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ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Duke Energy Carolinas, LLC (Duke Energy)
McGuire Nuclear Station (MNS), Units 1 and 2
Docket Numbers 50-369, 50-370
Renewed License Numbers NPF-9 and NPF-17

Subject: Response to June 18, 2015, and May 8, 2015, NRC Requests for Additional Information Regarding License Amendment Request to Implement a Risk-Informed Performance-Based Fire Protection Program (TAC Nos. MF2934 and MF2935).

References:

1. MNS Letter, License Amendment Request (LAR) to Adopt National Fire Protection Association (NFPA) 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants, dated September 26, 2013, Agencywide Document and Management System (ADAMS) Accession Number ML13276A126.
2. NRC Letter, McGuire Nuclear Station, Units 1 and 2 - Acceptance Review Results RE: License Amendment Request to Adopt National Fire Protection Association 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants, (TAC Nos. MF2934 and MF2935), dated December 31, 2013, ADAMS Accession Number ML13354B879.
3. MNS Letter, Supplemental Information For License Amendment Request (LAR) to Adopt National Fire Protection Association (NFPA) 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants, dated January 8, 2014, ADAMS Accession Number ML14016A097.
4. NRC Letter, McGuire Nuclear Station, Units 1 and 2 - Acceptance of Requested Licensing Action RE: License Amendment Request to Adopt National Fire Protection Association (NFPA) 805 Performance-Based Standard for Fire Protection for Light-Water Reactor Generating Plants (TAC Nos. MF2934 and MF2935), dated January 15, 2014, ADAMS Accession Number ML14014A279.

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5. NRC Letter, Request for Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program (TAC Nos. MF2934 and MF2935), dated August 28, 2014, ADAMS Accession Number ML14233A366.
6. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, dated October 13, 2014, ADAMS Accession Number ML14297A162.
7. NRC Letter, Request for Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program (TAC Nos. MF2934 and MF2935), dated October 27, 2014, ADAMS Accession Number ML14295A307.
8. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, dated November 12, 2014, ADAMS Accession Number ML14328A628.
9. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, dated December 12, 2014, No ADAMS Number.
10. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, dated January 26, 2015, ADAMS Accession Number ML15036A084.
11. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request to Implement A Risk-Informed Performance-Based Fire Protection Program, dated February 27, 2015, No ADAMS Number.
12. MNS Letter, Response to August 28, 2014, NRC Request for Additional Information Regarding License Amendment Request to Implement A Risk-Informed Performance-Based Fire Protection Program, Dated March 13, 2015, No ADAMS Number.
13. NRC Letter, Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, Dated May 8, 2015, ADAMS Accession Number ML15125A328.
14. NRC Letter, Request for Additional Information Regarding License Amendment Request To Implement A Risk-Informed Performance-Based Fire Protection Program, Dated June 18, 2015, ADAMS Accession Number ML15147A628.
15. MNS Letter, Response to June 18, 2015, NRC Request for Additional Information Regarding License Amendment Request to Implement a Risk-Informed Performance-Based Fire Protection Program, Dated July 15, 2015.

By letter dated September 26, 2013 (Reference 1), Duke Energy submitted a LAR to adopt a new, risk-informed, performance-based (RI-PB) fire protection licensing basis for the MNS Units 1 and 2.

On December 31, 2013 (Reference 2), the NRC requested supplemental information in order to make the September 26, 2013, LAR complete and acceptable for review by the NRC. By letter dated January 8, 2014 (Reference 3), Duke Energy provided the requested supplemental information to the NRC. By letter dated January 15, 2014 (Reference 4), the NRC accepted the September 26, 2013, LAR for review.

By letters dated August 28, 2014, and October 27, 2014 (References 5 and 7, respectively), the NRC requested additional information (RAI) in order to complete their review of the September 26, 2013, LAR. Those letters grouped the RAIs into 60-day, 90-day, 120-day, and radiation release responses. Duke Energy provided the 60-day, 90-day, and some of the 120-day RAI responses by letters dated October 13, 2014, November 12, 2014, and December 12, 2014 (References 6, 8, and 9, respectively). Responses to the radiation release RAIs and some of the remaining 120-day RAIs were provided by letter dated January 26, 2015 (Reference 10).

By letter dated February 27, 2015 (Reference 11), Duke Energy submitted responses to all remaining first-round RAIs, excluding Probabilistic Risk Assessment (PRA) RAI 03. This submittal also included revised responses to PRA RAI 12 and PRA RAI 17. By letter dated March 13, 2015 (Reference 12), Duke Energy submitted response to PRA RAI 03.

By letter dated July 15, 2015 (Reference 15), Duke Energy submitted responses to a portion of the second-round PRA RAIs (Reference 14).

McGuire's response to all remaining PRA and Fire Modeling (FM) RAIs is enclosed in Enclosure 1 of this letter. Enclosure 2 contains the updated sensitivity study associated with the response to FM RAI 02.b.01. Revisions to the LAR submittal package associated with these RAI responses are included in Enclosure 3 of this letter.

Attachment 2 of Enclosure 2 contains pictures, drawings, and analysis of fire sensitive areas. Due to the security sensitive nature of this information, Duke Energy requests that it be withheld from public disclosure pursuant to 10 CFR 2.390(d)(1). Duke Energy classifies this attachment as Sensitive Unclassified Non-Safeguards Information (SUNSI). When this attachment is separated from the rest of the enclosure, this submittal is de-controlled.

The conclusions reached in the original determination that the September 26, 2013, LAR contains No Significant Hazards Considerations and the categorical exclusion from performing an Environmental/Impact Statement have not changed as a result of the RAI responses in Enclosure 1.

This submittal affects regulatory commitments as shown in Attachment S of the LAR. See revised pages shown in Enclosure 3 of this letter.

Please direct any questions on this matter to Brian Richards at (980) 875-5171.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 20, 2015.

Sincerely,

CC/J L III for SDC Acting MNS Plant Manager

Steven D. Capps

Enclosures 1, 2, and 3

xc:

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ENCLOSURE 1

Duke Energy Response to the MNS NFPA 805 LAR
PRA and FM RAIs (Second-Round)

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST TO ADOPT

NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805

PERFORMANCE BASED STANDARD FOR FIRE PROTECTION

FOR LIGHT WATER REACTOR GENERATING PLANTS

DUKE ENERGY CAROLINAS, LLC

MCGUIRE NUCLEAR STATION UNITS 1 AND 2

DOCKET NOS. 50-369, 50-370

By letter dated September 26, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13276A126), Duke Energy Carolinas (Duke) submitted a license amendment request to change its fire protection program to one based on the National Fire Protection Association (NFPA) Standard-805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," 2001 Edition, as incorporated into Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.48(c). In order for the U. S. Nuclear Regulatory Commission (NRC) staff to complete its review of the license amendment request (LAR), the following additional information is requested:

PRA RAI 03.a.01

The response to PRA RAI 03.a provides the results of an uncertainty analysis on the total fire core damage frequency (CDF) and large early release frequency (LERF), that includes accounting for state of knowledge correlations, but no corresponding results are provided for delta-risk. Provide the results of the uncertainty analysis impact on the delta risk results and discuss if the RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" risk guidelines are met using the mean results.

McGuire Response:

An updated FPRA model was created to incorporate the changes made to address the RAI responses. The following table contains the mean FPRA CDF and LERF results for each unit and is intended to replace the results reported in the original LAR submittal Table W-1 for the Fire and Total Plant Risk rows (as amended by an updated Table W-5 in the March 13, 2015, submittal). These mean results were calculated using the ACUBE program, which reduces the over-estimation introduced by the Min Cut Upper Bound method for large probability cutsets.

	Fire (/rx-yr)	**Total Plant Risk (/rx-yr)**
Unit 1 CDF	3.81E-05	6.82E-05
Unit 1 LERF	4.36E-06	6.85E-06
Unit 2 CDF	5.16E-05	8.17E-05
Unit 2 LERF	4.76E-06	7.25E-06

The reported mean result includes the effects of correlation on FPRA parameters as discussed in the submitted response to PRA RAI 06. The following tables provide the mean and point estimate results for Units 1 and 2 (all of which were calculated using the ACUBE program). The results meet the Regulatory Guide 1.174 guidelines for overall and delta risk.

Unit 1 Comparison Results

	Unit 1 CDF (/rx-yr)	**Unit 1 ΔCDF (/rx-yr)**	**Unit 1 LERF (/rx-yr)**	**Unit 1 ΔLERF (/rx-yr)**	**Unit 1 WL LERF Offset (/rx-yr)**
Point Estimate	3.75E-05	2.96E-06	4.12E-06	4.60E-07	5.10E-06
Mean	3.81E-05	3.02E-06	4.36E-06	4.87E-07	5.35E-06

Unit 2 Comparison Results

	Unit 2 CDF (/rx-yr)	**Unit 2 ΔCDF (/rx-yr)**	**Unit 2 LERF (/rx-yr)**	**Unit 2 ΔLERF (/rx-yr)**	**Unit 2 WL LERF Offset (/rx-yr)**
Point Estimate	5.08E-05	3.27E-06	4.52E-06	6.20E-07	5.72E-06
Mean	5.16E-05	3.31E-06	4.76E-06	7.40E-07	6.05E-06

Note: Min Cut Upper Bound point estimate results are used throughout the tables for the ΔCDF and ΔLERF results by fire area which are provided in the next section. Post transition, the correlated mean results will be compared to point estimate values as the FPRA is revised to monitor the alignment between the two approaches.

The following tables contain the point estimate ΔCDF and ΔLERF results by fire area for each unit. These tables are intended to replace the results reported in the original LAR submittal tables W-3 and W-4 for Unit 1 and Unit 2, respectively (as amended by updated Tables W-6 and W-7 in the March 13, 2015, submittal). See Enclosure 3 of this submittal for all LAR revisions resulting from this RAI response. These point estimate results were not calculated using the ACUBE program, and therefore, the summation of CDF/LERF from Tables W-6 and W-7 will be higher than the mean results reported in the tables above.

PAGES 4-9 HAVE BEEN INTENTIONALLY REMOVED FROM THIS VERSION DUE TO CONTAINING SECURITY RELATED INFORMATION.

PRA RAI 03.b.01

The response to PRA RAI 03.b identifies that the following RAI responses resulted in changes to the PRA:
PRA RAI 01.a
PRA RAI 01.b
PRA RAI 01.c.i
PRA RAI 02.f
PRA RAI 02.i
PRA RAI 10
PRA RAI 16
PRA RAI 17
PRA RAI 18
PRA RAI 19
PRA RAI 22
FM RAI 01.a through 01.g
FM RAI 04

The response mentions the following RAIs as being discussed in parts A or D:
PRA RAI 01.d
PRA RAI 06
PRA RAI 09
PRA RAI 12
PRA RAI 13
PRA RAI 20
PRA RAI 21
PRA RAI 23
FM RAI 01.j

The response lists some RAIs which were "addressed" in the aggregate PRA, other RAIs for which the PRA was "adjusted" in the aggregate PRA, and finally some RAIs that are "discussed." The difference between addressed, adjusted, and discussed is not explained and oftentimes the responses to the original RAIs do not describe what specific changes were or could be made to the PRA. Part b of RAI 3 requested a summary of the disposition of each issue in the aggregate PRA and the post-transition PRA. This was not provided. Please provide a table with the requested information.

McGuire Response:

The following table summarizes how each RAI within the scope of RAI 03 was addressed:

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
PRA RAI 01.c regarding the Fire PRA HRA	The HEP multipliers were replaced with a combination of fire-specific quantified HEP values and NUREG 1921 screening criteria values in the final aggregate analysis.	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 01.c, will be used for self-approval of post-transition changes.
PRA RAI 01.d regarding credit for automatic suppression	The RAI was addressed qualitatively. No changes were made as the FPRA model uses NUREG/CR-6850 generic unreliability factors, which were determined to be appropriate as provided in the response to PRA RAI 01.d. These factors continue to be used in the final aggregate analysis (see response to PRA RAI 03.d in the response letter dated 3/13/15).	The self-approval PRA model applies NUREG/CR-6850 generic unreliability factors.
PRA RAI 06 regarding application of state-of-knowledge correlations (SOKC). (Also see PRA RAI 3.a.01)	There is no synergistic impact; the RAI was addressed quantitatively as a one-time analysis. SOKC was applied to the final aggregate analysis variant and delta risk results. The results are included in the response to PRA RAI 3.a.01.	Self-approval post-transition changes will be reported using point estimate values. A comparison of the total FPRA SOKC mean to the point estimate for the total FPRA risk results will be performed following FPRA model updates.
PRA RAI 09 regarding deviations from NRC guidance	The RAI was addressed qualitatively. No unreviewed methods or deviations were utilized in the FPRA model development (see response to PRA RAI 03.d in the response letter dated 3/13/15).	No unreviewed methods or deviations were used; therefore there is no impact to the self-approval PRA model from this RAI.
PRA RAI 10 regarding reduced circuit failure probabilities	The updated guidance in NUREG/CR-7150 was either incorporated into the final aggregate analysis model or the values used were shown to be bounding.	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 10, will be used for self-approval of post-transition changes.

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
PRA RAI 11 regarding ignition bins missing from the sensitivity study	The RAI was addressed qualitatively. As discussed in response to PRA RAI 11 (see response to PRA RAI 03.d in the letter dated 3/13/15), the bins other than 4 and 15, with alpha values less than or equal to 1 were determined to not impact the variance from deterministic requirements (VFDR) delta risk results.	The sensitivity was updated in support of the RAI-03 re-quantification. The delta risk results considering the frequency difference between NUREG/CR-6850 and Fire PRA FAQ 08-0048 remained below the applicable R.G. 1.174 acceptance thresholds. There are no impacts to the self-approval PRA model from this RAI.
PRA RAI 12 regarding main control room (MCR) abandonment on loss of habitability	The RAI was addressed qualitatively. Clarification on MCR abandonment scenarios was provided as requested in the RAI (see response to PRA RAI 03.d in the response letter dated 3/13/15, PRA RAI 12.01,PRA RAI 13.01.h, and PRA RAI13.02.c).	The RAI asks for a documentation clarification, therefore there are no impacts to the self-approval PRA model from this RAI.
PRA RAI 13 regarding treatment of recovery actions	There is no synergistic impact; the RAI was addressed quantitatively as a one-time analysis. The risk of scenarios where ex-MCR actions are relied upon as the sole success path based on the final aggregate PRA model was evaluated (see response to PRA RAI 03.a in the response letter dated 3/13/15, and PRA RAI 13.02 b).	This was a one-time analysis and will not be carried forward in the transition risk results.
PRA RAI 16 regarding sensitive electronics	The guidance from FAQ 13-0004 related to sensitive electronics was incorporated into the final aggregate analysis model.	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 16, will be used for self-approval of post-transition changes.
PRA RAI 17 regarding reduced heat release rate (HRR) for transients	This RAI was addressed quantitatively by updating the analysis to assume a 317 kw fire and the thermoplastic cable damage criteria for locations specified in the response to RAI 17 (See PRA RAI 17 in response letter dated 2/27/15). The results were were incorporated into the final aggregate analysis model.	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 17, will be used for self-approval of post-transition changes.

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
PRA RAI 19 regarding fire propagation from electrical cabinets and fire frequency allocation, also includes RAI 19.a.01 and 19.b.01	Subsequent to the PRA RAI 03 response of March 13, 2015, the MNS Fire PRA model has been updated to incorporate the following: • Changes made to the final version of FPRA FAQ 14-0009 (ML15118A810). • Spurious operations for non-severe (i.e., non-propagating) MCC fire scenarios. The internal hot short-induced spurious operation probabilities were applied to the internal spurious events using the guidance contained in NUREG/CR-7150 for panel wiring. • 133 electrical cabinets that were confirmed to be well-sealed, robustly-secured, and contain circuits less than 440V were eliminated from Bin 15, resulting in an increase in the scenario frequency associated Bin 15 ignition sources. The impact on the MNS Fire PRA results due to the above changes are included in the quantification supporting the updated PRA RAI 03 response.	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 19, 19.a.01, and 19.b.01, will be used for self-approval of post-transition changes.
PRA RAI 20 regarding the multi-compartment analysis (MCA)	The industry average-type factor originally used in the MCA was updated to include consideration of a compartment specific "initial term" and a barrier failure term equal to the sum of the barrier failure probabilities for each type of barrier present. All of the compartments still screen from consideration as potential MCA scenarios (see response to PRA RAI 03.d in the response letter dated 3/13/15).	The updated analysis showed there are no new MCA scenarios; therefore there are no impacts to the self-approval PRA model from this RAI.

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
PRA RAI 21 regarding the modeling of multiple spurious operations (MSOs)	This RAI was addressed qualitatively. Another MSO Expert Panel will be held to further confirm the impacts of the new generic MSOs from Revision 2 of NEI 00-01 as part of Implementation Item 19 in Table S-3 of the revised LAR (see response to PRA RAI 03.d in the response letter dated 3/13/15).	Another MSO Expert Panel will be held as part of Implementation Item 19 in Table S-3 of the revised LAR
PRA RAI 22 regarding modeling of junction boxes	No Bin 18 junction boxes were identified during the initial ignition source walkdowns. In conjunction with the response to PRA RAI 19.c, 133 electrical cabinets that were confirmed to be well-sealed, robustly-secured, and contain circuits less than 440V were eliminated from Bin 15, resulting in an increase in the scenario frequency associated Bin 15 ignition sources. None of these 133 cabinets met the definition of a Bin 18 Junction Box. Thus, consistent with the responses to PRA RAI 19.c and PRA RAI 22, the Bin 18 count remains zero.	The Bin 18 count remains zero, therefore there are no impacts to the self-approval PRA model from this RAI.
PRA RAI 23 regarding modeling of cable fires caused by welding and cutting (CFWC)	This RAI was addressed qualitatively. Justification for the cable loading weighting factors was provided (see response to PRA RAI 03.d in the response letter dated 3/13/15).	The cable loading weighting factors used were appropriate; therefore there are no impacts to the self-approval PRA model from this RAI.
FM RAI 01.j regarding flame spread on cable trays	A sensitivity analysis has been prepared in support of the response to RAI FM-02a,b which is related to thermoplastic cable insulation concerns. The scope of the sensitivity has been expanded to address follow-up RAIs FM-01.j.01, FM-02.b.01, and FM-02.c.01, which relate to fire growth concerns including flame spread within cable trays.	This RAI will be incorporated into the self-approval PRA model via implementation item 19 in Table S-3 of the revised LAR.

The following table summarizes how RAIs outside the scope of RAI 03 impacted the self-approval post-transition model:

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
FM RAI 01.a through 01.g regarding the acceptability of CFAST for MCR abandonment time	The control room abandonment calculation was updated to address RAIs FM-1a thru 1g. The updated abandonment times that resulted were incorporated into the development of the control room abandonment scenarios and included in the final aggregate analysis model and included in the RAI 03.a analysis submittal (see response letter dated 3/13/15).	The final aggregate FPRA analysis, which has been quantitatively updated in response to FM RAI 01.a through 01.g, will be used for self-approval of post-transition changes.
FM RAI 04 regarding limitations of use of the GFMTs approach	Of the six basic limitations that must be considered when applying the original GFMT approach to determine zone of influence (ZOI) and hot gas layer (HGL) temperatures, only the CFAST model limitation related to the maximum aspect ratio of an enclosure required an adjustment to the quantification. As described in response to RAI FM-04, room burnout scenarios for the load centers in the essential switchgear rooms were added to the quantification in support of RAI-03 to account for potential HGL impact on ZOI. All of the other GFMT limitations were addressed qualitatively as described in the FM-04 response.	The final aggregate FPRA analysis, which has been quantitatively updated in response to FM RAI 04, will be used for self-approval of post-transition changes.
PRA RAI 01.b regarding non-armored cable impacts	Updated circuit failure probabilities for identified non-armored cables to appropriate NUREG/CR-7150 values in the final aggregate analysis model and included in the RAI 03.a analysis submittal (see response letter dated 3/13/15).	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 01.b, will be used for self-approval of post-transition changes.
PRA RAI 02.a(f) regarding ISLOCA impacts on FPRA	The ISLOCA model was updated in the final aggregate analysis model to include an additional operator action and included in the RAI 03.a analysis submittal (see response letter dated 3/13/15).	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 02.a(f), will be used for self-approval of post-transition changes.

Method	1) How addressed in the final aggregate analysis results provided in support of the LAR	2) How addressed in the PRA used at the beginning of the self-approval post-transition changes
PRA RAI 02.d(i) regarding RN unavailability	RN opposite unit maintenance event added to the final aggregate analysis model and included in the RAI 03.a analysis submittal (see response letter dated 3/13/15).	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 02.d(i), will be used for self-approval of post-transition changes.
PRA RAI 18 regarding MCR MCB fires	The final aggregate analysis model incorporates FAQ 14-0008, which was also included in the RAI 03.a analysis submittal (see response letter dated 3/13/15).	The final aggregate FPRA analysis, which has been quantitatively updated in response to PRA RAI 18, will be used for self-approval of post-transition changes.
FM RAI 01.k.01	The final aggregate analysis model has been updated to incorporate the impacts from placement of transient fuel packages in corners. Transient scenarios were added or adjusted to reflect target damage from corner effects identified during plant walkdowns.	The final aggregate FPRA analysis, which has been quantitatively updated in response to FM RAI 01.k.01, will be used for self-approval of post-transition changes.

Note: PRA RAI 1a was not identified by Duke Energy as within the scope of RAI 3 and therefore is not included in the table above.

PRA RAI 12.01

In PRA 12, the NRC staff noted the discussion in license amendment request (LAR) Section V.2.7 that describes two main control room (MCR) abandonment on loss-of-habitability scenarios. The NRC staff requested "[a]n explanation of how the [conditional core damage probabilities] CCDPs account for the range if probabilities for properly shutting down the plant, and discussion of how they were applied in the scenario analysis." Three different levels of fire severity were provided as examples illustrating the source of the range of shutdown probabilities. The response stated, in part, that:

"Each MCR abandonment scenario encompasses the range of results from few functional failures to multiple functional failures, each condition (b.i, b.ii, & b.iii) leading to the most severe end state where the SSF is the sole remaining success path after abandonment. In the MNS Fire PRA, for the abandonment scenarios, the number of fire induced failures and spurious operations is based on the panel of origin that produces the highest conditional core damage probability (CCDP). Therefore, the abandonment scenarios account for the worst case impacts on the SSF regardless of a potentially more favorable outcome."

The response further clarifies that:
"*. .. main control board frequency was applied in the quantification of the abandonment scenario for the main control board (MCB) fire. The remaining fire area wide ignition frequency (including electrical cabinet and transient frequency), was applied to the abandonment scenario for the non-MCB fires in the control room."*

Although the response states that two scenarios are modelled (one following MCB fires and another following non-MCB fires) it is unclear whether a single CCDP/CLERP is used for the two abandonment scenarios. No discussion or justification was provided as to why not accounting for the range of probabilities in the fire PRA will result in a well characterized or conservative risk change-in-risk estimate. The NRC staff requests the following information to determine whether accounting for the range of probabilities for properly shutting down the plant following loss of MCR habitability would change the acceptable change-in-risk estimates to unacceptable estimates.

a) Identify the fire frequency, CCDP, and conditional large early release probability (CLERP) assigned to each abandonment scenarios for both the compliant and the variant plant.

McGuire Response:

a) The following tables list the compliant and variant case fire frequency, CCDP and CLERP for the two McGuire Main Control Room (MCR) abandonment scenarios:

Unit 1 Abandonment Case Risk Results

	MCB Abandonment Scenario		Non-MCB Abandonment Scenario	
	Variant	**Compliant**	**Variant**	**Compliant**
Frequency	1.63E-03	1.63E-03	1.99E-03	1.99E-03
NSP	3.09E-03	3.09E-03	5.84E-03	5.84E-03
CCDP	1.11E-01	1.11E-01	1.07E-01	1.06E-01
CLERP	2.19E-02	2.19E-02	2.14E-02	2.12E-02

Unit 2 Abandonment Case Risk Results

	MCB Abandonment Scenario		Non-MCB Abandonment Scenario	
	Variant	**Compliant**	**Variant**	**Compliant**
Frequency	1.63E-03	1.63E-03	1.99E-03	1.99E-03
NSP	3.09E-03	3.09E-03	5.84E-03	5.84E-03
CCDP	1.11E-01	1.11E-01	1.13E-01	1.12E-01
CLERP	2.19E-02	2.19E-02	2.20E-02	2.19E-02

As can be seen in the results, the difference between the compliant case CCDP and the variant case CCDP is negligible. However, it should be noted that this is not due to assuming any additional failures in the compliant case (as discussed in the PRA RAI 12.01.b response). Instead, the negligible difference is due to the design of the Standby Shutdown Facility (SSF). The SSF is designed as the mitigating response facility for MCR abandonment, and as such, the procedures and plant are designed to eliminate many fire-induced failures when transitioning command and control to the SSF. Therefore, complete transfer of command and control to the SSF effectively addresses most of the non-compliances.

In addition to the MCR abandonment scenarios, the MNS FPRA model quantifies the delta risk associated with fires in the MCR area that do not cause an abandonment of the MCR. Whereas the delta risk between the variant and compliant plants for the abandonment scenarios is negligible, the reported overall delta risk for the MCR fire area is not. Note that the results reported in the above tables are the FRANC point estimate results.

PRA RAI 13.01

The response to PRA RAI 13 discussed how the change-in-risk was calculated for fire areas (other than the MCR and cable room) that are designated as safe shutdown facility (SSF) areas in accordance with 10 CFR 50, Appendix R Section III.G.3. This response was augmented with information provided in the slides for the public meeting on April 14, 2015 (ADAMS Accession No. ML 15099A587), which included further explanation about how the compliant and post-transition plants for these areas were modelled in the Fire Probabilistic Risk Assessment (FPRA). Based on the methods used by McGuire in the FPRA as described in the meeting, please provide the following:

c) Confirm that each of the SSF fire areas has been reviewed by the NRC and has been determined to meet the alternative shutdown option in Section III.G.3 of Appendix R and all the criteria laid out in Section 2.4 b) of RG 1.205, "Risk-Informed, Performance Based Fire Protection For Existing Light-Water Nuclear Power Plants." Provide any limitations and conditions associated with any of the areas and, if any, clarify why such issues are addressed by or not relevant to the FPRA analysis.

McGuire Response:

c) Table 1 below is a listing of the fire areas where the SSF is the assured train for Safe and Stable conditions for NFPA 805 (designated as SSS for Standby Shutdown System) that were previously reviewed by the NRC (ref: NUREG-0422; Supplement No. 6; Safety Evaluation Report related to operation of McGuire Nuclear Station, Units 1 and 2; Duke Power Company; Office of Nuclear Reactor Regulation; U.S. Nuclear Regulatory Commission; Docket Nos. 50-369 and 50-370; February, 1983 Section C.2 "CONFORMANCE WITH PARAGRAPH III.G, FIRE PROTECTION OF SAFE SHUTDOWN CAPABILITY"). The present day FA number assignment is identified along with unit applicability.

Table 1 – MNS Previously Approved SSF Fire Areas Credited for NFPA 805

MNS Unit 1 Fire Area	MNS Unit 2 Fire Area	SER Fire Area Description	NFPA 805 Assured Train
FA 1	FA 1	Residual Heat Removal Equipment Area	SSS
FA 2	FA 3	Auxiliary Feedwater, Pump Area	SSS
FA 4	FA 4	Charging Pump and Nuclear Service Water Pump Area	SSS
FA 13	FA 13	Battery Room Common Area	SSS
FA 14	FA 21	Component Cooling Water Pump Area	SSS
FA 19	FA 20	Cable Spreading Rooms	SSS
FA 24	FA 24	Control Room	SSS

Fire Area 25 is the only fire area that was not specifically included in the NUREG-0422; Supplement No. 6 Safety Evaluation Report. FA 25 is the Aux BLDG 767' common elevation, which houses redundant trains of CR / CR area chillers HVAC.

Docketed correspondence from Duke Power (Hal B. Tucker) to NRC (Harold R. Denton) 10/1/1985 "McGuire Nuclear Station Fire Protection Review" states "This document is provided to supplement information contained in the McGuire FSAR and reflects the plant design as previously reviewed and approved by NRC. Accordingly, no additional

reviews are requested and no license fees are provided." Within this docketed correspondence, each plant FA's attributes are discussed. Page c-56 of the correspondence analysis states, in part, for FA 25 "The capability to achieve and maintain hot standby conditions utilizing the SSS is assured in this area by virtue of location of SSS - required equipment and cabling outside this fire area and breaker coordination on non-required SSS loads. The design of normal plant systems has been reviewed for spurious operations relative to SSS operation and has been found acceptable."

The bases for three hour fire area boundaries for FA 25 remain valid with the transition of deviations and engineering evaluations. Electrical isolation and physical separation of SSF cables and equipment has been demonstrated by the present day NSCA for FA 25.

The SSF was designed for Appendix R Fires. For all FAs designating the SSF as the credited SSD train for Safe and Stable conditions, all of the provisions of RG 1.205, Rev. 1, Section 2.4b are met upon completion of SSF transfer.

PRA RA 13.02

The response to PRA RAI 13 states that the compliance assessment for fire areas 01 (UI and U2), 02, 03, 04 (U1 and U2), 13 (U1 and U2), 14 (U1 and U2), 19, 20, 21 (U1 and U2), 24 (U1 and U2), and 25 (UI and U2) relies upon transfer of primary command and control to the Standby Shutdown Facility (SSF) as the Nuclear Safety Performance (NSP) success strategy (i.e., the NSP success path).

a) Clarify how the 10 CFR 50.48(c) rule (including the NFPA-805 Standard as incorporated by reference) and associated guidance, allows the assignment of the remotely located. SSF facility as the single NSP success for all fires in some fire areas outside of the MCR.

b) The response to RAI 13.b states, "[p]er MNS plant procedures, only control room habitability due to the fire will cause a complete abandonment of the MCR (as opposed to implementing SSF functions while maintaining command and control in the MCR as discussed in the response to PRA RAI 13.a)." According to the guidance in RG 1.205, all actions to recover NSP successes strategies and taken outside of the MCR while maintaining command and control in the MCR are recovery actions. Why are there no recovery actions identified for these areas?

c) How and when (i.e., in what PRA accident sequences) is the NSP SSF success strategy for the aforementioned fire areas modelled in the compliant plant PRA model, and in the post-transition plant PRA model.

McGuire Response:

a) NFPA 805 Section 4.2.3 requires one success path of required cables and equipment be assured to achieve and maintain the nuclear safety performance criteria. The SSF may be used to provide an assured success path to achieve and maintain the nuclear safety performance criteria, similar to the use of a Train A, Train B, or Train A & B success path. The Nuclear Safety Capability Assessment (NSCA) assesses fire areas assuming all equipment in and cables routed through the fire area have failed. When a NSCA fire area analysis is performed, the train least impacted is selected as the assured success path. Cable routes were carefully laid out during the construction of the SSF so that fire areas that utilized the SSF as the assured success path were as free of fire damage as possible. Any impacts to the success path due to cable routing through the fire affected area were identified as VFDRs.

   As noted in PRA RAI 13.01 'c' response, all of the SSF assured fire areas have been previously approved by NRC (ref: under NUREG-0422; Supplement. No. 6; Safety Evaluation Report related to operation of McGuire Nuclear Station, Units 1 and 2; Duke Power Company; Office of Nuclear Reactor Regulation; U.S. Nuclear Regulatory Commission; Docket Nos. 50-369 and 50-370; February, 1983 Section C.2 "CONFORMANCE WITH PARAGRAPH III.G, FIRE PROTECTION OF SAFE SHUTDOWN CAPABILITY") or has been included in a docketed correspondence to the NRC (ref: Docketed correspondence from Duke Power (Hal B. Tucker) to NRC (Harold R. Denton) 10/1/1985; "McGuire Nuclear Station Fire Protection Review").

b) The NSCA is the foundation for which recovery actions are based on. Recovery actions result from VFDRs identified against the safe shutdown success path. Attachment G identifies recovery actions for the SSF fire areas. This is consistent with the guidance in FAQ 07-0030.

   In the NSCA for these fire areas, the SSF is the success path and the SSF is the Primary Control Station (PCS). Any actions taken outside of the PCS relied on to demonstrate availability of the SSF success path due to VFDRs identified against the success path are identified as recovery actions in Attachment G and the additional risk of the recovery actions are accounted for in Attachment W.

   The FPRA model is a separate model from the safe shutdown model. The FPRA logic is consistent with plant design and operating procedures. The FPRA shows most fires have multiple success paths available. The FPRA model has some cut sets utilizing command and control in the MCR and some cut sets after transfer to the PCS. In accordance with FAQ 07-0030, FPRA is an input to whether the recovery action identified from the NSCA is required for risk or defense in depth. Utilizing this guidance, no recovery actions were identified to demonstrate availability of a success path for the nuclear safety performance criteria.

c) The Deterministic Fire Analysis assumes that the entire Fire Area (FA) is impacted by the fire for the SSF Fire areas (i.e., all equipment in the area fails). However, the Fire PRA (FPRA) model does not assume a full room burnout by default and instead determines the fire impacted components and cables for each fire scenario. Most of the fires evaluated in the FPRA do not result in a full room burnout of the FA.

   As discussed in the response to PRA RAI 13.01.h, for the purposes of this discussion, command and control refers to the location where the operators are operating

equipment to achieve and maintain the plant in a Safe and Stable condition. From the perspective of the Deterministic Fire Analysis, all of the SSF fire areas rely upon transfer of command and control to the SSF. However, the FPRA model allows for command and control to be maintained in the MCR if the MCR mitigating equipment required to achieve Safe and Stable conditions has not been failed in the fire scenario. The FPRA model automatically credits SSF mitigation strategies for FPRA accident sequences where the functions that can be performed by the SSF are lost from the MCR but are available from the SSF. These functions include control of secondary side heat removal via the turbine-driven Auxiliary Feedwater (CA) pump and Reactor Coolant Pump (NCP) seal injection from the spent fuel pool using the Standby Make Up Pump (SBMUP).

There are two Main Control Room (MCR) abandonment scenarios in the FPRA model which were designed to force the transfer of primary command and control to the SSF on a loss of habitability. For the remaining SSF FA scenarios (including the non-MCR abandonment cases in the MCR), the fire accident scenario will determine whether command and control is transferred to the SSF or remains in the MCR based on the availability of equipment. This modeling reflects the as-built as-operated post-transition plant.

The same model is used to calculate both the compliant and variant plant cases, so there are no differences in the modeled equipment other than removal of the variances from the compliant case. If cutsets for the variant case indicate the scenario to be a likely candidate for transfer of command and control to the SSF based on loss of function, then the compliant case cutsets will also indicate transfer of command and control to the SSF. In other words, removal of the variances from the compliant case does not change the location of command and control. This modeling treatment will be carried forward in the post-transition plant FPRA model.

FM RAI 01.j.01

NFPA 805, Section 2.4.3.3, states, in part, that the probabilistic risk assessment (PRA) approach, methods, and data shall be acceptable to the NRC. License Amendment Request (LAR) Section 4.5.1.2, "Fire Model Utilization in the Application," states, in part, that fire modeling was performed as part of the Fire PRA development.

In a letter dated January 26, 2015 (ADAMS Accession No. ML 15036A084), the licensee responded to FM RAI 01.j and explained that, to account for fire propagation in cable trays, the vertical zone of influence (ZOI) was extended to the ceiling and that the horizontal ZOI encompasses the 35° angle as discussed in NUREG/CR-6850. The licensee further referred to tests conducted by EPRI and NEI to justify ignoring flame spread over armored cable with a PVC jacket beyond the 35° cone. Subsequently, in its response to FM RAI 02.b the licensee stated that a recent review of FPRA-related cables indicates that approximately 15% are thermoplastic, and that 24% of the total cable population in the plant is thermoplastic.

The EPRI/NEI tests that the licensee refers to involved a cable tray that was located approximately 5 ft. above and to the side of the 350 kW ignition source. In both tests the PVC jacket started to melt and drip to the floor, but did not ignite. The objective of these two tests was to assess the performance of jacketed armored cables located in the hot gas layer (HGL). The results do not apply to cable trays that are located directly above the ignition source.

In light of this observation and the licensee's recent finding that approximately 24% of the cables in the plant are thermoplastic, re-quantify the impact of fire propagation in cable trays and the heat release rate (HRR) contribution from the cables on target damage and plant risk. Where applicable, consider the contribution from non-FPRA cables and non-cable secondary combustibles in the revised ZOI and HGL analyses.

McGuire Response:

The original response to FM RAI 01.j indicated that propagation of fire in stacks of vertical trays was explicitly included in the FPRA by impacting all trays in the stack (up to the ceiling), if the bottom tray in the stack was within the vertical zone of influence (ZOI) of the ignition source. While the impact of the HRR from these additional trays was not explicitly included in the HGL calculation, margin was included in the HRR assumed in the HGL calculation, to account for these additional trays. In response to this follow-up RAI, an analysis was performed in which the HRR margin was compared to a HRR that includes the actual number of trays impacted (in addition to the peak HRR from the ignition source). The details of this analysis are in section 4.0 of the updated sensitivity analysis provided in response to FM RAI 02.b.01 (see Enclosure 2 of this letter). The results show that in all cases, the available margin adequately accounts for the additional HRR from the specific number of trays impacted, or that full room burnout scenarios have been added to the RAI 3 re-quantification where margin was not adequate. As such, a detailed re-evaluation of the HGL impact will have a negligible impact on CDF and LERF.

Additionally, as noted in this follow-up RAI, the original response demonstrated that the horizontal ZOI encompasses the 35 degree angle discussed in NUREG/CR-6850, Section R.4.2, but that explicit modeling of horizontal flame spread outside of the conservative horizontal ZOIs was not performed. In order to determine the potential impact on the risk reported in the LAR from horizontal flame spread beyond the horizontal ZOI, the updated sensitivity analysis performed in response to FM RAI 02.b.01 accounts for the potential for

additional target damage due to horizontal flame propagation. Details are provided in sections 5.0 and 6.0 of the updated analysis. The results indicate that a conservative evaluation of the impact of fire propagation in cable trays, when added to the impact of thermoplastic cable insulation, results in a risk increase of approximately 1.74E-06/yr CDF and 3.02E-07/yr LERF for Unit 1, and approximately 1.39E-06/yr CDF and 2.65E-07/yr LERF for Unit 2. A similar conservative evaluation of the impact on the transition risk from VFDRs was also performed, resulting in an increase of approximately 7.76E-07/yr CDF and 1.16E-07/yr LERF for Unit 1, and approximately 6.52E-07/yr CDF and 7.04E-08/yr LERF for Unit 2.

A more explicit treatment of these issues will be performed, as appropriate, during the re-evaluation of the thermoplastic cable impact on plant risk, previously added as implementation item 19 in Table S-3 of the LAR.

FM RAI 01.k.01

NFPA 805, Section 2.4.3.3, states, in part, that the PRA approach, methods, and data shall be acceptable to the NRC. LAR Section 4.5.1.2, "Fire Model Utilization in the Application," states, in part, that fire modeling was performed as part of the Fire PRA development.

In a letter dated November 12, 2014 (ADAMS Accession No. ML14328A628), the licensee responded to FM RAI 01.k and stated that location effects on the ZOI of transient fires within 2 ft. of a wall or corner were accounted for by multiplying the HRR by 2 or 4, respectively. In a letter dated January 26, 2015 (ADAMS Accession No. ML15036A084), the licensee revised its response to FM RAI 01.k, in particular the part pertaining to wall and corner effects on the ZOI for transient fires. In the revised response the licensee stated that "The hypothetical transient fuel packages were placed where targets such as cable trays or risers would be impacted. Since the target damage could be achieved by placement of the ignition source away from the wall or corner (i.e., an open location transient fuel package), no further adjustments were applied."

It is stated in Section 11.7.1.6 of NUREG/CR-6850, Volume 2, that "[Transient] ignition sources should be located near areas of the room where critical targets are located, including "pinch-points" where targets from two different safety divisions can be damaged by the same fire." It is not clear from the licensee's revised response that this guidance was followed.

Explain how the licensee ensured that critical targets or pinch-points located close to a wall or corner were identified and considered in the transient fire target damage analysis.

McGuire Response:

The methodology for the Fire PRA supporting the 2013 LAR submittal included guidance that if a transient is placed at a wall or corner, the transient fire heat release rate should be increased. During transient fire scenario development, because critical targets and pinch points located at walls and corners could be captured based on open floor area transient ZOIs, it was deemed unnecessary to deliberately place the transients at walls and corners. In response to the above follow-up RAI, an evaluation of fire scenarios based on placing transients at corners was performed and the results have been incorporated into the fire PRA, updated to address the latest round of RAIs. Concerning treatment of transients placed at walls, a fire modeling analysis has been performed supporting the simplified treatment of wall configurations by assuming that they are equivalent to an open configuration.

FM RAI 02.b.01

LAR Section 4.5.1 states, in part, that "In accordance with the guidance in RG 1.205, a Fire PRA model was developed for MNS consistent with the requirements of Part 4 "Requirements for Fires At Power PRA," of the American Society of Mechanical Engineers (ASME) and American Nuclear Society (ANS) combined PRA Standard, ASME/ANS RA-Sa-2009, "Standard for Level 1 /Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Application," ..." ASME/ANS Standard RA-Sa-2009, Part 4, requires damage thresholds be established to support the FPRA.

In a letter dated February 27, 2015 (ADAMS Accession No. ML15083A223), the licensee responded to FM RAI 02.b, and stated that the higher damage thresholds associated with thermoset cables were used based on the assumption that the cables at McGuire Nuclear Station, Units 1 and 2, are predominately constructed with EPR or XLPE (thermoset) insulation, a galvanized steel interlocking armor, and a thin flame retardant polyvinylchloride (PVC) exterior jacket. The licensee further stated that a subsequent review of cable information showed that there is a higher percentage of thermoplastic insulation in the plant than initially considered, that approximately 15% of the roughly 12,000 FPRA-related cables are thermoplastic cables (and approximately 24% of the total plant cable population), and that these thermoplastic FPRA-related cables are relatively evenly distributed throughout the plant with only six fire areas being appreciably above the overall average.

The licensee also identified five conservatisms in the present analysis that may (partly) offset the impact of the presence of thermoplastic cables on the Fire PRA. To quantify this impact the licensee performed a sensitivity analysis and determined that a more thorough evaluation of the thermoplastic cable insulation impact does not result in a risk increase greater than 1 E-06/year for CDF or 1 E-07/year for LERF. Finally, the licensee stated that the thermoplastic cable impact on the risk will be re-evaluated when the results of ongoing NRG/industry research on the severity of cabinet fires will be published. This re-evaluation is an implementation item and will be added to Table S-3 of the LAR.

The sensitivity analysis described in Attachment 2 to the response to FM RAI 02.b appears to assume that cable fires do not propagate in stacks of horizontal trays. In light of the fact that the response to FM RAI 01.j.01 is likely to invalidate this assumption, revise the aforementioned sensitivity analysis taking ignition of and fire propagation in cable trays into account.

McGuire Response:

The original analysis and subsequent responses have assumed the horizontal stack of cable trays do propagate vertically, and damage is assumed for all cables in the stack. As described in the response to FM RAI 01.j.01, the sensitivity analysis has been revised to take into account the requested additional fire spread associated with ignition of, and fire propagation in, cable trays. The analysis is included as Enclosure 2 to this submittal letter.

FM RAI 02.c.01

NFPA 805, Section 2.4.3.3, states, in part, that the PRA approach, methods, and data shall be acceptable to the NRC. LAR Section 4.5.1.2, "Fire Model Utilization in the Application," states, in part, that fire modeling was performed as part of the Fire PRA development.

In a letter dated October 13, 2014 (ADAMS Accession No. ML14297A162), the licensee responded to FM RAI 02.c, and subsequently revised the response in a letter dated December 12, 2014 (ADAMS Accession No. ML14365A071). Both the initial and the revised response contain the following statement: "The heat release rate contribution from the small amount of flame-retardant, self-extinguishing jacket material that might collect on the top surface of the ignition surface (e.g., electrical panel) is considered negligible in comparison with the peak HRR of the ignition source and is therefore considered insignificant with respect to the postulated target damage."

The licensee's Design Basis Specification for Fire Protection indicates that approximately 45% of the combustible mass of power cables and 60% of the combustible mass of control cables is outside the armor.

Provide a quantitative assessment to justify the licensee's conjecture that the HRR contribution from the jacket material is negligible and its impact on the postulated target damage is insignificant.

McGuire Response:

In review of the some of the cables used at MNS, the assumption of the 45% combustible mass outside the armor for power cable and 60% for control cables is highly conservative in many instances (none were identified that would be evaluated as higher percentages). However, MNS is unable to determine accurate percentages of combustible mass for each cable tray. As a result the updated sensitivity study provided in response to FM RAI 02.b.01 provides a quantitative assessment of the HRR contribution from fire propagation. This quantitative assessment does not take any credit for the percentage of combustible material that is inside the armor (i.e., it uses a weighted average between the heat release rate per unit area associated with thermoset and thermoplastic cables, based on the amount of each type of cable in the stack under evaluation as recommended in NUREG/CR-7010, without regard to the armor). The statement in the Design Basis Specification for Fire Protection is being removed.