REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
RC-1	Page 3-14, Sentence 1	Add a parenthetical at the end of the sentence to provide more direction of the applicability of the approach. "... suppression rate (Interruptible, Growth, transient, etc.)."	Revised as suggested.	8/1/19

RC-2	Figures 4-3 and 4-4	Modeling doesn't match the summary description Key Finding on pdf page 9.	Agreed. There was an inconsistency between how the data was averaged versus how the test data was developed to be applied during fire modeling. Revised the key findings to clarify the parameters for fire modeling. These bullets now read:
			• Based on an analysis of relevant experimental evidence, the HRR timing profile for *interruptible* fires can be modeled in one of two ways (see Section 4.2.2):
			  ○ Using a pre-growth period of 9 with a negligible HRR, 7 minute time to peak, 5 minutes at steady state, and a 13-minute decay period.
			  ○ The addition of a pre-growth period to the timing profile prescribed in NUREG/CR-6850
			    ▪ A pre-growth period of 4 minutes with a negligible HRR
			    ▪ 12 minute time to peak, 8 minutes at steady state, and a 19-minute decay period.
				8/5/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			• For growing fires, the HRR timing profile in NUREG/CR-6850 is recommended (12 minute time to peak, 8 minutes at steady state, and 19-minute decay period). See Section 4.2.4.	
RC-3	Figure 5-11	The word fire is over top of the y axis labels.	Shrank text to fit on one line	7/31/19
RC-4	Page 6-5	Why is 4 minutes used versus 8 minutes for the pre-growth period?	See updated discussion in Section 4.2 (and comment RC-2)	8/5/19
RC-5	Section 4.1.1 & Section 4.2	In Section 4.1.1, an interruptible fire is said to have a growth period up to 8 minutes. Later in in Section 4.2, 4 minutes is recommended. As no criteria is provided to determine what value to use, this introduces unclear and ambiguous guidance. The pre-growth period should be defined and used like the growth, steady-state, and decay periods. A single recommended value should appear in all sections and examples within the NUREG.	Revised Section 4 to better separate the process of analyzing the fire test data with the fire modeling recommendations. The analysis of data is in Section 4.1. The interpretation of the results and the fire modeling values are in Section 4.2. The revision for Section 4.2 now describes that: *a.)* When modeling using the experimentally HRR profile using times presented in Section 4.1.1 a pre-growth period duration of 9 minutes may be used. *b.)* When maintaining modeling results using the NUREG/CR-6850 HRR profile durations, a pre-growth period with a duration of 4 minutes may be used to ensure that the time to peak does not become greater than that of the experimentally derived time. See the revised discussion in Section 4.2.1.	8/5/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
WebEx (SL-1)	5.3.3.2	Does MCR indication only apply to an annunciated alarm? Would it apply to other types of indications in the MCR?	Yes. Operator response to audible alarms is based on both the ‘attention-getting’ and importance of the audible cue and training on the associated Alarm Response Procedures, which requires the operators to investigate the source and confirm the validity of the alarm. While it is recognized that operators do continually scan the board for changes and review the status of equipment upon a shift change, it is not believed that the speed and reaction to a warning light would be the same as an annunciated alarm.	08/22/2019
NEI-1	viii	*Statement from report: Key Findings: The typical HRR profile for interruptible fires is a pre-growth period with a negligible HRR for up to 8 minutes, 12-minute time to peak, 8 minutes at steady state, and a 19-minute decay period (see Section 4.1.1).* *Comment:* The growth profile for interruptible fires discussed in Section 4.1.1 is pre-growth for 8 minutes, 7 minutes time to peak, 5 minutes steady state, and 13 minutes decay. If both curves are acceptable for use, then both should be listed as key findings.	The Key Findings have been updated to list all applicable modeling profiles. See Comment RC-2	8/5/19
NEI-2	3-2	*Equipment trouble alarms in the main control room (MCR) due to fire will occur in the early stages of the fire development.* Suggest clarification if other notification to the MCR is acceptable other than trouble alarms.	See response to SL-1	8/22/19
NEI-3	3-9 & 3-10	*Table 3-2 and Table 3-3* It may be worth reiterating that the data used for Table 3-2 is the 2000-2014 data because the next page shows Table 3-3 which	Agreed, changed the title of Table 3-2 to read “Interruptible and growing split fractions (2000-2014)” and Table 3-3 to “Electrical ignition source	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		uses the 1990-2014 data for the non-suppression curve, and the number of interruptible vs growing fires is not equivalent between the tables.	probability distribution rate of fires suppressed per unit time (1990-2014)"	
NEI-4	3-12	*3.5.2 NSP Floor for the MCR* This data is presented in both NUREG-2230 and NUREG 2178 Vol. 2. Suggest removal from one of the NUREGs replacing it with a simple reference to the other.	The NSP floor discussion will remain in NUREG-2230 since this report will be published first. In NUREG-2178 Vol 2 the section on the NSP floor will be eliminated and the reader will be pointed back to NUREG-2230 for the technical basis.	8/12/19
NEI-5	3-14 & 3-15	*MCR will use the interruptible and growing suppression rates presented in Section 3.5 for fire durations in excess of 18 minutes.* Additional clarification could be provided to explain that this crossover occurs at the time on the interruptible or growth curve where NSP=1.00E-3	Revised as: For example, a cabinet fire in the MCR will use the **Control Room suppression rate up to a value of 1E-03, after which the I**nterruptible and **G**rowing suppression rates presented in Section 3.5.1 **will be used** for fire durations in excess of 18 minutes.	08/13/19
NEI-6	3-14	*For example, a fire in a cabinet located within the MCR will use the interruptible and growing suppression rates presented in Section 3.5 for fire durations in excess of 18 minutes.* Add a parenthetical at the end of the sentence to provide more direction of the applicability of the approach. "... bin specific suppression rate (Interruptible, Growth, transient, etc.)."	Redundant with comment RC-1	8/12/19
NEI-7	Chapter 4	*Figures 4-3 and 4-4*	Redundant with comment RC-2	7/31/19

REVIEW / COMMENT DOCUMENTATION

Reviewer:	Various	**Phone:**		**Document #, Rev:**	NUREG-2230 / EPRI 3002016051
Discipline/Department:	Various	**Date:**	July 2019	**Title:**	Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		The modeling does not match the summary description key finding on page 12.		
NEI-8	Section 4.1.1	*A period of up to 8 minutes with no measurable HRR may be included prior to the period of fire growth. If included, this pre-growth phase must be reflected in any calculations of the time to damage, time to detection, and time to suppression.* Here, an interruptible fire is said to have a growth period up to 8 minutes. Later in in Section 4.2, 4 minutes is recommended. As no criteria are provided to determine what value to use, this introduces unclear and ambiguous guidance. The pre-growth period should be defined and used like the growth, steady-state, and decay periods. A single recommended value should appear in all sections and examples within the NUREG.	See resolution to RC-5	8/5/19
NEI-9	4-7	*The growth profile described in NUREG/CR-6850 is recommended for modeling growing fires.* If the use of the NUREG/CR-6850 curve is recommended, then it may be clearer to identify this in section 4.1.2. with the full explanation as is in section 4.2. As it reads right now it appears the NUREG is suggesting this as a new curve, only to say it is not recommended later.	Agree, we have revised Section 4 to explain the timing profiles for both growing and interruptible fires. The key findings and summary sections have also been updated.	8/5/19
NEI-10	Chapter 5	*Throughout* The fire events database (EPRI 3002005302) that is referred to in NUREG-2230 indicates that: A distinction is now made between fires that were capable of damaging a PRA important component and those that were not capable	Reviewed EPRI 3002005302. This text is from Section 2.5 to discuss the difference between a *potentially challenging* (did not damage external targets, but under alternate could have) and a *challenging fire* (a fire that did have observable effects). Fire events are screened if they are	7/31/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		but, in the absence of automatic or manual suppression, might have become capable. However, this distinction appears to simply remove fires that are outside of the protected area. This screening criteria do not properly characterize whether or not a fire has any possibility of becoming an initiator that affects FPRA components. For example: 1. The fire could affect components that are in the PRA but never be expected to become an initiator, in which case it would simply become another type of unavailability. On the other hand, the fire could be an initiator, but would never be expected to affect FPRA components, and there are examples of this in the FPRA database.	outside of the FPRA scope (administration building, warehouse, cafeteria, etc.). The remaining set of fire events is screened against the rules in EPRI 1025284 and carried forward in EPRI 3002005302. The fire events are included if they meet the potentially challenging (or greater) criteria. It is true that screening criteria is irrespective if the component(s) have the potential to result in an initiator. This information is difficult to discern from the event narrative. Likewise, we agree there are components that may result in an initiator, but may not impact PRA components. This issue cannot be consistently addressed given the current information collected on fire events. Please see EPRI 3002016053 for a discussion on when a conditional plant trip probability can be used for scenarios that are unlikely to result in a plant trip.	
NEI-11	5-19	*Very low: 0.5 – Compartment is subject to controls and procedures that result in a factor less than a low rating level* The stated value of 0.5 for very low is incorrect. Per the FAQ 12-0064 closure memo, this value is 0.3.	The values have been updated to be consistent with the final version of the FAQ.	08/15/2019

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
NEI-12	5-19	*These modifications are the only exceptions that may be made and are done so for the purposes of estimating personnel detection.* Clarification should be provided whether this only impacts NUREG-2230 event tree calculations or also alters existing FAQ 12-0064 transient analysis using 0.3 and 3 for very low and medium.	See comment above (NEI-11) for the correction on the very low factor. Per the text on Page 5-19: These rating levels are used to make an estimation of the probability that personnel would be present in a compartment and therefore capable of detecting a fire. Note, the changes described below apply only to estimating the numerical probability that personnel are expected to be in a compartment. The influencing factors assigned for the purposes of apportioning the transient ignition frequency should be maintained for estimating the probability of personnel detection. No changes may be made to the use of the influencing factor values as applied to the transient ranking scheme as described in NUREG/CR-6850 and FAQ 12-0064.	8/12/19
NEI-13	5-21	*For occupancy, the rating level associated with medium was revised from 3 to 5.* This discussion should also include the change from 0.3 to 0.5 for very low. This applies to the maintenance factor as well.	See NEI-11	8/12/19
NEI-14	5-22	*Line 4: Recalling Figure 2-2, almost 50% of the fires that have occurred in electrical cabinets have been detected by plant personnel*	Agree. Replaced "almost 50" with "55%"	8/1/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		Figure 2-2 shows that 55% of the fires that have occurred in electrical cabinets have been detected by plant personnel.		
NEI-15	Chapter 6	*Section 6.1: First Interruptible: 8.41E-02* Treatment of automatic smoke detection failure in Section 6.1 is inconsistent with Figure 6-1 and Appendix C, Tables C-2 through C-17 equations. Smoke detection ineffectiveness and unreliability are mutually exclusive so these values should be added together when calculating the first interruptible detection failure probability. This impacts all examples through Chapter 6 and Appendix D	Figure 6-1 reviews the NUREG/CR-6850, Appendix P approach and does not include the smoke detection ineffectiveness. As presented in Figure 6-2, smoke detection unreliability and ineffectiveness are included in the detection failure calculation under an OR gate, resulting in an addition of the two terms. The value for the First Interruptible detection step presented in Example 6.1 shows a value of 8.41E-02 (revised to 2.6E-02 based CMWRA29) and results from: Automatic Smoke Detection (OR Gate): Unreliability: 0.05 Smoke detector ineffectiveness: 0.**07** 0.05+0.**07** – (0.05 x 0.**07**) = 0.**1122** Personnel Detection: 0.231 First Detection AND Gate: 0.231 x **0.1122** = **0.02595**	8/12/19

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			Notes provided below each table in Appendix C present the calculation for the values. Per the note below Table C-2: (Probability of No Personnel Present [Table 5-6]) × ((MCR Indication Unreliability [Section 5.3.3.2] + MCR Operator HEP [Section 5.3.3.3]) – (MCR Indication Unreliability [Section 5.3.3.2] × MCR Operator HEP [Section 5.3.3.3])) × **(Smoke Detection Ineffectiveness [Table 5-2] + Smoke Detection Unreliability [NUREG/CR-6850] + Smoke Detection Unavailability [0.01, assumed])** Note: The value for smoke detector ineffectiveness has been revised as the result of a comment related to the Monte Carlo analysis on smoke detection, so the values may have changed but the calculation method remains the same.	
NEI-16	Chapter 6	*Section 6.1: Second Growing: 3.64E-01* Treatment of automatic smoke detection failure in Figure 6-2 is inconsistent with Figure 6-1 and Appendix C, Tables C-22 through C-25 equations. Smoke detection ineffectiveness and unreliability are mutually exclusive so these values should be added together for the second growing detection failure probability. This impacts all examples through Chapter 6 and Appendix D	As presented in Figure 6-3, smoke detection unreliability and ineffectiveness are included in the detection failure calculation under an OR gate, resulting in an addition of the two terms. The value for the Second Growing detection step presented with Example 6.1 shows a value of 3.64E-01 (revised to 1.12E-01 based on CNWRA29) and results from:	08/13/19

REVIEW / COMMENT DOCUMENTATION

Reviewer:	Various	**Phone:**		**Document #, Rev:**	NUREG-2230 / EPRI 3002016051
Discipline/Department:	Various	**Date:**	July 2019	**Title:**	Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			Smoke Detection Occurs in Time (AND Gate): Smoke detector ineffectiveness: 0.**07** Flag to confirm smoke detection modeling suggests detection occurs prior to the time to damage: 1.0 0.**07** x 1.0 = 0.**07** Unreliability: 0.05 Second Detection OR Gate: 0.**07** + 0.05 – (0.**07** x 0.05) = 0.**1122** Notes provided below each table in Appendix C present the calculation for the values. Per the note below Table C-22: (Smoke Detection Ineffectiveness [Table 5-2] **+** Smoke Detection Unreliability [NUREG/CR-6850] **+** Smoke Detection Unavailability [0.01, assumed] Note: The value for smoke detector ineffectiveness has been revised as the result of a comment related to the Monte Carlo analysis on smoke detection, so the values may have changed but the calculation method remains the same.	
NEI-17	6-8	*Figure 6-6: 0.72 & 0.28*	Updated Figure 6-6	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		Replace 0.72 and 0.28 with 0.723 and 0.277 respectively to be consistent with Table 3-2		
NEI-18	6-8	*Figure 6-6: 0.0324581* Update 0.0324581 to 3.25E-02 to be consistent with other similar values.	Updated Figure 6-6	8/12/19
NEI-19	6-9	*Table 6-1: Note: No additional credit is given for the higher maintenance rating. Additionally, no credit may be taken for an adjacent occupancy with a lower rating.* In the current calculation examples, credit is actually given for the higher maintenance rating of the adjacent compartment. Suggest to revise the note or calculation accordingly.	The guidance in Section 5.3.3.5 states: Credit for adjacent spaces may only be taken for a maximum of half of the rating of the source compartment. The entry in Table 6-1 takes half the credit of a medium rating (+**5/2**), even though the adjacent space has a High rating (10). The text should be revised as: Table 6-1: Note**: Credit for the adjacent space may only be taken for values up to that of the source compartment. Therefore, only a value of 5 – equal to the medium rating of source compartment – is credited. A value of 10 – associated with the High rating – is not allowed.** Additionally, no credit may be taken for an adjacent occupancy with a lower rating.	08/07/19
NEI-20	6-9	*Table 6-1: (5+0/2)/10+(5+**5/2**)/50 = 0.0575* The second half of the equation appears to be missing that subtracts the adjacent compartment's higher maintenance rating (Equation 5-2). It also appears the final value should be updated	Yes, this is correct. Updated the text in Table 6-1 under the “Low occupancy and higher maintenance ratings in adjacent spaces”	8/1/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		to 0.575 with the equation: (5+0/2)/10+(5+**5/2**)/50 – (5+0/2)/10 × (5+**5/2**)/50 = **0.575**		
NEI-21	6-10 & 6-11	*Table 6-2* Add "*Pns* =" in front of the Pns value in the Automatic Smoke Detection Failure Probability and Pns column. Similarly the detection failure probability should be denoted as well to avoid misinterpretation.	Added.	8/12/19
NEI-22	7-1	*For the purposes of fire modeling, the NUREG/CR-6850 growth profile may be used with a suggested consideration for interruptible fires.* This statement appears to suggest that the Figure 4-3 interruptible curve cannot or should not be used as opposed to the old 6850 curve with a delay. Clarification may be warranted.	For interruptible fires the analyst has two options. They can use the specific interruptible fire profile OR they can use the NUREG/CR-6850 profile with pre-growth. The text in the key findings, Section 4, and Section 7 have been updated to make this clear and consistent.	8/5/19
NEI-23	7-1	*For interruptible fires, a period of up to 8 minutes with no measurable heat release rate (HRR) may be included prior to the period of fire growth.* Suggest adding a statement that use of 4 minutes is recommended for the pre-growth period with reference to section 4.2.	See revised guidance in Section 4.2.	8/5/19
NEI-24	7-3	*7.5 NSP Estimation Update* There is no mention of the revised NSP floor for the MCR in the summary. If this was primarily developed by NUREG-2178 V2, this should be noted since the results are still presented in this NUREG as well.	Added summary of the NSP floor for the MCR in Section 7.5	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
NEI-25	Table 7-3	NUREG-2169 | All Fires | 457 | 6691 "All Fires" number of events and total duration do not match NUREG-2169, Table 5-1. If this has been updated by NUREG-2230 or NUREG-2178 V2, the reference should be updated.	This was updated to include the new cabinet fires occurring since 2009. Additionally, per the discussion in Section 3.5.1, events occurring prior to 1990 have been excluded from the suppression rate assessment. The source column entry has been updated to: NUREG-2169, NUREG-2230	08/07/19
NEI-26	Table 7-3	*All Fires | 457 | 6691* In previous versions of this chart, such as NUREG-2169 Table 5-1 and NUREG/CR-6850 Supp1 Table 14-2, the "All Fires" curve is the sum of all the previous line items for events and duration. This does not appear to be the case for NUREG-2230. If a differing methodology was used, explanation or disclaimer should be provided.	The 457 is incorrect. This value comes from an older iteration of the developed methodology. As discussed in Section 3.5.1, suppression times for events from the period between 1980 and 1989 were excluded. No change was made in the methodology of how the All Fires category is determined. The correct listing should be: **NUREG-2169, NUREG-2230 | All Fires | 398 | 5878**	08/07/19
NEI-27	8-1	*REFERENCES* If NUREG-2178 V2 is referenced in the document, it should be provided as a reference as well.	Added Reference: NUREG-2178, Volume 2/EPRI 3002016052, Refining and Characterizing Heat Release Rates From Electrical Enclosures During Fire (RACHELLE-FIRE), Volume 2: Fire Modeling Guidance for Electrical Cabinets, Electric Motors, Indoor Dry Transformers, and the Main Control Board, Draft for Public Comment, U.S. Nuclear Regulatory Commission, Washington, DC, and EPRI, Palo Alto, CA, 2019. And added cross-reference in text.	08/22/2019
EDF-1	Section 1	First, EDF fully agrees with the need to improve the modeling of the fire scenario progression to better reflect Operating	No changes to text. Comment reflects similar project undertaken by EDF.	8/1/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
	Page 1-1	Experience, especially for electrical cabinets which represent major contributors to the Fire-CDF. As you did, EDF noted that Fire-PRA insights were not consistent with French OPEX which shows that most fires are contained and limited to the ignition fire source thanks to prompt suppression. Therefore, EDF developed in 2018 its own approach that consists in a deeper analysis of the French OPEX to distinguish various fire progression scenarios. Whereas the 'philosophy' that inspired both yours and our methodology is similar, both methodologies differ. Comments that follow are directed towards your methodology proposal.		
EDF-2	Section 3.3.1.5 page 3-7	"they do not continue to grow~~th~~ prior to"	Corrected	7/31/19
EDF-3	Section 3.4.1 page 3-8	The document should define the application scope of the so-defined *Interruptible Fire* and *Growing Fire* Split Fraction as regards the quantification tasks of the FPRA methodology. For the FPRA Task 7 'Quantitative screening', the fire ignition frequencies to use shall not distinguish interruptible / growing fire. Such distinction shall only be made through Task 14 "Fire risk quantification" and detailed fire scenarios analysis.	Scope revised as: *The scope of the methodology described in this report is limited to electrical cabinet sources (Bin 15, electrical cabinets)* ***with detailed fire modeling***.	08/20/2019
EDF-4	Section 4.1.1 page 4-4	It is proposed to define a pre-growth period with zero HRR for interruptible fires to reflect the time period over which prompt suppression can prevent the fire growth.	Agree, the experimental results are likely more severe than real events (for Interruptible and Growing Fires).	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		The 8 min duration that is proposed is derived from experimental results. I believe (but, correct me if I am wrong) that experimental tests have been conducted with the objective for the fire to develop, i.e. involving specific igniters. They should still be more severe than real events. Therefore, I believe that associating the 8min pre-growth period derived from experimental tests with the fire non-suppression probabilities derived from the fire events **will still lead to non realistic results in terms of the proportion of interruptible fires non suppressed before any damage out of the fire source equipment**. Then, I suggest to further use the fire events from the FEDB to define a split fraction to distinguish *Interrupted* and *non-Interrupted* interruptible fires. The *Interrupted* interruptible fires would be defined as interruptible fire events which have been suppressed before any damages out of the fire source equipment. The *Non-interrupted* interruptible fires would be defined as interruptible fire events which have not been suppressed before any damages out of the fire source equipment. For the *Interrupted* interruptible fires fraction, as by definition the damages are limited to the fire source equipment, there is no need to carry out any fire physical calculation to define the timing of damages. For the *Non-interrupted* interruptible fires, fire physical calculation shall use the HRR profile defined fir interruptible fire without any pre-growth period (meaning the pre-growth period	Under the proposed classifications if a fire was found to damage targets outside the fire ignition source, it is classified as a growing fire since it grew large enough to damage targets outside the equipment. No recorded fire event has damaged equipment after suppression activities have started, so there would be no fraction of fires that could be classified as non-interrupted, interruptible fires. Applying the proposed guidance in detailed fire modeling should not result in any instances where damage occurs during the pre-growth period, regardless of how the probability of non-suppression determined or used. This is because during that period there should be no HRR modeled, and therefore no critical HRR that could damage equipment (it is essentially a supplemental period of time that may be considered in the Interruptible fires path analysis). Totally removing the fraction of fires does not seem appropriate as it is unknown that should the attempts to suppress the fire failed, there would be no risk associated with those events. Instances where the initial suppression failed would be represented by the events that identified multiple suppression efforts were required and those events are classified as growing fires. Totally removing this time period or fraction of events does	

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		in Figure 4-3 shall be suppressed) as this is considered through the *Interrupted/Non-interrupted* split fraction. In addition, the fire suppression probabilities to be applied to *Non-Interrupted* interruptible fire shall be established considering only *Non-Interrupted* interruptible fire events from the FEDB (meaning the fire suppression probabilities curve in Figure 3.3 shall be updated).	not match the practiced method currently practiced in Fire PRA applications.	
CNWRA1	General	As the reader is going through the document, it is difficult to determine and keep track of which event data were used in the development of each of the elements of the methodology listed in Section 1.1. It would be helpful to include a summary table (e.g., in an Appendix) that specifies the period in the event databases that was used for each element. For example, the table would show that event data for the period between 2000 and 2014 were used to determine the split fractions reported in Table 3-2. The table would also explain why the period was chosen. In the example, the reason is that earlier event data was not sufficiently detailed to classify a cabinet fire as interruptible or growing. A reference to the table could be included in Section 1, Introduction.	The table captions have been updated in resolving comment NEI-3 to show the period of data used for each element presented. For example: The caption associated Table 3-2 presenting the *Interruptible* and *Growing* fire split fractions now includes the time period (2000-20140. A similar change is made for the suppression rates (1990-2014). The table presenting fire ignition frequency already includes the time period (2000-2014).	8/30/19
CNWRA2	Page 3-1, Lines 5-11	There is some repetition in the first paragraph of Section 3.1, which makes it confusing for the reader. It is suggested to delete the first four sentences in the section, i.e., start with "Following the approach described in NUREG/CR-6850 …" Alternatively, the four sentences could be a separate introductory paragraph. If these four sentences are retained,	Retained the first few sentences as introductory paragraph to bridge the gap between Sections 2 and 3. Reduced repetition and revised the final sentence as suggested.	8/12/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		it is suggested to reword the fourth sentence as follows: "In other words, these are fires that were not fully involved, did not impact surrounding equipment, or did not damage cable trays or conduit nearby."		
CNWRA3	*Page 3-8, line 4*	Replace "… Section 3.3 …" with "… Section 3.3.1 …"	Updated Section link to 3.3.1	8/12/19
CNWRA4	Page 3-9, Table 3-2	Revise table caption to read "Interruptible and growing split fractions based on 2000-2014 event data".	Corrected with comment NEI-3	8/12/19
CNWRA5	*Page 3-9, lines 11-12*	It is stated that a unique suppression rate associated with the MCR already exists. It is suggested to add a reference to NUREG-2169.	Revised as suggested.	08/13/19
CNWRA6	*Page 3-11, lines 8-10*	This sentence is confusing. Some minor rewording is suggested as follows: "The interruptible and growing …counted under Bin 15, as defined in NUREG/CR-6850, based on events that occurred between 1990 and 2014."	Reworded as suggested.	8/12/19
CNWRA7	*Page 3-11, lines 10-13*	It is stated that 14 of the Bin 15 electrical cabinet events in "this period" did not contain enough information to categorize them as interruptible or growing fires. The preceding sentence seems to imply that this statement refers to the period between 1990 and 2014. However, it is assumed that the period is actually limited to the years between 1990 and 1999 because between 2000 and 2014 the event database contained sufficient information to categorize cabinet fires as interruptible or growing. Please confirm or clarify. According to Table A-2, it appears that there were 39 Bin 15 fires in the event database for the period between 1990 and 1999. Nine events are assigned a fire classification of	Yes, this comment is correct. We had enough supporting information to classify the 2000-2014 time period, but not the 1990-1999 period. Additionally due to the density in the data for the 2000+ time period the 1990s data is not used to calculate frequency (consistent with NUREG-2169). Revised as: Eight of thirty-nine Bin 15 electrical cabinet events that occurred between 1990 and 1999 did not contain enough information to categorize them as	08/13/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		interruptible fires, while six are considered growing fires. Ignoring incident number 20357 for which Pns is undetermined leads to 14 events that occurred between 1990 and 1999 and that were included in the analysis to determine the additional fire suppression rates. Please confirm that these events are the 14 events that are referred to in the aforementioned statement. If so, explain why the remaining 25 events in Table A-2 were not included. In line 12 it is stated that half of the count and suppression time was split evenly between the two classifications. However, Table A-2 indicates that nine of the fourteen cabinet fires were considered interruptible and only five were classified as growing. Please clarify. Finally, what are the criteria that were used to classify any of these 14 cabinet fires as interruptible or growing? If the events were indeed split evenly between the two classifications, it is worth mentioning that this approach is conservative compared to using the split fractions in Table 3-2 to estimate how many of the 14 cabinet fires were interruptible.	interruptible or growing fires. To capture these events, half of the count and suppression time was split evenly between the two classifications. Eighteen of the events occurring in the 1990s could be classified as interruptible and growing and were considered in their respective suppression rate calculations. For the remaining events, no suppression time could be determined from the event reports. Events for the 1990-1999 period are: 12 Interruptible (1 N/A from suppression for self-extinguished, Event 98) 8 Growing (1 N/A for self-extinguished, Event 20357) 12+8=20-2=**18** (1990-1999 period events included in in the suppression rate calculations). The Interruptible vs. Growing classification is known for these events and they are included in the suppression rate calculations similar to those events in the 2000-2014 period. Of the remaining (39-20= 19) events, the suppression time for 8 were able to be estimated from the information in the event reports. The count and suppression time for these events was split 50/50 between the Interruptible and Growing suppression rate calculations.	

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various | **Phone:** | **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various | **Date:** July 2019 | **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			Two of the events were excluded, one event (20302) occurred at location outside the scope of the Fire PRA and the other (20276) self-extinguished. The suppression time for the remaining 9 events was not able to be determined. Therefore, they could not be used. A note *'Suppression time indeterminate'* has been added to the suppression notes for clarification. These events are: 20267, 20268, 20269, 20273, 20275, 20282, 20312, 20334, 20346	
CNWRA8	*Page 3-12, line 15*	Add "The latter is usually 24 hours (see NUREG-2122)." at the end of the paragraph.	Revised as suggested. Added NUREG-2122 to reference list.	08/13/19

REVIEW / COMMENT DOCUMENTATION

Reviewer:	Various	**Phone:**		**Document #, Rev:**	NUREG-2230 / EPRI 3002016051
Discipline/Department:	Various	**Date:**	July 2019	**Title:**	Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA9	*Page 3-12, line 25*	The generic frequency for the MCB provided is 2.05E-3 and reference is made to NUREG 2178, Volume 2. Section 8.3.1 of NUREG 2178, Volume 2 shows this generic fire frequency split by power mode, either Full Power Initiating Event (FPIE) or Low Power Shut Down (LPSD). It seems appropriate to apply a split fraction to refine the generic frequency, but the floor value analysis only uses the value for FPIE. What is justification for not considering LPSD conditions in the development of the generic fire frequency for the MCB?	The applicable modes for each bin originate from NUREG/CR-6850 and carried forward in NUREG-2169. For Bin 15, this assumption has been carried forward into NUREG-2230, although, the event experience includes one or two LPSD events that may not have been possible if the plant was at power. Due to the wide variability of components contained within this bin, this item has been reserved for future research. For the main control board, upon looking at the experience it was determined that maintenance/work performed in event 51002 would have not occurred during power operations. To reconcile, the fire ignition frequencies for the main control board have been split between at power and LPSD. Aside from Bin 4 and Bin 15 (AA), the values for Bin 6 and 7 use the at power frequencies (there are different values for LPSD).	8/22/19
CNWRA10	*Page 3-12, line 30*	Replace "… (NUREG-2230) …" with "… (see Table 3-9) …"	Agree. Replaced NURG-2230 with Table 3-9.	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA11	*Page 3-13, line 2*	Provide a basis for the 300-700 range of the number of cabinets counted as ignition sources in a single unit NPP. This seems inconsistent with the average plant-wide count of 750 in Table 6.2.3 of IMC 0308 Attachment 3 Appendix F.	Revised as: • *The electrical cabinet frequency is based on the number of cabinets counted in the MCR in the FPRA. This count can vary widely from NPP to NPP. The generic frequency value is 3.43E-2/yr (**Table 3-9**), which applies to a single NPP. **Component counts for both BWRs and PWRs were reviewed and average Bin 15 component count is around 800 per unit. The lowest observed count was over 300.** To generalize the analysis, it is assumed that the apportioning factor is a random variable sampled following a uniform distribution with a range between 1/300 and 1/**13**00. The practical implication of this assumption is that there are on average **8**00 cabinets counted as ignition sources in a single unit NPP and align with experience performing FPRAs. **Since the Bin 15 fire frequency is divided amongst the ignition sources, the lower the component count, the higher the ignition frequency per component. Using a lower bound of 300 provides reasonable assurance that the ignition frequency is overestimated.***	08/22/2019
CNWRA12	*Page 3-13, line 10*	Provide a basis for the 10%-30% range of the apportioning factor (fraction of the control, auxiliary and reactor building floor area representing the MCR).	Revised as: • *[…] To generalize the analysis, it is assumed that the apportioning factor is a random variable sampled following a uniform distribution with a range between 10% and 30%. The practical implication of this assumption is that, on average,*	08/22/2019

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			20% of the transient frequency is in the MCR. This conservatively assumes that the MCR, ***often a single room****, represents 20% of the combined control, auxiliary, reactor building floor area.*	
CNWRA13	*Page 3-13, lines 19-21 and Equation (3-2)*	Delete the sentence “This results … 1.21E-4/day.” because this calculation is incorrect, as it does not account for the random variables (total number of cabinets in the plant and apportioning of the area of the MCR). Instead, change Equation 3-2 as follows: $Pr(t \leq 24\ h)$=(3.7E-03)/365≈⁄1E-05 (3-2)	Revised as suggested.	08/13/19
CNWRA14	*Page 3-13, line 33*	According to NUREG-2178, Volume 1, the 98th percentile peak HRR of a large open electrical enclosure with thermoplastic cable contents is 1,000 kW. Five minutes after ignition the fire in such a cabinet would grow to 174 kW. Three minutes after ignition the HRR is 63 kW. A value closer to 3 minutes may be a more appropriate lower limit for the range.	At 3 minutes, it is very likely that the fire is still growing and spreading within the cabinet. At 63kW it is unlikely that the MCR is abandoned due to either heat flux, temperature, or optical density. Therefore, 5 minutes will remain as the lower bound.	08/20/2019
CNWRA15	*Page 3-14, line 2*	Explain how the non-suppression floor value for a dual unit MCR was estimated.	*Table 3-5 entry revised as:* *Two-unit NPP:* ***Double the generic frequency associated with the MCB, electrical cabinets, and transients***	08/13/19
CNWRA16	*Page 3-14, line 19*	Replace “… Section 3.5 …” with “… Section 3.5.1 …”	Agreed. Updated reference section.	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA17	*Page 3-17, Table 3-9*	The frequency for electrical cabinet fires is for AA power modes (not separated by AP or AL power modes). Moreover, the power mode in the table is AA, but the PRA type is FPIE. This is confusing, since it is explained in Chapter 8 of Volume 2 of NUREG 2178 that the split between FPIE and LPSD is related to power mode. Please explain why the frequency is split by power modes for the MCB but not for electrical cabinet fires. Clarify the difference between PRA types and power modes and how that affects the fire frequencies used in the analysis.	The applicable modes for each bin originate from NUREG/CR-6850 and carried forward in NUREG-2169. For Bin 15, this assumption has been carried forward into NUREG-2230, although, the event experience includes one or two LPSD events that may not have been possible if the plant was at power. Due to the wide variability of components contained within this bin, this item has been reserved for future research. For the main control board, upon looking at the experience it was determined that maintenance/work performed in event 51002 would have not occurred during power operations. To reconcile, the fire ignition frequencies for the main control board have been split between at power and LPSD. This approach is consistent with NUREG/CR-6850 where some fire ignition frequency bins are applicable to all modes. There are some fire ignition source bins that may have different factors including maintenance, storage of combustibles, welding, etc. that are not relevant to a mode of operation and the fire ignition frequency is split into at power and LPSD conditions.	8/22/19
CNWRA18	*Page 4-3, line 18 and Table 4-1*	The averages of the pre-growth, growth, steady burning and decay durations may not be the most representative or appropriate values to use. For example, if the dataset consists of a large number of values that are clustered together and a relatively small number of values that are	The purpose of this research is to increase realism in Fire PRA. Using the insights from the FEDB, the FEDB experience overwhelmingly suggests that the fire is extinguished before external target damage occurs. Therefore, simply selecting the	08/30/2019

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

<table>
<tr><th>Comment No.</th><th>Document Number Section / Paragraph</th><th>Review Comments (Print)/Basis for Comment</th><th>Comment Disposition / Resolution</th><th>Reviewer Acceptance / Date</th></tr>
<tr><td></td><td></td><td>much larger, is likely to be the more representative statistic to use. It is suggested to add a row with the median values at the bottom of Table 4-1 as shown below, and to use the median when that is more representative or conservative.

Table 4-1
HRR timing for interruptible electrical cabinet fires
<table>
<tr><th rowspan="2">Test</th><th colspan="4">Units in Minutes</th></tr>
<tr><th>Pre-Growth Period</th><th>Time to Peak</th><th>Steady Burning</th><th>Time to Decay</th></tr>
<tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr>
<tr><td>Average</td><td>8</td><td>7</td><td>5</td><td>13</td></tr>
<tr><td>Median</td><td>6</td><td>6</td><td>3</td><td>13</td></tr>
</table>
Using the more conservative values of the average or the median leads to pre-growth and time-to-peak values of 6 minutes each, followed by 5 minutes of steady burning and a linear decay to a HRR of zero over a period of 13 minutes.</td><td>more conservative of the two is not an appropriate recommendation.
The mean will be the metric used to estimate the HRR profile period durations:
• The mean better captures the range of the distribution, which is important for realism.
• The skew in the experimental evidence is also seen in the OPEX, which may not be appropriately reflected in the PRA when using the median.
A short discussion is added in Section 4.2.
Note: A new set of criteria have been established and applied to the data determined to represent Interruptible fires and presented in Table 4-1. A new discussion has been added to describe the criteria and resulting test data used to estimate the pre-growth period duration of an Interruptible fire.</td><td></td></tr>
<tr><td>CNWRA19</td><td>Page 4-5, line 16 and Table 4-2</td><td>The previous comment applies to the HRR profile for growing fires. The additional row with the median values for the data in Table 4-2 is shown below.
Again, using the more conservative values of the average or the median leads to a time to peak of approximately 10 minutes, followed by 9 minutes of steady burning and a linear decay to a HRR of zero over a period of 26 minutes.</td><td>See response to CNWRA18.</td><td>08/30/2019</td></tr>
</table>

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

<table>
<tr><th>Comment No.</th><th>Document Number Section / Paragraph</th><th>Review Comments (Print)/Basis for Comment</th><th>Comment Disposition / Resolution</th><th>Reviewer Acceptance / Date</th></tr>
<tr><td></td><td></td><td>Table 4-2
HRR timing for growing electrical cabinet fires
<table>
<tr><th rowspan="2">Test</th><th colspan="3">Units in Minutes</th></tr>
<tr><th>Time to Peak</th><th>Steady Burning</th><th>Time to Decay</th></tr>
<tr><td>⋮</td><td>⋮</td><td>⋮</td><td>⋮</td></tr>
<tr><td>Average</td><td>12</td><td>9</td><td>26</td></tr>
<tr><td>Median</td><td>10</td><td>5</td><td>19</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>CNWRA20</td><td>Page 4-7, lines 7-14</td><td>The median time to decay in Table 4-2 is 19 minutes, which is identical to the decay time in NUREG/CR-6850. Using the median decay time of 19 minutes (instead of the mean decay time of 26 minutes) provides a rational basis for softening the effect of long duration fires with relatively low intensity in the later stages of the experiments.</td><td>See response to CNWRA18.</td><td>08/30/2019</td></tr>
<tr><td>CNWRA21</td><td>Page 4-7, lines 24-26 and Page 4-8, lines 1-8</td><td>On page 4-7, the final recommended guidance allows the analyst to select a time of up to 8 minutes for pre-growth of the fire (0 kW). On page 4-8, it is explained why a period of 4 minutes was selected in the examples discussed in Chapter 6.
It is likely that users of this document will use the examples from Chapter 6 as a template and use a 4-minute growth time by default. Consider adding language to explain by example how an appropriate value of the pre-growth time can be estimated for a specific NPP and set of conditions. Alternatively, if 4 minutes is the recommended pre-growth time, consider modifying the language on page 4-7 to be consistent and provide justification for this recommendation.</td><td>Agree, see the response to comment RC-2 for resolution.</td><td>8/12/19</td></tr>
<tr><td>CNWRA22</td><td>Page 5-3, lines 8-9</td><td>Replace “The Pns for each profile is summed together to determine the total scenario specific NSP.” with “The total</td><td>Revised.</td><td>8/12/19</td></tr>
</table>

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		scenario-specific NSP is determined as the weighted sum based on the split fractions of the Pns for each profile.”		
CNWRA23	*Page 5-6, Table 5-2 and lines 1-2*	The Monte Carlo analysis will have to be redone and the resulting probabilities of no detection in Table 5-2 will need to be updated. Details are provided in the technical comment section on Appendix B.	Monte Carlo analysis has been revised. See individual comments below.	08/22/2019
CNWRA24	*Page 6-3, line 5*	Start a new paragraph with “Because the MCC …” because this sentence starts the discussion of the development of the solution of the NSP event tree according to the new methodology, while the previous sentence ends the discussion of the solution obtained according to the methodology in NUREG/CR-6850 Appendix P.	Revised as suggested	8/12/19
CNWRA25	*General (but related to Table in Section 7)*	It would be helpful to include Table 7-3 in the executive summary.	Table 7-3 is included to provide a single location reference for the currently published suppression rates as of the date of the publication of NUREG-2230. While multiple suppression rates are revised as a result of this analysis, the totality of the suppression rates is not appropriate for the executive summary on a methodology focused on a single Bin. No changes made.	08/22/2019
CNWRA26	*Table A-2*	Explain in the text how cabinet fires that occurred between 1990 and 1999 were classified as interruptible or growing (see comments on Page 3-11, lines 10-13).	See response to comment CNWRA7.	08/22/2019

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA27	Appendix B – General	In light of the comments provided below, it appears that the Monte Carlo analysis described in Appendix B will need to be redone. Appendix B in draft NUREG-2230 is reproduced in Attachment A. A proposed revised draft of Appendix B incorporating the comments with track changes turned on can be found in Attachment B. A clean copy of the revised Appendix B is provided in Attachment C. The proposed revision of Appendix B includes some editorial changes that are not discussed here. Comments below and parts of the text that require additional discussion are highlighted in yellow.	Monte Carlo analysis revised. See responses below.	08/22/2019
CNWRA28	*Page B-1, lines 13-14*	The purpose of the Monte Carlo analysis is to determine the probability that a smoke detector will actuate for electrical cabinet fires. A probability is calculated for each type of enclosure that is listed in Table 7-1 of NUREG-2178, Volume 1. To determine this probability, it is not necessary to calculate the time to activation. One only needs to determine for each set of sampled parameters whether the sampled peak HRR is sufficient to result in smoke detector activation. The detector may actuate at a lower HRR, i.e., during the growing phase (i.e., the peak HRR is a sufficient but not a necessary condition for detector activation) but this does not affect the count of Monte Carlo realizations that result in detector activation.	While the time to activation is not used in the methodology outlined in this report, it does function as a surrogate of activation that can be judged against available experimental results, allowing for a judgment on the validity of the model.	08/23/2019
CNWRA29	*Pages B-1 and B-2, Table B-1*	Proposed changes to the table are summarized below.	Gamma distribution updated with larger data set. Monte Carlo analysis revised to randomly select a cable jacket type from available references and	08/30/2019

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		• Because it is not necessary to calculate the time of smoke detector activation, the HRR profile duration parameters can be deleted. • Figure B-1 in Section C.2 indicates that a gamma distribution is not a particularly good fit. A better-fitting distribution should be used. • Two ranges should be defined for the smoke yield, one for TP and another for TS cables. The former should be used for fires of cabinets that contain TP cables, the latter for cabinets with TS/QTP/SIS cables. The SFPE handbook ([29]; Table A.39) provides smoke yield data for two types of TP cable (PE/PVC and PVC/nylon/PVC-nylon). The values range between 0.076 g/g and 0.136 g/g. The range of the smoke yield for TS cables is 0.082-0.175 g/g. Also, some consideration should be given to the fact that the smoke yield values in the SFPE handbook appear to be too high (see Gottuk, D., Mealy, C. and Floyd, J., "Smoke Transport and FDS validation," Proceedings of the Ninth International IAFSS Symposium, pp. 129-140, 2008. doi:10.3801/IAFSS.FSS.9-129). Using smoke yield values that are too high overestimates the probability of smoke detector activation. • The radiative fraction should be varied. A higher radiative fraction results in a lower convective fraction and, therefore, a lower probability of smoke detector activation. Consequently, varying the radiative fraction is important. NUREG-1805 recommends using a generic value of 0.3 but states that the radiative fraction for different types of fuels varies between 0.15 and 0.60 (see Chapter 5 in NUREG-	use a soot yield, heat of combustion, and radiative fraction for individual iterations. This allows us to produce realistic value sets for the analysis. To address the comments related to the validity of the SFPE/Tewarson data, we've reviewed the current simulation results. While the average detectable HRRs are in the ranges associated with the comment noted reference (Gottuk, Mealy, and Floyd) of 50 - 100 kW, the results are heavily skewed towards HRRs of 10-30 kW. This range better fits the testing used to develop the SFPE/Tewarson data. Therefore, we believe the SPFE/Tewarson data is appropriate for the Monte Carlo analysis. Text revised as: *Where y_s is the soot yield of the fuel in kg/kg and all other parameters have been identified. The soot yield values used in the Monte Carlo sampling process are taken from the values for electric cables in the SFPE handbook [29; Table A.39]. The* ***value used for the*** *soot* ***yield – and subsequently heat of combustion and radiative fraction – for each sample is selected randomly from the values for electric cables listed in*** *the Society of Fire Protection Engineers (SFPE) handbook [29; Table A.39].*	

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		1805). The low values are for light gaseous fuels, alcohols, etc. and are not relevant here. The radiative fraction for cable fires can be estimated from the ratio of the radiative to the chemical heat of combustion reported in Table A.39 of the SFPE handbook [39]. The resulting range for the radiative fraction of TP cables (PE/PVC and PVC/nylon/PVC-nylon) is 0.37-0.63 with a mean of 0.50 and median of 0.49. For TS cables (EPR/Hypalon, XLPE/XLPE, and XLPE/neoprene) the range is 0.34-0.62 with a mean of 0.47 and median of 0.50. Consequently, a single range of 0.35-0.63 for the two cable types seems reasonable. However, the last part of the previous comment (i.e., the observation that the soot yields in the SFPE handbook are too high) also applies here and indicates that further investigation to find a suitable range for the radiant fraction may be warranted.	*Change required updates to:* *Table 5-2: 08/22/2019* *Figure 5-12: 08/22/2019* *Examples (Most figures and tables): 08/22/2019* *Appendix C Tables: 08/23/2019* *Appendix D Tables 08/30/2019 (includes changes to IF supp rate, and propagation through report, examples, and appendix*	
CNWRA30	*Page B-3, Subsection on Ceiling Jet Density*	A sentence is added to indicate that the ceiling jet consists primarily of entrained air and that for estimating its density, the combustion products can be neglected.	Revised as suggested.	08/22/2019
CNWRA31	*Pages B-3 and B-4, Subsection on Dilution Factor*	There is no need to introduce this factor. This subsection is renamed to “Normalized Ceiling Jet Mass Flow Rate” because that is what is calculated in this subsection.	Revised as suggested.	08/22/2019
CNWRA32	*Page B-4, Subsection on Soot Density*	This subsection is renamed to “Soot Mass Concentration” because that is what is calculated in this subsection.	Revised as suggested.	08/22/2019
CNWRA33	*Pages B-5 through B-8, Section B.3*	It is proposed that this section be deleted. As mentioned in the comment on Page B-1, lines 13-14, to determine	While the time to activation is not used in the methodology outlined in this report, it does function	08/22/2019

Reviewer:	Various	**Phone:**		**Document #, Rev:**	NUREG-2230 / EPRI 3002016051
Discipline/Department:	Various	**Date:**	July 2019	**Title:**	Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		whether a smoke detector will actuate for a set of sampled parameters it is not necessary to calculate the time to activation. Consequently, an evaluation of the capability of models to predict smoke detector activation time has little or no bearing on the validity of the results of the Monte Carlo simulation. Moreover, Figure B-2 indicates that the predictive capability of the two models is very poor. More work is needed to investigate the reasons for the discrepancies and to improve the predictive capability of the models.	as a surrogate of activation that can be judged against available experimental results, allowing for a judgment on the validity of the model. The average model bias and standard deviation are 1.18 and 0.48 respectively. For comparison the average bias and standard deviation for FDTs, CFAST, MAGIC, and FDS reviewed in Supplement 1 to NUREG-1824 are 1.38 and 0.42, respectively. This comparison suggests that the model used in the draft NUREG is comparable to the models currently validated for use in Fire PRA.	
CNWRA34	General – Appendix D	Appendix D does not appear to be referenced anywhere in the main part of the document.	Text added to Section 5.3: *Sensitivity to the parameters are analyzed in the examples (see Section 6). Uncertainty in the development of the parameters is reviewed in Appendix D.*	08/13/19
CNWRA35	*Page D-7, lines 1-2*	Based on Table D-1 (page D-4, first two rows), the assumed pre-growth time is also a significant sensitivity parameter. Please add this parameter to the discussion on page D-7 to recognize its impact.	Text added: *Sensitivity to the interruptible fire pre-growth period duration is also expected since it provides a period of time where damage is not modeled to occur for nearly 70% of the fires in electrical cabinets.*	08/13/19
CNWRA36	Abstract *Page v, line 6*	Replace "… data has been …" with "… data have been …" because data is plural.	Revised sentence to read: As a result, further development of the methods has been performed and additional data have been collected and analyzed over the past decade. These improvements have allowed gaps in the	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			methods to be closed and more realistic estimates of risks to be obtained.	
CNWRA37	*Page 2-1, line 26*	Replace "… NUREG/CR-7197 …" with "… NUREG/CR-7197 (HELEN-FIRE) [11] …" because it is referred to as HELEN-FIRE in other parts of the document (e.g., captions to Figures 4-1 and 4-2).	This report is now consistently referred to as NUREG/CR-7197.	8/12/19
CNWRA38	*Figures 2-1 through 2-5*	It would be helpful to increase the size of the colored squares in the legends to the pie charts and used different hatched patterns so that it easier to distinguish the different categories in a B&W hardcopy.	Sizes of legends increased. If any of the percentages presented in the Figures contained in Chapter 2 are directly influential in the methodology presented in later chapters, all necessary discussion is repeated. No confusion as a result of a black and white copy is expected. No changes made.	08/22/2019
CNWRA39	*Page 3-11, line 13*	Replace "Due to the limited event information …" with "Due to the limited cabinet fire event information …"	Revised as suggested.	8/12/19
CNWRA40	*Page 3-12, Table 3-4*	Please spell out the column headings in this table, i.e., SS = Sum of Squares, df = Degrees of Freedom, etc.	Revised as suggested.	08/13/19
CNWRA41	*Page 3-13, lines 7-8*	There appears to be a typo in NUREG-2169. The location for Bin 7 in Table 4-4 is described as the "Diesel Generator Room". Based on Table 6-1 in NUREG/CR-6850 this should be "Control/Aux/Reactor Building". It is suggested adding a footnote to point this out.	Current plans are to revise NUREG-2169 within a year. Correction will be addressed at that time. No changes made.	08/20/2019
CNWRA42	*Page 3-13, lines 33-34*	Replace "occurs before a half of the growing time …" with "occurs before half of the growing time …"	Text re-written / comment no longer applicable.	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA43	*Page 3-15, Figure 3-4*	“Growth Fire” is referred to as “Growing Fire” in other places. Strictly speaking, the lower limit for the y-axis is 0.00001.	Legend revised to Growing. y-axis revised to scientific notation.	08/13/19
CNWRA44	*Page 4-1, line 22*	Replace “… Valtion Teknillinen Tutkimuskeskus …” with “… Technical Research Centre of Finland …”	VTT is initially identified by its native name in NUREG-2178, Vol. 1 – the most recent document published reviewing electrical cabinet fire HRRs. Therefore, the same will be done so here. No changes made.	8/13/19
CNWRA45	*Page 4-1, line 24*	Replace “… NUREG/CR-7197 [11].” with “… NUREG/CR-7197 (HELEN-FIRE) [11].”	Report now consistently referred to as NUREG/CR-7197.	8/12/19
CNWRA46	*Page 4-2, line 12*	Replace “… (Figure 4.2.A) …” with “… (e.g., Figure 4.2.A) …”	Revised as suggested.	8/12/19
CNWRA47	*Page 4-2, line 13*	Replace “… (Figure 4.2.B) …” with “… (e.g., Figure 4.2.B) …”	Revised as suggested.	8/12/19
CNWRA48	*Page 4-3, line 19*	Replace “… Chesapeake Bay Detachment (CBD) …” with “… (NIST) …” because CBD is essentially unknown and the tests were conducted by NIST.	CBD is how the tests are characterized in the reference, NUREG/CR-7197. No changes made.	08/23/2019
CNWRA49	*Page 4-5, line 17*	Replace “… Chesapeake Bay Detachment (CBD) …” with “… (NIST) …”	CBD is how the tests are characterized in the reference, NUREG/CR-7197. No changes made.	08/23/2019
CNWRA50	*Page 5-3, line 10*	Replace “… are conceptually similarly …” with “… are conceptually similar …”	Revised as suggested.	8/12/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
CNWRA51	*Page 5-27, lines 29-30*	Replace "… an motor control center (MCC) …" with "… a motor control center (MCC) …" or with "an MCC".	Revised as suggested (found in two places)	8/12/19
EK-1	General (Specific comments)	The report fails to address the effects of decision-dependent uncertainty on its dataset. The consequence of this oversight is that the dataset is invalid as of the date of publication. <u>Details on explanation of comments:</u> The fire statistics developed in the DRAFT NUREG are not helpful to investigators interested in avoiding catastrophe (core damage or more importantly, radiation release) because (at a minimum) they are disconnected from protective equipment availability. Only when sufficient protective system equipment are unavailable will catastrophe follow; a relevant example would be the sustained loss of electrical power in Generation II light water reactors due to fire. The NUREG should be rewritten to produce statistics on data related to protective system equipment unavailability due to fire. Such data would be in the form of event occurrence (date, time, where) and consequential protective system equipment unavailability (list of equipment affected, duration of unavailability); these data would be useful to reliability engineering investigators.	The objective of NUREG-2230 is to characterize fire ignition frequency, fire growth timing, and plant personnel response to fire. Fire ignition frequency and fire growth characteristics are independent of operator or plant personnel actions (with the exception of hotwork scenarios, and possibly testing and maintenance, etc.). This report is to be used in the risk-informed approach currently available to licenses under 50.48(c). It is meant to be used in the integrated context of leveraging risk insights that account for the likelihood, consequence, and impact of fire scenarios; according to the PRA policy statement of 1995. In this context the data set is valid.	8/30/19
	General (Specific comments)	The report claims the reported data can be used for model validation but fails to explain how the data can validate a model (nuclear plant risk model) in light of the fact that the dataset lacks the necessary correlate (that is, core damage or radiation release.) <u>Details on explanation of comments:</u>	Specific to the model validation in the DRAFT NUREG, validation of the smoke detection model described in Appendix B is performed following the fire modeling validation methodology in NUREG-1934. This is the only model validation effort performed in NUREG-2230.	8/30/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		When using empirical data as a predictor of future performance, as proposed in the DRAFT NUREG, there are at least two important cautions (enumerated below) that must be observed. Nowhere in the DRAFT NUREG is it explained how these cautions are being considered. (a) The data must be meaningful to the observation of interest – Lacking statistical data on catastrophe following fire or equipment unavailability is the only statistic with relevance to reliability. Note that the DRAFT NUREG has no information about protective system unavailability as part of the statistics developed. If the data are not meaningful in this regard, the statistics will not be helpful to investigators who intend to reduce the probability of protective system equipment unavailability due to fire. Statistics for any complicated process with risk for harm are obtained to understand frequency of harmful events. For example, data on pedestrian crossing deaths at an automobile intersection are collected by noting when a death occurs. At some level of loss of life, actions are taken to reduce the risk (traffic deaths) using, for example traffic signals, overhead walkways, and other means; the data are not collected at a level that checks for frequency of human error on braking the automobile, driver attentiveness, condition of the automobile, likely speed of approach, weather conditions, etc. Only the frequency of pedestrian deaths is required to bring about risk management action.	The data used in this report is relevant and appropriate. As noted in the report, the majority of fires are potentially challenging, and by definition, do not damage external targets. Furthermore, the protective system availability is independent of the fire initiation and treated through the PRA model and/or non-suppression probabilities. Due to the number of components, locations, and cable routing, even if this information was available, could not be applied practically. The output of the PRA (both numerically and insights) can and should be used to manage and improve plant risk (including fire). The suggestions to improve availability of protective system and decreasing the occurrence of fires are examples of changes that can be realized with a Fire PRA. However, that is not the objective of the development of guidance for performing a fire PRA. The objective of PRA method development is to develop practical, credible, and generically applicable methods and data that can be applied in a plant-specific fire PRA to extract the insights mentioned in the comment.	

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		(b) The end use of the statistics is (rationally should be) to improve the availability of critical protective system equipment or decrease the occurrence of fires affecting critical protective equipment availability (that is, risk reduction). A direct consequence of actions taken to avoid future occurrence (depending on the efficacy of the actions) invalidates the data used to “predict" the future. Prediction of future performance is the domain of decision-dependent uncertainty; decision-dependent uncertainty is avoided out of necessity by investigators using historical datasets by being careful to preserve prior data validity (ensure the future is predicted by the past). For example, hedge fund managers use historical data to develop high frequency trade algorithms and many are very successful. However, unlike risk management in commercial nuclear power where workers intend to change the future, the clever hedge fund manager is very careful to ensure her trading volume doesn't affect the past data: she must avoid the temptation to become “too greedy".	The second part of the comment cautions about the use of past data for predicting future performance. The commenter suggests that if the root cause is corrected, then past performance may not be representative. The use of OPEX is used for calculating initiating frequencies not only within the fire domain but also for internal events (reactor trip, turbine trip, LOOP) and internal flooding. Furthermore, the fire ignition frequencies are meant to be updated every few years to capture changes in performance. Changes in performance have been observed over the course of the fire PRA development. Since the use of past data is an accepted practice in the PRA community no changes are implemented.	
	General (Specific comments)	The data should be made useful by adding information related to the efficacy of protection. For example by correlating protective system unavailability to the fire data, the statistics would be useful to investigators. The prior comments are not entirely naive; the reviewer understands the end use of the DRAFT NUREG statistics is PRA. A critical point is PRA may or may not contain (have as a basic event) the most interesting aspect of a particular fire event that	The documentation of the fire events is typically commensurate with the severity of the fire event. Fires that have minimal damage, minimal suppression, and/or minimal plant impact are often brief write-ups of the event. More severe events, such as high-energy arcing faults (HEAFs) generally have more detailed information on the timeline, plant response, and in some cases an apparent or root cause. In summary, the level of detail suggested is not available for most	8/30/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		bears on risk management - the failure mode (or mechanism) which is the root cause. For example, dust buildup in a high voltage enclosure has been shown (this has happened) to result in switchgear fires; a particular PRA is very likely to have an initiating event of fire in such an enclosure as a basic event. Depending on the enclosure, the PRA may include a sequence that contains the event as a cause for protective equipment unavailability. The advantage of PRA over other forms of reliability analysis is that it generally goes further than FMEA for example by attempting to comprehensively include all scenarios that could be envisioned from the event. In contradiction to what is suggested in the DRAFT NUREG, supplying more detailed statistics to a PRA in pursuit of quantification will not help plant workers or regulators develop new strategies, different inspections, or tests that would reduce the probability of future catastrophe (this point is closely related to Hansson's \Tuxedo Fallacy"). Unless this reviewer is missing a more subtle point, it seems the objective of the work documented in the DRAFT NUREG is (should be) intended to help risk management. Such an objective can only come from engineering analysis of the event, correctly understanding the root cause, and developing strategies that would reduce protective system equipment unavailability (in this case from fire). Once actions are taken, the prior data and	potentially challenging fires nor does it invalidate the current approach or contents of the DRAFT NUREG. The PRA is not intended to go into the details of dust building in a high voltage enclosure. As such, the NUREG was written to capture details from the FEDB to the extent possible, albeit, not at the level that the commenter is suggesting. Such level of detail would cause the complexity of any approach to increase significantly, well-beyond the value of the current PRA approaches within the context of the PRA Policy Statement. The statistics developed and presented in the DRAFT NUREG are already intended to assist analysts in determining if and what new strategies, different inspections, or tests are necessary to reduce the risk of core damage or radiation release resulting from fires in electrical cabinets. In addition, as stated above, the continuous updating and collecting of information is focused on ensuring the risk management of such contributors supports decision-making. Use of prior data is only done when the representativeness of the data and time period	

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		concomitant statistics presented in the DRAFT NUREG are invalidated.	considered is assessed. This is not anathema with risk assessment or use of PRA within a risk-informed decision-making process. Otherwise, no prior data could ever be used and no risk management approach would ever be deemed practical.	
	General (Summary of Explanation of Comments)	Effective risk management requires understanding and addressing the root cause of events that can lead to catastrophe; a useful fire database would explain the root cause for fires, possibly categorizing similar causes The data in the report should at a minimum be recast to indicate events where availability of protective system equipment is affected (reduced). The DRAFT NUREG in a few places suggests the data can be used to produce “more realistic modeling of fire risk". This claim is misleading for many reasons but particularly when used in a setting of dynamic risk management. Models of fire hazard (for example, probabilistic models) cannot be verified using data as proposed in the DRAFT NUREG; for the model to be verified, data for fire terminating in catastrophe (for example, core damage or radiation release) would be needed. If it were possible to have such data then a model (PRA or some statistical method) could be validated; otherwise, in the absent ouch data, there is no way to validate “nearness" to reality. In point of fact, lack of evidence may be an indication that, while occurrence of fire is certainly to be avoided, fire is of less concern compared to other protective system breakdowns that have actually led to catastrophe.	The overarching comment seeks to derive the root causes of fires in nuclear power plants with the objective of reducing the likelihood of fires. While this is a noble objective, this is not the purpose of NUREG-2230. Nor is this the purpose of the EPRI Fire Events Database. The purpose of the FEDB is to gather data on fire events, extract data for input to fire PRA, and use the insights to inform fire PRA methods (e.g., NUREG-2230). The primary objective of NUREG-2230 is to enhance the modeling of electrical cabinets in both the fire growth and the plant personnel response. The draft NUREG presents a methodology developed from detailed reviews of operational experience from the U.S. nuclear industry, specifically those associated with fires in electrical cabinets. The result is a method of estimating the frequency of and the rate of suppression for fires in electrical cabinets that more closely resembles the lower rates of risk significant fires documented in fire event reports when compared to the results of	8/30/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		Dynamic risk management in learning organizations will cause observed fire root causes to be eliminated or significantly mitigated as they occur; that is, the intent of risk management in learning organizations is change the future based on observations. This effect, changing operation, maintenance, or design based on root causes in response to fire events can be characterized as decision-dependent uncertainty.	the process recommended to date. Compared to the methods and data provided in NUREG/CR-6850, this is an improvement. The appropriateness of the data can be compared to the very limited number of severe fire events observed. In addition, verifying more severe fires with core damage events is impractical since these seldom occur (no approach based on such a concept, probabilistic or deterministic) would provide value for actual risk management. Instead, the current approach is to characterize the distinction between challenging and non-challenging fires, consider how protective equipment may fail while responding to a fire, and evaluate whether the current fire protection posture provides reasonable assurance of adequate protection. Finally, the comment appears to state that organizational factors need to be considered in risk management. While those aspects are connected to the causes of potential fires, available data and modeling approaches that explicitly include such factors are immature and not currently part of the state of practice.	

REVIEW / COMMENT DOCUMENTATION

Reviewer:	Various	**Phone:**		**Document #, Rev:**	NUREG-2230 / EPRI 3002016051
Discipline/Department:	Various	**Date:**	July 2019	**Title:**	Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
	Discussion	The commercial nuclear power industry is experiencing difficulty competing in the current electrical market leading to the extent that several plants are forced into early retirement; and therefore plant operators (especially “merchants" in deregulated markets) are looking for maximum benefit for resources expended. This reviewer notes that developing and maintaining a “Fire PRA" costs plants millions of dollars. Such large costs would be justified if they led to, or could be shown to lead to, significant improvements to safety. The comments made in the previous are to say that expenditures that would add complexity to PRA will not improve the efficacy of protection against core damage or radiation release. As stated above, based on basic risk management practice, this reviewer claims it can not be shown that spending resources that would apply the statistics developed in the DRAFT NUREG (that is, add complexity to a PRA) will change the risk of core damage or radiation release in a nuclear power power plant; although the assessed values (numbers) may change, it would have no effect on safety. This reviewer recommends a more well-founded statistical analysis be conducted that at least gives estimates of the current state of affairs in terms of fires on protective system equipment availability. Of course any fire should be prevented if for no other reason than worker protection; root	The development and deployment of fire PRAs has led to numerous safety improvements, most notably through the implementation of NFPA 805. The methodology in NUREG-2230 was intentionally developed to be adaptable within the existing framework of NUREG/CR-6850. NUREG-2230 can be incorporated during the development of a new fire PRA, or can be incorporated in an existing fire PRA methodology. NUREG-2230 requires no walkdowns/target collection and minimal additional inputs (e.g., if taking credit for monitored equipment in the MCR). The authors of NUREG-2230 are not aware of “other statistical analyses” that discredit the current use of data or the methodology presented, and it is unclear how unmentioned “other statistical analyses” would perform in terms of cost to industry, complexity, and technical bases. This methodology may change the calculated plant fire risk and provide insights that are more consistent with the observed OPEX. The commenter is correct that this method will not change the actual plant risk, as that is only achievable through changes to plant procedures, plant modifications, or changes to other plant	8/30/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		cause analysis and risk management against recurrence (addressing the root cause) is the best path to prevention.	practices. The insights from this report can be used by analysts to better focus resources where the greatest improvements may be made. To ensure these actions taken to reduce risk are those that are capable of reducing the *true* risk associated with core damage or radiation release, a certain amount of complexity may be necessary. The methodology in NUREG-2230 is an approach based on statistical analysis. The development of the additional detail was necessary based on original methodology oversimplifications. This report describes more distinct treatment for fire growth and suppression and is independent of the consequences (e.g., impact and availability of protective system equipment). Lastly, it is not an objective of this work to reduce the frequency of fires in nuclear power plants. This objective of the fire ignition frequencies is to objectively characterize the occurrence. The plant fire protection group, preventative maintenance, and other industry groups may provide recommendations for reducing the occurrence of fires, however this is not the subject of this report.	
From NUREG-2178 Vol. 2 Comment Period				

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
DH-1	7	NUREG-2178 Chapter 7 is very confusing as to what the conclusion is providing. By reading it carefully, the chapter seems to propose a floor value for NSP of 1.0E-05. However, Chapter 8 provides a recommended floor value of 1E-04 (Table 807). So the chapters disagree. Please re-write the section to be less confusing and ensure Chapter 7 and 8 agree with the approach and the recommended floor value.	This comment is in relation to the earlier draft that was posted. This issue has been reconciled in the new version.	8/30/19
GG-1	Pg 7-1 Line 12-14 Pg 7-2 Line 35-37	This section is intended to re-evaluate the floor value of the MCR non-suppression probability as a replacement of the 0.001 value that is currently used. It should be noted that "the probability of having a fire at some point" in the MCR is already covered by the fire ignition frequency. Therefore, including it in the non-suppression probability will result in double counting the frequency component.	There is no double counting the frequency. The value developed in this section is a 'floor' or limit. This value will serve as the lowest value for which a P_{ns} value would be considered appropriate and acceptable for use in the Fire PRA. It is not used to determine the scenario specific P_{ns} or subsequent scenario frequency. The introduction discussion has be simplified to remove references to the P_{ns} model.	9/3/19
GG-2	Pg 7-1 Line 23	For at power operation, would not consider Bin 6 transient fires due to welding and cutting the MCR to be one of the typical ignition sources.	While FAQ 12-0064 does allow for a zero (0) Hot Work influencing factor rating where "*activities during power operation are precluded by […] operation*," it also includes the 'Extremely Low' rating for application to qualified MCRs. Therefore, while unlikely, it is possible Bin 6 transient fires may need to be considered in a MCR analysis. A reference to the FAQ has been added.	9/3/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * LEGIBLE AND REPRODUCIBLE * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
GG-3	Pg 7-1 Line 31	This paragraph starts with the discussion the Bin 15 electrical cabinet frequency is based on the number of cabinets counted in the MCR. The calculation then seemingly applies the full Bin 15 generic frequency to the MCR, whilst in reality the MCR would have a small fraction of the total plant wide Bin 15 count and this should be reflected in the calculation.	The count is reflected in the ignition source weighting factor. This apportioning among cabinets within the plant is captured in the uniform distribution assuming the number of cabinets ranges from 300 to 1300 cabinets in the entire plant as described in the text. The development of the proposed floor value includes a single cabinet, weighted by the varying count of total cabinets within the plant. Discussion was revised to describe that the ignition source weighting factor is credited in the calculation, not the simply the generic frequency.	9/3/19
GG-4	Pg 7-2 Line 6	Saying the MCR represents 20% of the total floor area of the control / auxiliary / reactor buildings is overly conservative.	A sensitivity case has been added to Table 3-5 assuming the floor area ranges between 1% and 10%.	9/3/19
GG-5	Pg 7-2 Line 11-14	The statement that "the Fire PRA estimates the probability of an event occurring over a 24-hour mission time" does not make sense in the context of fire scenario frequency calculation. The plant mission time in PRA refers to the time needed for the mitigation systems to bring the plant in a safe long-term condition. Therefore, the mission time plays no role in the calculation of the MCR fire scenario frequencies.	The commenter is correct that the mission time plays no direct role in the calculation of a MCR fire scenario frequency. It does, however, provide a period duration typically used in PRA analyses. As noted in the draft NUREG, the goal is to estimate a floor value that represents the best possible manual P_{NS}. This is done considering both the probability of having a fire and failing to suppress that fire. This consideration is developed under the idea that an unsuppressed Control Room fire within a period	9/13/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			of hours is very low likelihood. This is consistent with the OPEX, which so far suggests fire as suppressed in less than 10 minutes given the continuous pretense of operators in the room. Since the floor is a value set up to prevent unrealistically low estimations of the P_{NS}, a value based on a 24 hour period of time sets up a practical limit (i.e. this floor help to prevent a PNS from being unrealistically low as it will be higher than the probability of an unsuppressed fire). Considering an extreme case, should the probability of having a fire be 1.0, a floor value of 1.0 would not match the OPEX as there is no or is there ever expected to be a fire that is not eventually suppressed. Therefore, some consideration of the probability of suppressing the fire must be included. This is the basis for the dual consideration of both the probability of seeing a fire and failing to suppress the fire. Considering the generic fire ignition frequencies, the development of a probability of having a fire may be obtained if some decision on an appropriate period duration is made. Understanding that the floor value exists simply to truncate incredibly low P_{NS} values and does not represent any real value, the period duration is	

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
			open to a wide range of interpretation. Some possible durations include: ▪ 1 hour (a common detailed fire modeling scenario period: 1.0E-08 floor) ▪ 217 minutes (longest suppression time in OPEX: 3.6-E08 floor) ▪ 12 hours (assumed MCR operator shift duration: 2.0E-08 floor) ▪ 24 hours (mission time: 2.4E-07 floor) ▪ 1 Week (1.7E-06 floor) ▪ 1 Month (7.3E-06 floor) ▪ 1 Year (8.6E-05 floor) ▪ 18 Months (re-fueling cycle: 1.3E-04 floor) Justifications could be made for each of these proposed, if not alternate durations. The 24-hour period selected as it provides a generic basis for a period duration representative of probabilistic analyses. No changes made.	
GG-6	Pg 7-2 Line 35-37	The calculation of the non-suppression probability floor value presented in Section 7.3 does not appear to have a sound basis. If applied in practice as a direct replacement of the 0.001 floor NSP, this approach would result in the following scenario frequency equation : Scenario Frequency = Ignition Frequency x...x (Ignition Frequency expressed as a	The comment is incorrect that the proposed floor in the draft NUREG would result in a scenario frequency equation similar to: *Ignition Frequency x...x (Ignition Frequency expressed as a probability for 24 hours) x (Average NSP).*	8/30/19

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be: * CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION) * LEGIBLE AND REPRODUCIBLE * COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT * FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		probability for 24 hours) x (Average NSP) Where the Ignition frequency appears twice - first directly and then again as a probability of a fire within 24 hours. The double counting of the frequency drives the resulting number unrealistically low.	The only effect on a scenario frequency the floor value would have on a scenario frequency is the point at which the value would be truncated. Floor value discussion revised to clarify that the development of the stated floor value is a calculation of a scenario P_{NS} value.	
GG-7 (Email)	Email, 09/03/2019	I would also agree that after an initial period the MCR fire NSP could be considered no different than ordinary ignition source NCP. However, it doesn't seem very clear how the 18 min. initial period can be justified. The fact that the NSP curve reaches 1E-3 at that point doesn't seem to me a strong enough engineering basis. I think the text needs to answer the question why not switch to the other suppression curve earlier or later than the proposed 18 min.?	Eighteen minutes was selected because it is the time it takes to reach the floor value of 1E-3 described in NUREG/CR-6850. Since the new floor would be reached at durations longer than the evidence observed in the OPEX, the lower floor may not be appropriate as would not be captured in the data used for developing the manual suppression rate constant. To resolve this, the two-step method was proposed, with the 1E-3 floor value used as the transition point between using the main control room suppression rate constant and an ignition source specific suppression rate constant that would capture longer duration fires. Given the use of 1E-3, the transition point occurs at 18 minutes.	9/6/19
NEI-51	7.4 (7-3)	The first step uses the MCR suppression rate in Table 8-6 for calculations of the Pns with a floor value of 1E-03. This results in fires that are suppressed prior to approximately 18 minutes using a suppression rate of 0.385. The second step captures all remaining MCR fire durations up to the proposed floor of 2.4E-07 by making use of the ignition	Per the text in Section 3.5.2: *The second step captures **all remaining MCR** fire durations up to the floor of 2.4E-07 through the use of an ignition source bin specific suppression rate (interruptible, growing, **transient**, etc.).*	8/30/19

REVIEW / COMMENT DOCUMENTATION

Reviewer: Various **Phone:** **Document #, Rev:** NUREG-2230 / EPRI 3002016051

Discipline/Department: Various **Date:** July 2019 **Title:** Methodology for Modeling Fire Growth and Suppression Response for Electrical Cabinet Fires in Nuclear Power Plants

Comments shall be:
* CLEARLY STATED AS A MATTER OF FACT (OR A SPECIFIC QUESTION)
* LEGIBLE AND REPRODUCIBLE
* COMPLETE AND INCLUDE A REFERENCE TO THE AFFECTED DOCUMENT
* FOCUSED TO A SPECIFIC PROBLEM OR DEFICIENCY

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Comment Disposition / Resolution	Reviewer Acceptance / Date
		source bin specific suppression rate. For example, a fire in a cabinet located within the MCR will use the Interruptible and Growing suppression rates presented in NUREG-2230 [62] for fire durations in excess of 18 minutes. Specify that the two-step method is to be used for sources in the MCR besides the main control board	*No changes made.*	
NEI-67	Section 7.4, Figure 7-1, and Table 7-2 (7-3, 7-4, and 7-5)	The first step uses the MCR suppression rate in Table 8-6 for calculations of the Pns with a floor value of 1E-03. This results in fires that are suppressed prior to approximately 18 minutes using a suppression rate of 0.385. The second step captures all remaining MCR fire durations up to the proposed floor of 2.4E-07 by making use of the ignition source bin specific suppression rate. For example, a fire in a cabinet located within the MCR will use the Interruptible and Growing suppression rates presented in NUREG-2230 [62] for fire durations in excess of 18 minutes. Provide equations so the values in Table 7-2 can be replicated. Statement is unclear how to apply the two-step calculation	Equations for the calculation of the numerical suppression results for electrical cabinet (interruptible and growing) and transient ignition sources have been added.	9/6/19