scenarios were not postulated as contributors to fire CDF. Further justify not postulating smoke damage by addressing each of the potential damage mechanisms presented in Appendix T of NUREG 6850.

RESPONSE:

NUREG/CR-6850, Appendix T, Section T.2 identifies four modes (circuit bridging, contact fouling, binding of mechanical movement, and direct chemical/corrosive attack) of smoke damage. Of these modes of smoke damage, NUREG/CR-6850, Appendix T, Sections T.2.1.2 and T.2.1.4 state that contact fouling and direct chemical/corrosive attack were found to have minimal or no risk significance as testing disproved the potential for such failure modes to cause long-term component failures during the times being considered for the postulated fire and the concurrent shutdown of the plant. As such, these modes of smoke-induced component failure were not considered in the PTN Fire PRA.

NUREG/CR-6850, Appendix T, Section T.2.1.3 states that the binding of mechanical movement mode of smoke damage has no impact on relays, breakers, switchgear, MCCs, and similar devices where the motive force is substantial. The section states that only components dependent on fine mechanical movement involving small driving forces (e.g., strip chart recorders, dial meters, or hard disk drive units) which are not encapsulated (which would prevent smoke penetrating to the moving parts and thereby mitigate the potential for damage) are susceptible to this mode of smoke damage. The section states that this mode of failure is found to have little or no risk significance.

This conclusion of little or no risk significance due to smoke damage causing binding of mechanical movement was further evaluated and verified in the PTN Fire PRA. As discussed in Section 6.2 of the Fire Scenario Report, the only scenarios where smoke damage to indications used in the Fire PRA could occur are for scenarios involving fire in the Main Control Room (MCR) which do not result in evacuation of the MCR. Strip chart recorders are not credited in the Fire PRA model. No credit is taken for dial meters surviving a postulated fire in the same cabinet in which the meter itself is located. As indicated in Section T.1.2.3 of Appendix T of NUREG/CR-6850, only meters which were mounted directly above the fire panel and were destroyed by heat failed, although the test did not have a "not reasonably sealed" meter as part of the test to determine if they may be susceptible to smoke intrusion. Based on the limitations imposed in the Fire PRA (i.e., not crediting meters located in the same panel as the postulated fire, not using meters exposed to smoke except in non-abandonment scenarios in the MCR, not crediting strip chart recorders for indication) and on the results of the testing as stated in NUREG/CR-6850, Appendix T, Section T.1.2.3, the potential for mechanical binding because of smoke has been adequately considered.

As noted in NUREG/CR-6850, Appendix T, Section T.2.2, "Only one mode of component failure was found in this review to be of potential risk significance; namely, circuit bridging". The components of concern with respect to potential circuit bridging due to the presence of smoke are High Voltage Components and Lower-Voltage Instrumentation and Control Devices. These components are located within well defined panel enclosures with limited ventilation. The concentration of smoke within these panel enclosures is expected to be significantly lower than that in the surrounding fire zone during a fire. Manual suppression activities, including smoke removal, will tend to disperse the smoke and reduce its concentration. The likelihood of smoke damage to components outside the threshold damage zone of influence for non-383 cables given the enclosure of susceptible components within panel enclosures and the early actions of a fire brigade to disperse and remove smoke is considered extremely small. Smoke damage is expected to be enveloped by the non-383 cable damage threshold criteria applied for plume and radiant heating as well as the criteria applied for evaluation of hot gas layer effects for all fire scenarios.

PTN RAI PRA 01.y - Evaluation of Cables as Secondary Combustibles

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

y) F&O 10-16 against FSS-C1: Based on the response to this F&O it is not clear that cables were included in the heat release rate (HRR) as secondary combustibles. Describe how cables as secondary combustibles were addressed. Also describe how the potential for fire propagation to additional targets via intervening combustibles was considered.

RESPONSE:

Secondary combustibles were treated as an additional heat release rate in the Hot Gas Layer and Multi-Compartment Analysis that contributed to a decreased time to hot gas layer . Those scenarios impacting secondary combustibles were identified during walkdowns, including the number of secondary combustible trays and their configuration. For specific details on the treatment of secondary combustibles in the Hot Gas Layer and Multi-Compartment Analysis see the updated report.

The zone of influence of an ignition source was not treated as being impacted by secondary combustibles when evaluating target damage distances. Further fire modeling and analysis refinement is required and will be addressed in conjunction with addressing synergistic impact of RAIs. This evaluation is expected to be completed in conjunction with NRC review of the first round RAI responses.

PTN RAI PRA 01.z.ii

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

z.ii) F&O 10-18 against FSS A-1 and F&O 10-19 against FSS-H1: F&O 10-18 finds that exclusion of transients in some compartments could be contributing to a non-conservative estimate of CDF and LERF and recommends including transient scenarios in all compartments where fire modeling has been used. F&O 10-19 finds that lack of documentation on transient fires locations and boundaries presents a challenge for review and update. Note that the transient HRRs in locations where they could damage pinch points (specific locations where loss of targets could results in risk significant impacts), regardless of the "reasonableness" of this placement, should be addressed probabilistically, not precluded a priori unless physically impossible. Per Section 11.1.5.6 of NUREG/CR-6850, transient fires should at a minimum be placed in locations within the plant PAUs where critical targets are located, such as where conditional core damage probabilities (CCDPs) are highest for that PAU, i.e., at "pinch points." Pinch points include locations of redundant trains or the vicinity of other potentially risk-relevant equipment, including the cabling associated with each. Transient fires should be placed at all appropriate locations in a PAU where they can threaten pinch points. Hot work should be assumed to occur in locations where hot work is a possibility, even if improbable (but not impossible), keeping in mind the same philosophy. With this context, provide the following:

ii. Relative to the MCR, provide an assessment of the impact on the PRA results (CDF, LERF, ΔCDF, ΔLERF) of placing transients behind the open-back main control boards (MCBs) and back panels

RESPONSE:

Scenarios have been created for CDF, LERF, ΔCDF and ΔLERF that postulate transient scenarios behind the open back Main Control Boards (MCBs), between these MCBs and back panels. A fire was postulated in front of each two adjoining back panel combinations and the open back MCB across the walkway from these panels. Where possible, it was postulated that a fire could impact two MCBs. The fire locations were chosen, such that all combinations of adjacent panels were included. The total increase in risk for CDF, LERF, ΔCDF and ΔLERF from the postulated fires is given in Table 1 below.

Table 1: Risk for Transient Fires at the Open Back MCBs

	CDF (per year)	LERF (per year)	ΔCDF (per year)	ΔLERF (per year)
U3 control room risk increase	8.83E-06	7.80E-07	4.10E-08	5.28E-09
U4 control room risk increase	6.96E-06	1.23E-06	1.28E-07	1.82E-08
U3 control room LAR reported risk	1.74E-05	2.43E-06	2.33E-06	3.76E-07
U4 control room LAR reported risk	1.82E-05	2.56E-06	1.54E-06	7.22E-08

See RAI PRA 08 for a compilation of changes to the control room Fire PRA quantification.

PTN RAI PRA 01.aa - Sensitive Electronics Evaluation

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

aa) F&O 10-22 against FSS-C6: Staff sees where the methodology for determining heat damage to "sensitive" electronics is described in Section 6.3 of the Fire Scenario report. Staff notes that instead of using the screening damage criteria (i.e., 3 kW/m^2) the criteria for cable damage were used, and that damage was not assumed in the MCR and other areas where the fire could be quickly extinguished. Clarify that electronics (i.e., computers, digital converters, digital amplifiers, digital communications equipment, electrical devices that contains a semiconductor or an integrated circuit board as a key element[1]) that could be damaged by heat from a fire (and whose failure can contribute to CDF or LERF) were assessed. Provide the quantitative impact on CDF and LERF, and ΔCDF and Δ LERF of considering fire-induced failure of electronics based on the recommended criteria from NUREG/CR-6850.

[1] Institute of Electrical and Electronics Engineers (IEEE) Standard 142-2007, "Recommended Practice for Grounding of Industrial and Commercial Power Systems" defines "electronic equipment" in a generic sense, as referring to "all analog and digital semiconductor-based equipment, including data processing, telecommunications, process measurement and control, and other related electronic equipment and systems."

RESPONSE:

Sensitive electronics (i.e., computers, digital converters, digital amplifiers, digital communications equipment, electrical devices that contains a semiconductor or an integrated circuit board as a key element) that were part of the internal events model and were required for evaluation in the fire PRA and that could be damaged by heat from a fire were assessed. This assessment was done using an approach consistent to that described in FAQ 13-0004. In other words, the shielding of components from direct radiant exposure by the robust enclosure of the panel within which the heat sensitive components are located can be conservatively substituted by modeling the component as being a non IEEE-383 thermoplastic cable – which would not be as sensitive to heat but would also be modeled as receiving direct radiant exposure from the postulated fire.

Resolution of the quantitative impacts of this approach to modeling sensitive electronic equipment on CDF, LERF, Δ CDF, and Δ LERF will be re-assessed once FAQ 13-0004 is finalized.

PTN RAI PRA 01.bb - Suppression damage

Please clarify the following dispositions to FPRA F&Os and supporting requirements (SRs) assessment identified in Attachment V of the License Amendment Request (LAR), as amended by the letter dated September 19, 2012 (Agencywide Documents Access and Management System Accession No. ML12278A106), that appear to have the potential to noticeably impact the FPRA results and do not seem fully resolved:

bb) F&O 10-23 against FSS-C5: The CC-I/II Supporting Requirement for SR FSS-C5 is: "JUSTIFY that the damage criteria used in the Fire PRA are representative of the damage targets associated with each fire scenario." What is the basis for concluding the F&O issue is beyond the scope of the SR? This F&O response refers to qualitative evaluation of the potential impact of suppression on equipment and implies that suppression activities, either manual or automatic, impacts do not damage components modeled in the FPRA. Provide further justification demonstrating that fire suppression activation does not fail components modeled in the PRA. Use guidance presented on NUREG 6850 Vol. 2 page 11-26 on additional failure mechanisms including consideration of water spray from fire suppression systems.

RESPONSE:

Fire Brigade training ensures that fire suppression activities will be limited to those areas and use types of equipment to preclude damage to equipment other than that which is directly impacted by the fire. Automatic suppression systems associated with fusible head sprinkler systems (wet pipe sprinkler systems and preaction sprinkler systems) will provide localized water suppression in those areas where the temperature reaches the fusible link setpoint temperature. This will limit suppression activities to the vicinity of the ignition source and its targets. Fixed water spray systems are open head systems designed to provide protection to specific hazards (e.g., Instrument Air Equipment Areas in fire zones 78 and 83, Main/Startup/Auxiliary and C-Bus transformers in fire zones 81/82/86/87 and 999, and the Turbine Lube Oil Reservoir Areas in fire zones 76 and 81) and will not impact equipment other than that associated with the hazards which they are designed to protect. Halon suppression systems are designed to preclude damage to the protected components upon discharge. The only types of suppression systems which could impact equipment beyond the source of the fire and its vicinity would be associated with automatic deluge sprinkler systems which are located in the North-South Breezeway (fire zone 79A) and the Component Cooling Water (CCW) pump areas (fire zones 47 and 54). The CCW pump areas are outdoor areas with equipment designed for outdoor service and would therefore be designed and periodically subject to the same type of environment as the deluge suppression system. The North-South Breezeway contains cables but no equipment. The cables would not be adversely impacted by the actuation of the deluge system.

PTN RAI PRA 08 - MCR Modeling

Describe in general how MCR modeling was performed. In light of the audit walkdown observation that the MCB including the "benchboard" is one continuous panel, justify why propagation of fires between panels was not postulated or re-evaluate removing this assumption. Also, given another walkdown observation that many of the back panels are completely open justify why transient fires in the back panel area were not postulated. Explain why MCR abandonment as a result of "loss of function and control" is not provided in the MCR. Include as part of the description of MCR modeling discussion of how heating ventilation and air conditioning was considered. Also further justify the statement in Section 3.2.1 of the MCR Abandonment Times report that "half of the panels will involve a single cable bundle and the other half will be multiple bundle fires" along with discussion of the impact of these assumptions on the MCR analysis. Provide a sensitivity that compares the CDF, LERF, Δ CDF, and Δ LERF of the current analysis to consideration of MCB fire propagation in the MCBs placement of transient fires in the back panel area that leads to both abandonment and non-abandonment scenarios.

In conjunction with this question, note the following two examples:

a) In Table 2-1 of the Fire Risk Evaluation (FRE) Report, in the FRE for Zone MM (pp. 611-620), is a list of the zones where the MCR VEWFDS is credited (via the 0.02 NSP). Noting that Turkey Point claims to take no other NSP credit beyond that from the VEWFDS (0.02), consider FAQ 50 in NUREG/CR-6850, Supplement 1, and note that the NSP for time to damage = 5 min in the MCR is ~0.2. Therefore, if the NSPs for all the zones in Table 2-1 where the NSP of 0.02 was used were increased 10x to use the MCR NSP curve from the FAQ, the CDF in the MCR could be higher by ~8E-5 without the VEWFDS credit, bringing it to ~9.3E-5 (at end of Table 2-1, note total CDF = 1.26E-5). Most of this arises from four zones, 106-U, V, R-1 and BW. Since the total is usually taken as the bounding delta-CDF for the MCR, one can see it would be very large, almost 1E-4, unless other factors not credited because of the overwhelming effect of the VEWFDS were brought into play.

b) In Table 3-1 through 3-6 of the Fire Scenario Report, a generic error of assuming NSP < 0.001, including many set to zero, may lead to potentially serious underestimates of MCR abandonment CDF. For example, in Table 3-4, although only three bins have NSPs < 0.001, these three account for 72.1 percent of the ignition frequency, but the assumed NSP = 0. With NSP = 0.001, an additional 0.723 x 0.001 x (1 – 0.9) = 7.23E-5 is added onto the estimate of 2.09E-6, a factor ~35x larger.

RESPONSE:

As part of the revision to the main control room (MCR) Fire PRA quantification, new Main Control Board (MCB) scenarios have been created to account for the fact that the MCB panels are internally open to each other. As such, the analysis has been updated to postulate fires that damage adjacent panels in the MCB. The new scenarios are postulated so that all component failures associated with adjacent panels are failed and the ignition frequency (IGF) for each scenario is equivalent to two times the MCB fixed ignition source frequency. As part of the refinement of the control room evaluation, a 0.02 credit for incipient detection non-suppression probability (NSP) was increased to 0.19 (based on guidance in FAQ 08-0050 for in-cabinet smoke detection credit) and a NUREG/CR-6850 Appendix L MCB factor of 9E-03 was applied (assuming zero distance between components impacting the CCDP – see RAI PRA 01.r for more details with respect to this analysis change).

Scenarios have been created for CDF, LERF, ΔCDF and ΔLERF that postulate transient scenarios behind the open back MCBs and back panels. See the response to PTN RAI PRA 01.z.ii for more details relative to this analysis change.

Control room abandonment is only considered for cases where the Control Room environment (temperature and smoke) reaches the criteria specified in NUREG/CR 6850. For non-abandonment cases, credit may be taken at the PCS as needed to control functions impacted for a given Control Room panel fire. Credit for Control Room actions associated with components not impacted by the fire is allowed for the non-abandonment scenarios. The CCDPs associated with the non-abandonment scenarios are consistent with limited loss of control from the Control Room, and therefore, abandonment due to these failures is not considered necessary.

Control Room heating, ventilation, and air conditioning (HVAC) was considered in calculating the time to abandonment. It was assumed that HVAC would fail ten percent of the time and that ninety percent of the time would work successfully. This is considered to be a conservative estimate of the impact since HVAC operation is beneficial to removing smoke and the percentage of fires with HVAC failure (10%) is considered conservative since only failures in panels associated with HVAC system control will impact its operation. A sensitivity evaluation will be performed to evaluate the impact of this assumption on the Control Room abandonment time in conjunction with the revision to the control room abandonment analysis discussed in RAI FMOD 01.f

Any fire that starts in a cabinet with a multi-cable bundle will initially start in a single cable bundle. As such a multi-cable bundle fire will initially look like a single cable bundle fire. Therefore, the initial HRR/smoke generation will look like a single cable bundle fire and later develop into a larger fire with a greater impact on heat and smoke. The assumption that half of the panels contain single cable bundles and half contain multi-cable bundles is considered a reasonable assumption when calculating time to abandonment given that it is likely that a multi-cable bundle panel will behave much like a single cable bundle fire for half of the fire duration. A sensitivity evaluation will be performed to evaluate the impact of this assumption on the Control Room abandonment time in conjunction with the revision to the control room abandonment analysis discussed in RAI FMOD 01.f

The total impact on the main control room calculation of combining the main control board panels, the removal of incipient detection credit (as discussed above), and placing transients between the upright and back panels is given in Table 1 below (RAI Case):

Table 1: Net Impact on Control Room Risk Analysis (per reactor-year)

	Unit 3				Unit 4			
	CDF	Delta CDF	LERF	Delta LERF	CDF	Delta CDF	LERF	Delta LERF
RAI Case	1.73E-05	3.12E-06	9.67E-07	2.52E-08	1.19E-05	3.30E-06	1.40E-06	4.17E-08
LAR C/R (FA MM)	1.74E-05	2.33E-06	2.43E-06	3.76E-07	1.82E-05	1.54E-06	2.56E-06	7.22E-08
LAR total	7.28E-05	1.26E-05	6.17E-06	1.55E-06	6.75E-05	1.41E-05	5.13E-06	1.17E-06
C/R risk incr. (RAI Case minus LAR C/R)	-1.46E-07	7.90E-07	-1.46E-06	-3.51E-07	-6.28E-06	1.76E-06	-1.16E-06	-3.05E-08
New Total Plant Fire Risk	7.27E-05	1.34E-05	4.71E-06	1.20E-06	6.12E-05	1.59E-05	3.97E-06	1.14E-06

The reduction/small increase in risk documented above is a result of the significant reduction in risk for the main control boards when credit for 0.19 non-suppression probability based on installation of in-cabinet detection was incorporated in conjunction with the use of the NUREG/CR-6850 Appendix L panel factor. This reduction in risk from the baseline quantification offsets the increase in risk due to combining main control board panels and the addition of transient fire scenarios behind the open main control board. The combining of the main control boards did not result in a significant risk increase since the associated risk was initially quite high and could not increase significantly. The New Total Plant Fire Risk specified above is the equivalent to the TOTAL risk specified at the end of Tables W-6 and W-7 of the LAR and does not include the modification offset specified in the LAR/LIC-109 review supplemental input (Turkey Point to NRC letter L-2012-354, dated 9/19/2012). Additional risk offsets for LERF and reduction in risk due to use of NUREG/CR-6850 Supplement 1 ignition frequencies will further offset the risk values reported above. These offsets will be addressed in conjunction with the assessment of synergistic effects of RAI responses.

The examples identified in parts (a) and (b) of this RAI are addressed as follows:

(a) See RAI PRA 01.r
(b) The update of the control room abandonment analysis to apply the 0.001 minimum NSP will be addressed in conjunction with the revision to the control room abandonment analysis discussed in RAI FMOD 01.f.

PTN RAI PRA 11 - MCR Abandonment

Please describe how CDF, LERF, Δ CDF, and Δ LERF are estimated in MCR abandonment scenarios. Describe whether any fires outside of the MCR cause MCR abandonment because of loss of control and/or loss of control room habitability? It appears that "screening" values for post-MCR abandonment of 0.1 and 0.2 were used (e.g., CCDP, including human error, of failure to successfully switch control to the Primary Control Station and achieve safe shutdown) rather than detailed human error analyses having been completed for this activity. Please justify the screening values used. The justification should provide the results of the HFE quantification process, such as that described in Section 5 of NUREG-1921, which would include the following, or an analogous method:

a) The results of the feasibility assessment of the operator action(s) associated with the HFEs, specifically addressing each of the criteria discussed in Section 4.3 of NUREG-1921.

b) The results of the process in Section 5.2.7 of NUREG-1921 for assigning scoping HEPs to actions associated with switchover of control to an alternate location, specifically addressing the basis for the answers to each of the questions asked in the Figure 5-4 flowchart.

c) The results of the process in Section 5.2.8 of NUREG-1921 for assigning scoping HEPs to actions associated with the use of alternate shutdown, specifically addressing the basis for the answers to each of the questions asked in the Figure 5-5 flowchart.

d) The results of a detailed HRA quantification, per Section 5.3 of NUREG-1921, if the screening value is determined to not be bounding.

RESPONSE:

The following methodology, extracted from Section 5.7 of the Fire Risk Evaluation, details the methodology used for quantifying the variant and compliant case risks for the main control room.

The FRE for the Main Control Room (MCR) (Fire Area MM) utilized Fire PRA methods and guidance for analyzing MCR fires that are different than other Fire Areas due to the unique nature of the MCR fires (NUREG/CR-6850, Vol. 2, Appendix L). The possibility of forced abandonment was considered. MCR fire modeling was used to determine the time required to reach MCR abandonment environment conditions that would force abandonment. As described in NUREG/CR-6850, Volume 2, Section 11.5.2.1, fire protection features, room ventilation, and room geometry were inputs to the Control Room abandonment scenario. The MCR Fire PRA evaluates two scenarios for each ignition source (i.e., panel):

A fire at a given panel does not result in MCR abandonment
A fire at a given panel does result in MCR abandonment

The scenarios that do not result in abandonment were evaluated considering only equipment failures in the source panel. Scenarios that do not result in abandonment were evaluated in the Fire PRA and contribute to the calculated CDF and LERF contribution for the area, but were not considered as part of the delta risk calculations.

The scenarios that do result in abandonment were evaluated considering only a single success path using the equipment credited for the alternate shutdown capability (ASC). The treatment of this compliant case requires the development of a CCDP associated with abandonment of the MCR. The parameters that make up this value are the random failure events associated with the compliant single success path. To simplify the development of this CCDP, the CCDP is conservatively estimated by taking the sum of the following random events:

EDG Failure to Start – 7.2E-3
EDG Failure to Run – 2.6E-2
EDG Unavailable due to Maintenance – 1E-2
AFW Unavailable due to Maintenance – 1.3E-2

The sum of these events is 5.6E-2. This value is used as the compliant case CCDP for control room abandonment. The variant case abandonment is calculated using a qualitative assessment of the significance of the plant threat caused by the postulated fire event. This qualitative assessment uses the calculated CCDP associated with the fire impacts associated with the postulated source fire event. The following process was used for determining the variant CCDP. The intent of the criteria is to ensure that the variant CCDP is an appropriate bounding value.

FRANC Calculated CCDP	Bounding Abandonment CCDP used for risk quantification	Basis for CCDP used
< 1E-3	0.1	A CCDP of 1E-3 indicates limited consequence of the associated fire allowing the use of the PCS but assuming a bounding CCDP of approximately double the compliant case CCDP of 0.056
< 0.1, > 1E-3	0.2	A CCDP of 0.1 indicates a more significant consequence associated with the panel fire damage. A CCDP of approximately four times the abandonment compliant case CCDP is used
>0.1	1.0	A CCDP of > 0.1 indicates significant consequences that may not be recoverable from the primary control station; core damage is assumed for these scenarios

For LERF quantification, the same process used above has been applied to the scenario CCDP value, and this CCDP value was multiplied by the ratio of CLERP to CCDP (thus incorporating the extent to which containment isolation versus core damage contributes to the quantification of LERF).

The operator actions credited in the control room abandonment scenarios use the same methodology for adjusting Human Error Probabilities (HEPs) for these actions from the Full Power Internal Events (FPIE) PRA model or for defining screening HEPs as is used for other outside control room operator actions. See RAI PRA 01.l for a detailed discussion of the methodology used and a comparison between the PTN methodology and the NUREG-1921 methodology. The HEPs used in the FPRA provide the basis for the FRANC Calculated CCDPs as described in the table above. Additional conservatism to account for potential complexity of the abandonment scenario is applied by increasing the calculated CCDP to the values specified in the table above.

See response to RAI PRA 08 for a discussion of the criteria for control room abandonment due to loss of control and/or control room habitability.

PTN RAI PRA 12 - Control Power Transformer Credit

It was stated at the 2011 Nuclear Energy Institute (NEI) Fire Protection Information Forum that the Phenomena Identification and Ranking Table Panel being conducted for the circuit failure tests from the DESIREE-FIRE and CAROL-FIRE tests may be eliminating the credit for Control Power Transformers (CPTs) (about a factor 2 reduction) currently allowed by Tables 10-1 and 10-3 of NUREG/CR-6850, Vol. 2, as being invalid when estimating circuit failure probabilities. Provide a sensitivity analysis that removes this CPT credit from the PRA and provide new results that show the impact of this potential change on CDF, LERF, ΔCDF, and ΔLERF. If the sensitivity analysis indicates that the change in risk acceptance guidelines would be exceeded after eliminating CPT credit, please justify not meeting the guidelines.

RESPONSE:

A sensitivity analysis has been performed for CDF and LERF for the variant case for PTN Units 3 and 4. The results of this review are documented in Table 1. The sensitivity was done using the aggregate cutsets for the variant case. QRecover32 was used to find every location in the aggregate cutset where "*_3.30E-01" was found and the value was replaced with 0.66. To verify that the impact on the delta CDF and delta LERF are negligible, it was verified that no scenario that has a basic event set to 0.33 was associated with a VFDR component set to nominal in the credited zone. Additionally, top contributing cutsets have been examined to ensure they are not related to VFDRs. As such, it is expected that altering the basic event probability for the CPT credit from 0.33 to 0.66 for both the variant and compliant case will have little impact on the plant deltas for CDF or LERF.

Table 1 – CPT Credit Removal Sensitivity[1]

	Value with basic events set to 0.33 for hot short with CPT credit	Value with basic events set to 0.66 for hot short with CPT credit removed	Total Risk Increase (value/percent)
Unit 3 CDF	7.112E-05	7.178E-05	6.6E-07/<1%
Unit 3 LERF	6.418E-06	6.442E-06	2.4E-08/<0.5%
Unit 4 CDF	6.548E-05	6.882E-05	3.34E-06/<6%
Unit 4 LERF	2.839E-06	2.880E-06	4.1E-08/<2%

*Note 1. All values are from associated aggregate cutset file (aggregate cutset file CDF/LERF deviates slightly from than baseline CDF/LERF due to the conversion of FRANC cutsets to CAFTA cutsets, the delta risk calculated from both files is the same, the use of the aggregate file allows for editing of the aggregate cutset versus re-running all FRANC scenarios). The total increase provided above is based on the aggregate cutset risk. The percent increase is presented as a bounding number applicable to the aggregate cutset and the baseline quantification risk.

PTN RAI PRA 25 - Screening Values for Initial Quantification of the Pre-initiator HFEs

Provide the results (e.g., CDF, LERF, ΔCDF, ΔLERF) of a sensitivity performed on both the IEPRA and FPRA utilizing guidance provided in NUREG-1792, "Good Practices for Implementing Human Reliability Analysis," to establish screening values for individual pre-initiator HEPs and multiple HFEs in the same sequence. Ensure that the screening of any joint HEPs by the IEPRA is reevaluated by the FPRA.

RESPONSE:

The relevant excerpt from NUREG-1792 is shown below.

4.4.3 Good Practices

4.4.3.1 Good Practice #1: Use Screening Values During the Initial Quantification of the HFEs

The use of screening-level HEP estimates is usually desirable during the PRA development and quantification, with the estimates preferably assigned once much of the modeling is complete. This is acceptable (and almost necessary since not all the potential dependencies among human events can be anticipated) provided (1) it is clear that the individual values used are overestimations of the probabilities that would be developed if detailed assessments were to be performed and (2) dependencies among multiple HFEs appearing in an accident sequence are conservatively accounted for. These screening values should be set so as to make the PRA quantification process more efficient (by not having to perform detailed analysis on every HFE), but not so low that subsequent detailed analysis would actually result in higher HEPs. The screening estimates should consider both the individual events and the potential for dependencies across multiple HFEs in a given accident sequence (scenario). To meet these conditions, it is recommended that (unless a more detailed assessment is performed of the individual or combination events to justify lower values):

- No individual pre-initiator HEP screening value should be lower than 0.01 (this is typical of the highest pre-initiator values in PRAs, recognizing that the nature of these tasks usually involves the use of familiar procedures, performed under non-stress conditions on a frequent basis).
- Multiple HFEs in the same sequence should not have a joint probability value lower than 0.005 (accounts for a 0.5 high dependency factor) at this stage.)

(end of excerpt)

The screening values used in the Turkey Point PRA pre-initiator HRA were .003 for individual pre-initiators, and .0003 for multiple (common cause) pre-initiators. The value of 0.003 is representative of the value that would typically be obtained for a latent error involving a mis-positioning or other error when there would be at least some level of follow-up (i.e., an independent verification, post-maintenance test, etc.). This is a reasonable approach, since virtually every case in which errors could be important to the PRA models would incorporate some level of such follow-up. The value is high enough that any important events would be highlighted in the sequence cut sets and be candidates for more detailed analysis. At the same time, it is not so high that unimportant events would arise and needlessly require detailed analysis. The value of 0.0003 for multiple-train events can be considered to be bounding, but it is low enough that only the most important errors would survive the screening and require detailed analysis. If the Fussell-Vesely (FV) importance for a pre-initiator was greater than .005, the pre-initiator was analyzed in detail. In every case, the detailed analyses resulted in the pre-initiators' probabilities being significantly less than the relevant screening value of .003 or .0003, showing that the screening values used were appropriate.

The pre-initiator analysis was re-done using the screening values from NUREG-1792 (.0.01 for individual pre-initiators, and .005 for multiple (common cause) pre-initiators). All of the pre-initiators were set to these screening values with the exception of those for which detailed analyses already existed. The internal events CDF was quantified with these pre-initiator values, and the pre-initiators were sorted by FV importance. Those pre-initiators with a FV importance greater than 0.005 that had been assigned screening values were analyzed in detail. The higher, NUREG-1792 screening values resulted in many more pre-initiators with a FV importance greater than .005, and, therefore, many more pre-initiators that had to be analyzed in detail. The probabilities of those pre-initiators with a FV importance of less than .005 were left at their NUREG-1792 screening values. Given the maintenance philosophy at Turkey Point (and U.S. nuclear plants in general), with the emphasis on staggered train maintenance, independent verification, post-maintenance testing, and quality of procedures, it is not surprising that the pre-initiator probabilities from the detailed analyses were significantly lower than the NUREG-1792 screening probabilities. When the internal events CDF and LERF were quantified with the NUREG-1792 screening values and the pre-initiator probabilities from the new detailed analyses that had been performed, both CDF and LERF decreased slightly. The higher screening values from NUREG-1792 had created the need for more detailed analyses, thereby reducing the probabilities of a significant number of pre-initiators below that of the original screening values (.003 for single-train events and .0003 for multiple train-events).

The fact that every detailed analysis of a pre-initiator reduced its probability below that of the original screening values (.003 for single-train events and .0003 for multiple train-events) precludes the need for extending the sensitivity analysis to address the fire PRA results.

PTN RAI PRA 27b - IEPRA F&Os

Please clarify the following dispositions to IEPRA F&Os identified in Attachment U of the LAR that appear to have the potential to noticeably impact the fire PRA results and do not seem fully resolved:

b) F&Os HR-A2-01 and HR-B2-01 against HR-A2, HR-B1, HR-B2 & HR-I2: the disposition provided by the licensee notes that not all maintenance, surveillance, and calibration procedures and associated practices were examined. Describe the process by which pre-initiator HFEs are identified and the established rules for screening individual activities from further modeling consideration. Also, in light of the specific instances noted by the peer review where work practices having a simultaneous impact on multiple trains of a redundant system or diverse systems were either screened or not identified, justify the adequacy of the process used to identify such practices, and confirm that these practices were not screened from further modeling consideration.

RESPONSE:

F&O HR-A2-01 Description

This HR requires identification, through a review of procedures and practices, those calibration activities that if performed incorrectly can have an adverse impact on the automatic initiation of standby safety equipment. The system notebooks contain a detailed listing of testing and maintenance procedures that were identified for each system, but there is no discussion as to which procedures were determined to have the potential to result in equipment being left in a miscalibrated condition, and which were screened from consideration with the basis for screening.

F&O HR-A2-01 Response

Rather than examine all possible maintenance, surveillance, and calibration procedures and associated practices, a more practical method for the pre-initiator analysis was used which presumed that pre-initiators can potentially exist for all redundant standby trains modeled in the PRA and to insert screening values for their probability of occurrence. If quantification of the model with the screening values demonstrates that they are risk significant contributors (FV>0.005), then a specific review of potential maintenance, surveillance, and calibration procedures and practices that could cause the pre initiator condition to exist is performed against the screening rules in HR B1. Any procedures that met this criterion were identified and documented in the HRA Calculator file.

Review of Table 7 of the HHSI System Notebook revealed that only 2 of the 9 calibration procedures required pre-initiator events for the PRA model, and the events were already in the model following the method described above.

F&O HR-B2-01 Description

This SR does not allow screening of activities that could simultaneously have an impact on multiple trains of a redundant system or diverse system.

In the HHSI system notebook, the following valves are assumed not to be under maintenance while either unit is at power: MOV-*-864A, B; *-864C; *-845A, B, C, D; MOV-878A, B; MOV-*-856A, B; *-874C; *-882. Because these valves have the potential to impact BOTH Units, they cannot be screened in this manner. Based on this assumption, these valves would only be worked on while both Units are shutdown, which is probably not realistic.

F&O HR-B2-01 Response

For the MOV-*-864A, B valves, the model has a pre-initiator for leaving these valves in a closed position.

MOV-*-864C, the *-845 valves, and the *-882 valves are locked-open manual valves, so no test and maintenance or pre-initiator events are needed.

The HHSI recirculation valves, MOV-*-856A, B, if left closed following maintenance, will fail their related HHSI pumps. The need for pre-initiators for these valves was evaluated, and pre-initiators for the MOV-*-856A, B valves were added to the model. The *-874C valves are check valves and not subject to pre-initiator faults.

The MOV-878A and MOV-878B valves, if closed for maintenance, would prevent opposite-unit safety injection. The need for pre-initiators for these valves was evaluated, and pre-initiators for the MOV-878A, B valves were added to the model.

The Unit 3 and Unit 4 models were quantified with these pre-initiators added. The pre-initiators had a negligible effect on CDF and LERF.

PTN RAI PRA 27e - IEPRA F&Os

Please clarify the following dispositions to IEPRA F&Os identified in Attachment U of the LAR that appear to have the potential to noticeably impact the fire PRA results and do not seem fully resolved:

e) F&O QU-5: the requirement to document key assumptions and sources of uncertainty is not adequately dispositioned for a number of PRA elements. Describe how key assumptions and sources of uncertainty were identified and documented for AS-C3, HR-I3, DA-E3, IE-D3, IF-F3, SC-C3, and QU-F4. Include in this description identification of criteria used to judge the importance of assumptions and whether any sensitivity studies were performed as a result.

RESPONSE:

As expressed in Attachment U of the LAR, F&O QU-5 has been fully addressed and has no impact on the Fire PRA.

The assumptions and other potential sources of uncertainty, along with their importance are contained in various documents for each of the PRA elements. Accident sequence analysis (AS-C3), initiating events (IE-D3), and quantification (QU-F4) have this documented in their respective notebooks). For human reliability analysis (HR-I3), this data is contained for pre-initiators and post-initiators in their respective calculations (References 5 and 6). The data analysis calculation addresses DA-E3 in Tables 17 and 18. The success criteria calculation addresses SC-C3 in Tables 2 and 3.

The internal flooding analysis is now in its own hazard group with standard requirements for addressing assumptions and uncertainty for each of its five PRA elements. IF-F3 was replaced by IFPP-B3, IFSO-B3, IFSN-B3, IFEV-B3, and IFQU-B3. The internal flooding analysis calculation contains a section titled 'Assumptions and Sources of Uncertainty" that addresses these requirements.

Additionally, most of these responses were incorporated into an Uncertainty Notebook that was generated to describe the non-trivial assumptions and other potential sources of uncertainty associated with the various PRA elements. This document also characterizes and evaluates these uncertainties.

Following the 2002 Internal Events Peer Review, a gap analysis was performed to address the unmet standard requirements. Listed below are the descriptions and dispositions for each of the requirements pertaining to this RAI.

AS-C3 Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the accident sequence analysis.
AS-C3 Response
Assumptions and uncertainties are addressed in the Accident Sequence Notebook.

HR-I3 Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the human reliability analysis.
HR-I3 Response
The key assumptions for the HRA can be found in the reference documents for the approaches used: THERP, ASEP, HCR/ORE, CBDTM, etc. The technique used for assigning error factors to the HFEs is simplistic, with larger error factors for those HFEs with relatively smaller probabilities.

DA-E3 Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the data analysis.
DA-E3 Response
Tables 17 and 18 of data analysis calculation PTN-BFJR-02-026 provide a list and disposition of modeling uncertainties and assumptions.

IE-D3 Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the initiating event analysis.
IE-D3 Response
Key assumptions are discussed in the Initiating Events Notebook. Error factors or variances are calculated for each initiating event. A discussion of other sources of uncertainty has been added to the notebook.

SC-C3 Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the development of success criteria.
SC-C3 Response
Sources of uncertainty are characterized and provided in Tables 2 and 3 of calculation PTN-BFJR-09-014.

IF-F3 (IF**-B3) Description
DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with the internal flooding analysis.
IF-F3 (IF**-B3) Response
A new section titled "Assumptions and Sources of Uncertainty" has been added.

QU-F4 Description
DOCUMENT the characterization of the sources of model uncertainty and related assumptions.
QU-F4 Response
See QU-E1, E2, E3, and E4.

QU-E1 Description
IDENTIFY sources of model uncertainty.
QU-E1 Response
Model uncertainties are addresses in the various supporting documents, such as the HRA calculation, the Initiating Event Notebook, the AS notebook, and the model update calculation. Parametric uncertainty is addressed by taking the uncertainty data for the basic events and using the R&R uncertainty analysis code UNCERT to generate the uncertainty distribution of the top event quantification. These results are published in the model update calculations.

QU-E2 Description

IDENTIFY assumptions made in the development of the PRA model.
QU-E2 Response
Assumptions which affect the results are documented in the Key Assumptions and Details section of the model update calculation. Further, sensitivity studies are run for some of these assumptions.

QU-E3 Description
ESTIMATE the uncertainty interval of the overall CDF results. ESTIMATE the uncertainty intervals associated with parameter uncertainties (DA-D3, HR-D6, HR-G8, IE-C15) taking into account the state-of-knowledge correlation.
QU-E3 Response
Parametric uncertainty is addressed by taking the uncertainty data for the basic events and using the R&R uncertainty analysis code UNCERT to generate the uncertainty distribution of the top event quantification. These results are published in the model update calculations.

QU-E4 Description
For each source of model uncertainty and related assumption identified in QU-E1 and QU-E2, respectively, IDENTIFY how the PRA model is affected (e.g., introduction of a new basic event, changes to basic event probabilities, change in success criterion, introduction of a new initiating event).
QU-E4 Response
Assumptions which affect the results are documented in the Key Assumptions and Details section of the model update calculation. Further, sensitivity studies are run for some of these assumptions.

PTN RAI FMOD 01.j - Secondary Combustible Impact on Zone of Influence

Provide technical justification to demonstrate that the GFMTs approach as used to determine the ZOI of fires that involve multiple burning items (e.g., an ignition source and an intervening combustible such as a cable tray) is conservative and bounding.

RESPONSE:

The evaluation of the impact of secondary combustibles on the zone of influence (ZOI) of an ignition source is in progress. Further fire modeling and analysis refinement is required and will be addressed in conjunction with the evaluation of synergistic impact of RAIs.

The evaluations that address the secondary combustibles will also incorporate changes as a result of wall and corner effects as described in FMOD 01.p and FMOD 04. These evaluations are expected to also address the synergistic impact of the various RAIs and be completed in conjunction with NRC review of the first round RAI responses.

PTN RAI FMOD 01.k - Evaluation of Impact of Fire Propagation

NFPA 805, Section 2.4.3.3, states: "The PSA [probabilistic safety assessment] approach, methods, and data shall be acceptable to the AHJ." The NRC staff noted that fire modeling comprised the following:

- The Consolidated Fire Growth and Smoke Transport (CFAST) model was used to calculate control room abandonment times.
- The Generic Fire Modeling Treatments approach was used to determine the ZOI in all fire areas throughout plant.

Section 4.5.1.2, "Fire PRA" of the Transition Report states that fire modeling was performed as part of the FPRA development (NFPA 805 Section 4.2.4.2). Reference is made to Attachment J, "Fire Modeling V&V[verification and validation]," for a discussion of the acceptability of the fire models that were used.

k) Describe how the flame spread and fire propagation in cable trays and the corresponding HRR of cables was determined. Explain how the flame spread, fire propagation and HRR estimates affect the ZOI determination and HGL temperature calculations.

RESPONSE:

The following discussion provides the details of the analysis performed to determine flame spread and fire propagation in cables trays in order to calculate the associated Heat Release Rate (HRR). This HRR is used in developing the time to hot gas layer.

The baseline configuration evaluated involves two horizontal cable trays that are 0.45 m (1.5 ft) wide and release heat from the top and bottom or two horizontal cable trays that are 0.9 m (3 ft) wide and release heat on the top side only. The trays are adjacent to one another and positioned at the same elevation, or 2.44 m (8 ft) above the floor. The total cross-sectional width is thus 1.8 m (6 ft) when assumed to release heat from the top side only in accordance with NUREG/CR-7010 guidance.

The heat release rate development within secondary combustibles (cable trays) is calculated using the following equation:

$$\dot{Q}(t) = 0 \quad t < t_{ig} \qquad \text{(a)}$$

$$\dot{Q}(t) = nWL_i \, q''' + 2\, vnWq'''(t - t_{ig}) \quad t \geq t_{ig} \qquad \text{(b)}$$

where $\dot{Q}(t)$ is the heat release rate of the cable trays (kW [Btu/s]) at time t (s), t_{ig} is the ignition time of the cable trays (s), n is the number of surfaces releasing heat, W is the total cross-sectional width of the cable trays (m [ft]), L_i is the initial length of cable tray ignited by the ignition source (m [ft]), q''' is the heat release rate per unit area of the cable tray cables (kW/m^2 [Btu/s-ft^2]), and v is the lateral flame spread rate along the cable trays (m/s [ft/s]).

By assumption, the initial cable tray length ignited is equal to zero (ignition at a plane perpendicular to cable trays) and the ignition time is five minutes or 300 seconds. The flame spread rate is equal to 0.0003 m/s (0.12 in/s) per NUREG/CR-6850 and NUREG/CR-7010. The heat release rate per unit area of the cables is estimated using the following equation from NUREG/CR-6850:

$$\dot{q}=0.45\dot{q}\_bs^{\wedge} \qquad (c)$$

where $\dot{q}\_bs^{\wedge}$" is the bench-scale heat release rate per unit area measured for cables exposed to an incident heat flux of 60 kW/m² (5.3 Btu/s-ft²). The bench-scale heat release rate per unit area assumed in this calculation is 500 kW/m² (44.1 B Btu/s-ft²), which bounds the data for IEEE-383 qualified and non-IEEE-383 qualified/thermoset and thermoplastic cables listed in NUREG/CR-6850, Appendix R and in Section 7 of NUREG-1805. The resulting heat release rate per unit area for the cable trays used in this analysis is 225 kW/m² (19.8 Btu/s-ft²). A flame spread rate of 0.9 mm/sec as specified in NUREG/CR-6850, Section R.4.1.2 for non-IEEE-383/thermoplastic cables. This spread rate then define a rate of increase of the HRR based on the above HRR per unit area. For configuration not bounded by the above approach a bounding configuration in terms of the number of cable trays and their configuration is used with the same generic approach described above.

The Hot Gas Layer and Multi-Compartment Analysis was updated to address several RAIs involving the hot gas layer (HGL) analysis whose responses were deferred to the 120 day responses. To address the question in FMOD 04 about limitations of the Generic Fire Modeling Treatments, the enclosure aspect ratio limitation on HGL calculations was addressed in the analysis. For physical analysis units (PAUs) with aspect ratios beyond the limitations of the Generic Fire Modeling Treatments, the enclosure dimensions were truncated to represent a conservative volume with an aspect ratio within the Generic Fire Modeling Treatments limitations. To address PRA 01.x with respect to impacting greater than two secondary combustibles, the analysis incorporated an evaluation of as-built cable tray configurations and their associated HRR impact on the reduction in time to HGL. To address FMOD 01.q with respect to the potentially non-conservative approach of using an electrical cabinet HRR profile for a transient fire, the time to HGL curve was shifted by 10 minutes to reflect that a transient fire reaches its peak at 2 minutes versus 12 minutes for an electrical cabinet. See the Hot Gas Layer and Multi-Compartment Analysis report for the implementation of these methods. The updated total U3 and U4 CDF and LERF will be provided in an attachment to the Turkey Point Nuclear Plant FPRA Summary Report which incorporates several RAI responses involving the Hot Gas Layer and Multi-Compartment Analysis.

The resulting total U3 and U4 Fire CDF totals are 1.06E-04/year and 1.03E-04/year, respectively. The corresponding LERF totals are 1.34E-05/year and 1.09E-05/year for U3 and U4 respectively.

Further potential refinements to the analysis include additional scenario target partitioning and scenario specific fire modeling of secondary combustibles

In addition, the current CDF/LERF values are based on NUREG/CR-6850 baseline ignition frequencies. The use of the NUREG/CR-6850 Supplement 1 ignition frequencies is expected to result in a significant reduction in total risk with the above results as a bounding value for the required sensitivity analysis when using the Supplement 1 ignition frequency data.

The additional refinement and possible use of NUREG/CR-6850, Supplement 1 ignition frequencies will be addressed in conjunction with an evaluation of synergistic effects or RAI responses. This is expected to be performed subsequent to NRC review of the first round RAI responses.

To address PRA 01.dd with respect to identifying the specific ZOI used for each scenario, the data was incorporated into the 'scenarios to add' table of the U3 FRANC database. To address FMOD 01.u with respect to applying the ZOI for a wall transient instead of a corner transient for scenario 098-S1, the 'scenarios to add' table was updated to incorporate additional targets corresponding to a corner transient ZOI.

See RAI FMOD 01.j for a discussion of the status of the evaluation of secondary combustibles on ignition source zone of influence.

PTN RAI FMOD 02.e - Failure Criteria for Sensitive Electronics

It is stated in the damage threshold section of the Fire Scenario Report that "...NUREG/CR-6850 recommends failure criteria for solid-state control components of 3 kW/m^2 be used for screening purposes. However, given that the enclosure would provide protection to the sensitive internal contents from external fire effects, it is reasonable to apply the same ZOI established for cable damage. The omission of the credit for the enclosure is judged to offset the non-conservatism of the damage threshold." Describe the technical justification for this assumption.

RESPONSE:

The issue of sensitive electronics is the subject of a FAQ that is currently being worked on by Industry/NRC via NEI, Fire PRA FAQ 13-0004. The current direction of this FAQ is consistent with the statement made in the PTN Fire Scenario Report because the criteria proposed is to use cable damage threshold as the criteria for sensitive electronics inside a panel. The use of non IEEE-383 thermoplastic cable damage threshold criteria for PTN applies the more conservative of the two cable damage thresholds currently being evaluated in support of the draft FAQ. Resolution of this issue will be re-assessed once the FAQ is finalized.