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4/30/2015
80 FR 24290

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June 15, 2015

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Ms. Cindy K. Bladey
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Draft NUREG-2178, "Refining and Characterizing Heat Release Rates from Electrical Enclosures During Fire," [Docket ID NRC-2015-0059]

Project Number: 689

Dear Ms. Bladey:

On behalf of the nuclear energy industry, the Nuclear Energy Institute (NEI)[1] appreciates the opportunity to provide comments on the Draft NUREG-2178, "Refining and Characterizing Heat Release Rates from Electrical Enclosures During Fire," [Docket ID NRC-2015-0059].

This report, which provides updated information on heat release rates to be used in analyzing electrical cabinet fires as part of Fire Probabilistic Risk Assessment (PRA), represents a substantial improvement from the existing data as presented in NUREG/CR-6850, "Fire PRA Methodology for Nuclear Power Facilities." These improvements will, in line with the NRC's PRA Policy Statement of 1995, enable licensees to achieve more realistic Fire PRAs in support of numerous risk-informed regulatory activities.

The industry has noted several areas in which future editions of this report could be clarified and refined to further improve the realism of electrical cabinet heat release rates used in Fire PRAs, and these are discussed in the attached detailed comments. However, given the vast improvements offered by the current draft of the report, the industry does not believe it is necessary to delay finalization of this edition of the NUREG to address these comments.

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

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E-RIDS= ADM-03
Add= D. Stroup (DSW4)

If you have any questions or require additional information, please contact me (202-739-8101; vka@nei.org).

Sincerely,

Victoria K. Anderson

Attachment

c: Mr. Mark Henry Salley, RES/DRA/FRB, NRC
Mr. David Stroup, RES/DRA/FRB, NRC

Detailed comments on Draft NUREG-2178, "Refining and Characterizing Heat Release Rates from Electrical Enclosures During Fire"

Section	Statement from Report	Comment
General		Tests that involved the substantial burning of circuit cards should not be attributed to cable. Circuit cards provide a significantly different fuel source and geometry than cables, exhibit significantly different fire behavior than cables, and should be treated separately in the report. The circuit card data is causing excessive conservatism in the results for cable fires.
General		Additional discussion is needed for the guidance on open versus closed electrical enclosures. Currently, the only definition is two pictures, and there is a large difference between the two pictures which could lead to interpretation difficulties.
Page 1-6		The report states that the ZOI may be affected; however, on page 1-5, the report states that analyses already completed to NUREG/CR-6850 guidance need not be revised as they are more conservative. The unqualified statement that ZOI may be affected might give the reader the impression that all ZOI's must be reassessed. That would conflict with the previous statements that say that analyses already completed using NUREG/CR-6850 guidance need not be revised.
3.2.2		The discussion of the default loading in between the very low loading and the low loading seems misplaced, especially when the bullets list them in a different order in the beginning of the section. Perhaps link up to discussion in Appendix C.
3.2.2		The only reference to Appendix C is in the third paragraph. Considering the limited amount of pictures in this section, it would be beneficial to reference to the specific section in Appendix C for each fuel loading to reference for more pictures (e.g. reference low fuel loading to C.7.2). This could also pertain to 3.1 and 3.2.1 but was most relevant here due to the somewhat obscure nature of the topic.

Page 3-15	In order to assess these conditions, the enclosure ***must*** be opened and an assessment must be performed.	For an analyst to distinguish between low Fuel Loading and Default fuel loading, it is stated that the analyst ***must*** open the cabinet. This sentence should be revised for consistency with Table 4-2, which states "...Low Fuel Loading **may** require opening enclosure doors to assess the internal configuration consistent with the discussions in Section 3 of this report."
Page 3-16	***The fuel load is at most moderate*** and is comprised mainly of cables.	Clarify the meaning of a "moderate" fuel load. Possibly reference a picture that represents a "moderate" amount of cable.
Table 3-1		Consider providing images to represent the specific characteristics of a cabinet with 'Low Fuel Loading', as identified in Table 3-1.
Table 4-3		Based on NUREG-1824, Supplement 1, the validated range for the Froude Number is expected to increase greatly. Since the maximum and minimum fire diameters per HRR provided in Table 4-3 are variable based on the validated range of the Froude Number, consider stating that the values are provided in Table 4-3 are for information only based on the April 2007 version of NUREG-1824 and are subject to change.
4.1	Establishing Fire Diameter	This section only addresses how to determine if a fire diameter is within the validated range. It does not establish a practice for identifying the actual fire diameter for a specific fire scenario. It would be helpful to either identify a recommended Froude Number for each type of fire or fire source, or provide a way in which to determine the fire diameter based on the physical characteristics of the source (i.e., vent size). If no actual input can be provided to the analyst about how to develop the fire diameter, the name of this section should be changed to something that more closely resembles the content.
4.1		The example in Appendix F, Section 1.4 uses the area of combustible fuel as the footprint of the ignition source. If this is the recommended strategy, consider stating that in this section. If there is a different recommended strategy, consider identifying that but check to make sure it is consistent with the example in Appendix F.
4.2	"These special configurations may be taken into consideration during the assignment process, as described in the follow paragraphs."	Revise this sentence as such: "...during the assignment process, as described in the follow***ing*** paragraphs."

5.1.2	This analysis also does not provide any justification to alter the treatment of the thermal radiation horizontal ZOI.....Implications on the maximum extent of the vertical and horizontal ZOI due to an obstructed plume will be discussed in Chapter 6.	Wording seems to contradict or imply contradiction of line 41 and 42 of page 5-2. Suggest revision to clarify that this only covers the horizontal plume ZOI and not the radiant ZOI.
5.1.4	L/H = 0.22 to 2.06. These obstructions are considered to be in the near-flame region most appropriate for NPP applications, and are representative of a typical enclosure height evaluated in fire PRAs.	Please clarify the basis for this statement and the range given.
5.1.5	Since FDS has the inherent capability to predict plume temperatures under the influence of an obstruction	Suggest a reference to the validation for this statement.
5.2	The formulation of the equations and the numerical algorithm are contained in the FDS Technical Reference Guide [31]. Verification and validation of the model are discussed in the FDS Verification and Validation Guides [32, 33].	It may be helpful to note where validation or the technical basis for use of FDS with obstructed plumes is discussed.
5.2.1	However, no specific study associated with fire plume temperatures above obstructions was noted.	It may be helpful to note where validation or the technical basis for use of FDS with obstructed plumes is discussed.
5.2.3.2	The range of fire diameters selected for this study are 0.3 m (1 ft.), 0.6 m (2 ft.), 0.9 m (3 ft.), and 1.2 (4 ft.).	Suggest revision to clarify if this is an actual "diameter" or if this is this the side length of the burner used in FDS. This is important since diameter is also an input in the Heskestad plume calculation.

5.2.3.2	These configurations are not anticipated to invalidate the conclusions generated in this study because the substantial validation performed for FDS [33] exceeds the limits reported in NUREG-1824 [21], and the model inputs are prescribed within the existing validation range for use of the FDS.	"exceeds" seems to imply a negative connotation in this instance. Suggest revision to "expands" or something similar.
Figure 5-2	0.3048 m, 1.143 m, 1.9812 m	Rounding is inconsistent with numbers given in the paragraph above Figure 5-2. It may be useful to show the flat plate top in Figure 5-2 for reference since the description above it is given with respect to the top of the obstruction.
5.2.3.5	Each case study included three obstructed cases and one unobstructed case...the three obstruction geometries described in Sections 5.2.4.2 to 5.2.4.4. Additionally, a baseline, unobstructed, geometry is simulated...	This paragraph appears to repeat itself.
5.2.3.6	resulting in a grid resolution of 4 cm [dx (m)].	Suggest clarifying how the dimensions of burner and cabinet obstructions align with the chosen grid. There is a difference between what is programmed and what FDS "sees". If the obstructions don't align with the grid, FDS "rounds" the dimensions to the nearest grid cell, which can lead to results that don't match what is expected.
5.2.3.6	The compartment is open on all sides and includes a concrete floor.	Suggest revision to clarify the condition of the ceiling.
5.2.3.6	A larger ratio means	Consider revision for clarification. "D*/dx values in excess of the validated range indicate that"
5.2.3.7	Temperature predictions are obtained using slice files in FDS every 0.03 seconds	Include a brief description of how this data was obtained. FDS outputs the image file for a slice. The data need to then be extracted by visual judgment or using by manipulating the slice data file. This might be important to clarify for transparency purposes.
5.3.7		There is no mention of soot yield or heat of combustion as a sensitivity or input parameters.

Page 5-28	Also of note is that the temperature predictions for the three geometries are very similar, and it is not necessary to differentiate between them in the information.	The flat plate and three wall are very close to one another, but the arch is nearly 100 degrees different, which could be significant. Factoring in the arch could lead to non-conservative reductions in flat plat or three wall configurations. Consider providing each one separately, along with the combined reduction factors for instances where walkdowns or other data is unavailable. This comment applies to Table 5-2 as well.
Table 5-3	Opening (6.5%) versus Unobstructed	The 6.5% seems arbitrary because 5% is given as the cut off.
6	Correction for Zone of Influence Due to Obstructed Plume Effect	Consider revision to "Plume Zone of Influence" in the title for clarity.
6.2.5	In Figure 6-5, the solid red box represents	The figure is currently given in grey scale and may be reproduced in black and white in print copies.
6.3	Results suggest that a reduction of 38% (i.e., 1-B = 1-0.62 = 0.38) is appropriate when estimating the plume temperature rise above an obstruction using the Heskestad fire plume correlation. As a result of the change in plume temperature rise, an approximate 24% reduction in the vertical damage ZOI dimension for fire plume flows above an obstruction is observed. The reduced ZOI may result in fewer risk important targets being exposed by the ignition source, and therefore reduced risk in the fire PRA.	Instead of taking these numbers and reducing the correlations by x%. it might be better to recommend adding the bias factor to the formulas when calculations are conducted. This will account for variations in the exact % depending on the other inputs. This comment also applies to second paragraph of 7.3.

7 pg 7-1	"1. The classification of electrical enclosures in terms of function, size, content, and ventilation conditions, 2. The determination of peak heat release rate probability distributions considering specific electrical enclosure characteristics such as function, size, ventilation conditions, and combustible content"	These two objectives should use consistent wording for the classification criteria. e.g., content vs. combustible content. Listing the criteria in the same order would also be neater.
7 pg 7-2	"Examples of these electrical enclosures [classified as large, medium or small] include relay panels, termination cabinets, ***the main control board***, etc."	Figure C-19 shows a Main Control Board as a 'Large Closed Electrical Enclosure', which seems to imply that the recommended HRRs would be applied to the full MCB, without analyzing flame spread to adjacent sections. Please provide more detail for MCBs if the HRR is applicable to one vertical section or the full MCB.
7.3	"Results suggest that a reduction of 38% is appropriate when estimating the plume temperature rise above an obstruction ***and*** using the Heskestad fire plume correlation."	Remove the "and"
Table 7-1 (Table 4-2)		Table 7-1 does not include Notes 1 and 2 from Table 4-2. Consider including Note #2. This note is important to make sure an analyst knows which types of cabinets are counted as open doors to make sure they are treated appropriately.
7.4		This section references directly to Appendix F. Some more detail should be included on the depth of the examples and it should also include some of the findings/results of the example and implementation of this report (e.g. reduction of calculated CDF, the reduction in severity factors, etc), and then reference out to Appendix F for further discussion and details. Appendix F shows significant benefit to applying this guidance and this should be highlighted.
C.7		It would be beneficial to include a picture of what would constitute the upper limit of the very low fuel loading and low fuel loading.
Appendix D		Consider including discussion of power inverters in Appendix D. Since they have their own group, which appears to use the same HRR distribution as medium control enclosures with closed doors, this should be discussed in Section D.4.5.

D.2	Fuel Mass	Consider including additional details to explain why many of the tests in Table D-1 have "N/A" for the fuel mass.
Table D-1	Cable Loading Column	Test IDs "SNL-ST10", "CBD-54" and "CBD-80B" list a value of "N". The only values identified in Section D.2 for cable loading are Default (D) or Low (L). This should be made consistent.
Table D-1		In instances where cable type is known, it should be reported, as this will have a significant impact on the HRR of the cabinet fire.
D.4.1	"Therefore, the assessment is based mostly on using tests with lower cable loads and vertical electrical enclosures (i.e., no benchboard type enclosures) and with tightly bundled cables, as depicted in Figure D-5 and Figure D-6."	The wording of this sentence makes it seem like Figure D-5 and D-6 are pictures of the cabinets/cable bundles. Suggest re-wording to state that the tests resulted in lower heat release rates as depicted in Figure D-5 and D-6.
D.4.3	"***That test*** may overstate the fire potential due to the arrangement of fuel near the electrical ignition point."	Clarify which test this section is referring to.
D.4.6	"In addition, the working group agreed to inform the distribution based on the corresponding TP cable cases and extended the 98th percentile in the Default case to 200 kW to account for potential configurations not included in the experimental programs."	Recommend removing this sentence in full. The next sentence says the 98th percentile fire for the Default case was extended to 325 kW which is the value shown in Table D-8.
D.4.6	"That is, the working group agreed that the worst-case potential cables ignite and spread fire more easily."	This sentence doesn't seem to fit. Revise or remove.
D.4.6	Given the ***"closed cabinet"*** configuration, the working group agreed to maintain the 98th percentiles assigned earlier to TS cables and to increase the 75th percentiles of the distribution to account for the increased fire hazard associated with TP cable.	This section is for open cabinets. The sentence should be revised to update the justification for the open cabinets.

D.4.7		Consider including a discussion detailing that medium control enclosures with very low cable loading use the same HRR distribution as small enclosures.
Figures D-12 and D-29		The VTT test numbers get cut off on the X axis.
Appendix E	The fire models used for the simulations, the input data files, and a copy of NUREG-1934 (EPRI 1023259), Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG), are attached to this report.	These models and inputs have not been provided with the draft report, to my knowledge. If this will be Appendix G, as listed in the TOC, consider stating that directly.