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Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities

Comment On: NRC-2015-0112-0001

Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities (DELORES-VEWFIRE); Draft NUREG for Comment

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RULES AND DIRECTIVES
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General Comment

See attached file(s). Additionally, some recent operating experience with incipient detection systems will be available for NRC consideration by the end of September, industry will be submitting that separately.

Attachments

NUREG-2180 Comments_2015-09-08

SUNSI Review Complete
Template = ADM - 013
E-RIDS= ADM -03
Add= *W. J. Taylor (WJT)*

NUREG-2180 Comments - September 2015

Section	Statement from Report	Comment
General	"areawide"	There are multiple places throughout the report where the word "area-wide" does not include a hyphen. Suggest adding a hyphen between this word.
Section 2.1	However, only recently has there been an interest to use these systems in the regulatory context in fire PRAs, to support the application of NFPA Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric 9 Generating Plants, 2001 Edition."	The quotation marks should be placed after "...Plant," instead of after "...2001 Edition."" Also, consider providing reference number for NFPA 805.
Section 2.1	The performance objective for using these VEWFD systems is to provide earlier notification to plant personnel that may allow for additional time for human intervention before fire conditions that threaten reactor safety.	Consider rewording to "... before fire conditions that threaten reactor safety."
Section 2.1	Section 13 of Supplement 1 titled, "Incipient Fire Detection Systems," provides an interim position for determining the non-suppression probability for fire scenarios that have installed incipient fire detection systems installed.	Consider rewording to "...for fire scenarios that have installed incipient fire detection systems installed. " or "...for fire scenarios that have installed incipient fire detection systems installed."
Section 2.2	A fire development profile is typically discussed in terms of "fire stages." These are commonly referred to as the "incipient," "growth," "steady-state," and "decay" stages as illustrated in Figure 2-1 (Ref. 5).	The figure reference should be Figure 2-2, not Figure 2-1.
Section 2.3	...while smokes from smoldering fires tend to have a larger fraction of particles micrometer sized or greater, and they tend to scatter more incident light that the fraction absorbed.	Replace "that" with "than".
Section 2.4.1	The size of the particle produced by diffusion flame ⁴ combustion also varies with the heating...	Place note superscript location after combustion: "The size of the particle produced by diffusion flame combustion ⁴ also varies with the heating..."

Section 2.4.2		Use "." for multiplication in light obscuration equation, rather than "x" to be consistent with other equations in this section, and to avoid confusion on whether or not "x" is a variable rather than an operation.
Section 3.1.1.1, Risk Applications		Be consistent with how numbers are displayed in scientific form (i.e., E-6 or $\times 10^{-6}$) within a paragraph.
Section 3.1.1.3	The basis for using VEWFD systems as specified in NASA-STD-8719.11 Revision A, Safety Standard for Fire Protection (Ref. 24).	Change "as" to "is".
Section 3.1.3	Part of the reasoning for using ASD technologies are employed in telecommunication facilities, in part, as a result of difficulties in implementing conventional spot-type smoke detection in environments with high air ventilation rates and numerous complex physical configurations.	Considering rewording to: " Part of the reasoning for using ASD technologies are employed in telecommunication facilities, in part, as a result of difficulties in implementing conventional spot-type smoke detection in environments with high air ventilation rates and numerous complex physical configurations."
Section 4.2, p. 4-3, line 47	"The tabulated values are shown in Error! Reference source not found. below."	Reference Error.
Section 4.4	Figure 4-15	IR Camera view port is not labeled in the figure.
Section 5	Tables 5-5, 5-6, 5-7, 5-8, and 5-9	Spacing in some cells looks odd (ex. It looks like there are 5 spaces between VEWFD and Pre-Alert), and centering of text is not consistent. Table 5-2 looks good.
Section 5.2	General	There are large spaces between text and the associated figures, with the figures ending up on the next page. Perhaps change the text to "Keep with next" to adjust the large spaces so that the text stays with the associated figure and makes it easier for the reader to observe the figures while reading the text.
Section 5.4, p. 5-27	"The decreasing 11 mean time difference trend was ASD2 alert, ASD3 alert, SS alert, and ION alarm."	Missing a comma. In general there were a decent number of times that commas were missing from lists, or an extra "and" was included. It made it somewhat confusing to read in a few places.

Section 5.5, p. 5-31, line 13	"The decreasing mean time difference trend was ASD4 alert, 13 ASD5 alert and SS alert (tie), ION alarm and PHOTO alarm."	Missing a comma. Also PHOTO alarms does not seem to be in any of the results for this section. Perhaps a typo.
Section 5.8, p. 5-41	Figure 5-44	Hard to read figure caption. Suggest making page landscape, or rotating the caption text to read left to right.
Section 6.4, Page 6-8	The last event "Conventional Detection/Suppression" estimates the probability of successfully suppressing a fire given a failure of one of the earlier events. To estimate the success of these branches, timing considerations such as operator or fire brigade response, and time to target damage be estimated, and the suppression / detection event tree from NUREG/CR-6850 (EPRI 1011989) can be solved.	There are multiple η values shown in the fire event tree with no clarification on what they mean. Suggest adding a reference to Section 11.2 where these values are defined.
Figure 6-5		n3 for when the VEWFD is successful, but later steps (MCR response) do not succeed is not clear and doesn't seem to align with the later definition posted in Section 11.2. N3 is defined in section 11.2 as delayed detection sequences J-N from table 11-1 which is delayed detection. This should still be an early detection credit for purposes of calculating manual suppression probability. The value used is not in sequence for both Figures 6-4 and 6-5, so maybe this is a typo. Consider clarifying,
Figure 6-5		the $1 - \pi_3$ and $1 - \pi_1$ branches (figure 6-5) effectively removes credit for automatic detection and suppression. Fix this so that automatic detection and suppression can be credited.

Section 8.1.2, page 8-4:	<p>“With the lack of available information and the importance of understanding the duration of an incipient stage, conducting a formal expert elicitation type effort to develop a consensus opinion would be one approach. Unfortunately, the efficacy for such an effort was not realized until late in this project, and as such the needed resources, budget and time were not available to conduct such an effort. Thus, in an attempt to estimate the information needed, a detailed evaluation of the fire events database was conducted”</p>	<p>The information provided on the evaluation of the fire events database in Section 8 and Appendix D does not make it clear whether or not the events reviewed are applicable to the new FIFs and NSPs issued in NUREG-2169 [EPRI 3002002936]. If the events reviewed for NUREG-2180 are not applicable with NUREG-2169, considering reviewing applicable fire events.</p>
Appendix D (Table D-1):	<p>Reviewer 1 and 2 do not always agree, however discussion on how this was incorporated is not included.</p>	<p>Consider discussing to identify the result when reviewer 1 and reviewer 2 may have disagreed.</p>
7	Table 7-1	<p>The guidance on when to use which category for Fraction of fire that have an incident phase is not clear. Please clarify this.</p>
Table 7-2		<p>Table 7-2 is currently in the middle of the unreliability source discussion. Suggest moving this table to the end of Section 7.2.2.</p>
Table 7-2		<p>There is no reference to Table 7-2 in the report. Suggest adding a sentence discussing the information contained in Table 7-2.</p>
Section 8.1.2, page 8-4:	<p>"the phenomena that <i>effect</i> the duration of the incipient stage"</p>	<p>"effect" should be changed to "affect"</p>
Section 8.1.2, page 8-4:	<p>"but could potentially follow a logarithmic or, exponential growth profile, or <i>anyone</i> in between."</p>	<p>"anyone" should be changed to "anything"</p>

9.3	<p>"Area-wide applications were not specifically addressed in the HF analysis. However, based on discussions with plant personnel, it is expected that the personnel response to an area-wide incipient alert and alarm will be the fundamentally the same as for in-cabinet applications. The only difference is the FO and technician will be sent to a room rather than a bank of cabinets after receipt of an "alert." The technician will need to locate the incipient fire source within that room. The larger area that must be surveyed should be accounted for in the timing analysis."</p>	<p>There is limited guidance on how to account for the larger area in the analysis. This was also a point of contention from at least one utility during the LAR Audit.</p>
Table 10-1 & Section 10.5.2	<p>Foot note 32 says "...the field operator's field of vision can encompass three cabinets in essentially the same way as for a single cabinet."</p>	<p>Therefore, why does the 3 cabinets timing add 5 minutes more than a single cabinet? And if 5 minutes, then this should be to the field operator and not the technician. So it would be 8-15 minutes, not 12-19.</p> <p>Later when this information is referenced in section 10.5.2 the success criteria for 3 cabinets does not agree with table 10-1 notes</p>
Section 9	<p>The way in which an ASD VEWFD system is implemented (e.g., planned response, system design, application) determines how humans will interact with the system and, ultimately, may affect whether prevention or prompt suppression is achieved.</p>	<p>According to Appendix P of NUREG/CR-6850, "Prompt suppression refers specifically to suppression actions by a fire watch, and can be credited following prompt detection in hot work fire scenarios only."</p> <p>This is the first time this term is used in this document. It may be worth defining what this means in the context of this report to clarify that the context is the same or different from other documents such as 6850 since 6850 defines this specifically for hot work fires. This might be important for crediting these systems in fire modeling and FPRA. Alternatively it could be added as a term in section 15.</p>

Figure 9-1 and 9-2 Section 9.2.1.1	Variations in system implementation and response operations that were observed during the information-gathering stage are noted by superscript letters in the figures and addressed further in Section 9.2.1.1.	The figures identify the superscripts by letter, but it appears the list in 9.2.1.1 is a bullet list. It may be more clear to list which superscript a section is referring to especially if you are looking back and forth from the figure to the descriptions that follow.
9.2.2.1.1	successful prevention or rapid suppression	Unclear if rapid and prompt are synonymous here. Suggest consistency in the language for clarity, unless these are different terms, in which case the difference should be identified.
Figure 12-2 and Figure 12-3		Suggest using the scientific number format similar to Figure 12-1, Figure 12-4 and Figure 12-6.
Page 12-4 & Figure 12-2	Accordingly, the non-suppression probability is the sum of sequences I, M and N, which is $0.457 + 0.050 + 0.00 = 0.507$.	In Figure 12-2, Sequence I is shown as 0.434 and the Total is shown as 0.484. The sentence on Page 12-4 should be updated to use the appropriate numbers.
Section 12.1.4	In this example, various room smoke detection systems are evaluated for their ability to enhance the suppression capability for a potential fire hazard located in a mix of power and control cabinets all.	Suggest removing the word "all" at the end of the sentence. This seems out of place.
Page 12-10 & Figure 12-2	According to Section P.1.5, the non-suppression probability is the sum of Sequences I, M and N, which is $5.0 \times 10^{-1} + 0.0 + 0.0 = 6.1 \times 10^{-1}$	In Figure 12-2, Sequence I is shown as 5.71E-01 and the Total is shown as 5.71E-01. The sentence on Page 12-10 should be updated to use the appropriate numbers.

General	Enhanced suppression	<p>Right now enhanced is defined as:</p> <p>"Success in the enhanced suppression event represents the probability that any potential fire is suppressed before fire damage to targets of concern." (page 6-8)</p> <p>"This section documents the review of fire events from the fire events database where an operator was present in the room of origin when a flaming condition began." (Page D-19)</p> <p>This term is used throughout the report. It appears to be very similar to prompt suppression. If these are not meant to represent the same concept, how they are defined should be clearly stated. This could be added as a term in section 15 for clarification.</p>
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