Mendiola, Doris

Subject: FW: [External_Sender] Comments on Draft NUREG-2180
Attachments: EPRI Comments - NUREG-2180.pdf

1

From: Lewis, Stuart [mailto:slewis@epri.com]
Sent: Wednesday, September 09, 2015 03:42 PM
To: Bladey, Cindy
Cc: Lindeman, Ashley <alindeman@epri.com>; Taylor, Gabriel
Subject: [External_Sender] Comments on Draft NUREG-2180

7/7/2015
80 FR 38755

Ms. Bladey,

Attached is a letter transmitting comments from the Electric Power Research Institute on draft NUREG-2180. I regret that we missed the deadline for the submission of comments. We would be grateful if the attached comments could be considered as NRC pursues completion of this report.

Best regards,
Stuart Lewis

Stuart Lewis, PE
Senior Program Manager
Risk & Safety Management

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Add= G. J. Taylor (GJT)

ELECTRIC POWER
RESEARCH INSTITUTE

September 9, 2015

Cindy Bladey, Chief
Rules, Announcements, and Directives Branch (RADB)
Division of Administrative Services
Office of Administration
Mail Stop: OWFN-12-H08
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: Docket ID NRC-2015-0112
Comments on Draft NUREG-2180, *Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities (DELORES-VEWFIRE)*

Dear Ms. Bladey:

Thank you for the opportunity to comment on the draft NUREG - *Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities (DELORES-VEWFIRE),* prepared by the Nuclear Regulatory Commission's Office of Nuclear Regulatory Research (NRC-RES).

Incipient detection, or early warning fire detection systems, are used around the world to protect critical infrastructure in industrial facilities, telecommunications, and other applications to detect conditions before they develop into actual fires. Understanding how this technology can be implemented in nuclear power plants to provide a meaningful safety benefit is certainly a worthwhile effort.

If you have questions about any of these comments or would like to discuss resolution, please contact Ashley Lindeman of my staff at 704-595-2538 or via alindeman@epri.com.

Sincerely,

Stuart Lewis
Senior Program Manager
Risk and Safety Management

RSM-090115-102
Attachment 1 – EPRI Comments on Draft NUREG-2180

ELECTRIC POWER RESEARCH INSTITUTE

Attachment 1

EPRI Comments on *Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities (DELORES-VEWFIRE)*

Comment No.	Document Number Section / Paragraph	Comments / Basis for Comments
1	Figure 2-3	The growth profiles presented all reflect conditions after ignition, and do not indicate the available time during the incipient stage. This should be noted because the times are otherwise somewhat misleading.
2	Section 2.3 Page 2-6 Lines 33-38	*For instance, flaming fires tend to produce smokes that have a large fraction of sub-micron particles that tend to absorb a greater fraction of incident light than the fraction scattered, 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.* Typical flaming fires produce more particles that are sub-visible (< 350 nm) and smoldering fires produce more visible participates (> 350 nm). The proportion of scattering to absorption is related more to the material than to the burning method. Drysdale (the cited reference) does reference that agglomerated smoke particles can be greater than 1 µm, but does not appear to comment on the relative reflectance or absorbance of flaming versus smoldering fires.
3	Section 2.4.1 Lines 5-7	*The earliest indication of a fire occurrence usually involves the heating of materials during the pre-ignition (incipient) stages, which produces submicron particles ranging in size from 5×10-4 to 1×10-3 micrometers.* 1x10-3 µm is only 1 nm; incipient stage combustion can produce particles much larger than this. If this is referring only to pyrolysis, these numbers are within range. The definition of incipient combustion includes the smoldering phase, which can produce particles much larger than 0.001µm
4	Page 3-5 Line 16-19	It appears that the differences in plant response / alarm response are not due to the analysis (IPEEE versus modern fire PRA methodology), but rather due to location within the plant. The first case is ex-control room and the second case is within the control room.
5	Page 3-5 Line 21-43	The focus of this report appears to be on VEWFDS response and a comparison / development of a method to credit VEWFDS in fire PRA methodology. The use of "fire PRA case" and "non-fire PRA case" may cause confusion. Suggest rewording these paragraphs to describe the application of the technology "to protect x" versus the analysis application. The plant risk due to fire is the plant risk due to fire. Unless plant practices, site knowledge, or physical plant modifications are made, the actual plant risk will not change. Over the course of developing fire PRA technology we can employ a more realistic or detailed

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		approach to more accurately characterize plant risk, but we're not actually changing the plant risk without first understanding vulnerabilities, etc. Therefore, it would be best to leave the analysis goals (IPEEE - to search for vulnerabilities versus fire PRA - NFPA 805, etc.) out of the description.
6	Page 3-8 Line 20	The insights from non-nuclear experience note that at one point NASA had over 100 ASD systems, but none remain. Is there any insight into why these systems are no longer installed?
7	Page 4-2 Lines 8-11	*Alert level of 0.2 %/ft obscuration at each port (or sensitive spot detector), and an Alarm level of 1.0 %/ft obscuration, these were the target sensitivities for ASDs and the sensitive spot detector.* These are the minimum allowable levels to meet the definition of a VEWFD system. If set to these levels (at each hole location), then it may be equivalent to high sensitivity spot detectors. For area-wide detection, the added benefit of the active air sample would likely improve ASD performance, but in cabinets with very little forced airflow there should be no difference. The primary benefit of ASD is that you can set them to alert at much more sensitive levels, whereas the 0.2 %/ft is about the limit for most high sensitivity spot detectors. The in cabinet tests did evaluate pre-alarm levels for ASD less than 0.2 %/ft. The sensitivity of the ASDs differed for each test. It would be helpful if some discussion could be provided as to the effect of sensitivity on ASD performance.
8	Page 4-6 Lines 8-9	*The first 10 materials were degraded by conduction of heat from a copper block bus bar whose temperature was ramped from ambient to 450 °C or 485 °C.* The ramp time is critical to establish detection differences between detection technologies. The best method may have been to ramp to a single temperature and determine whether detection could occur or not, and identify the minimum wire temperature that could be detected, not to ramp to the highest temperature and compare times to detection. Thus, the reported time may be arbitrarily linked to the heating rate of the block, not any real in-plant scenario. A difference of a few seconds in the tested scenarios may be the difference of several minutes to hours in a real event.
9	Page 4-6 Lines 22-24	*Early scoping experiments were conducted with fewer than five wires, but it was observed that the best chances for*

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		conventional alarm response were realized with the five-wire arrangement. This statement indicates that the conventional detectors required more smoke to be present for detection to be achieved. The conclusions do not state this clearly and this point is not discussed in any subsequent section.
10	Page 4-19	Figure 4-17 It appears one ASD was sampling from the 4th hole while the other two were sampling from the 3rd hole, a transport difference of 0.61 m. This may not have a major impact, but could cause a few seconds of difference.
11	Page 4-45 through 4-48 Figures 4-45 through 4-49	ASD 4 and 5 sample orientations The number and orientation of sampling points is different on the return air grill and for area wide. The issue is that the spacing for the ASD4 between the cabinets is 3.35 m but for ASD5 is 5.08 m, with no samples between the rows. Suggest adding some text to clarify the observed difference.
12	Page 4-49 Line 44-45	*The average smoke response times for three measurements at the first cabinet were 19.4 ± 2.4, 33.2 ± 6.7 and 13.7 ± 0.2 seconds for ASD1, ASD2 and ASD3, respectively. The measurements at the last cabinet were 20.3 ± 1.8, 32.0 ± 1.7 and 15.3 ± 1.2 seconds for ASD1, ASD2 and ASD3, respectively.* The transport time for ASD2 at the last cabinet is shorter than for the first cabinet.
13	Page 5-1 Lines 42-44	*It is important to note that this experimental research was not designed to assess the performance of VEWFD models or types against one another, but rather, was designed to assess the potential VEWFD performance against conventional detectors.* Different detectors operate using unique principles, and one-to-one comparative analyses conducted by matching the obscuration levels are not always appropriate. In reality, the alarm threshold levels specified for each device installed would be unique.
14	Page 5-3 Figure 5-1	Alarm and pre-alert The report compares the Pre-alert response (0.1%/ft for light scattering ASD) to the alarm response for the spot ionization detector (1.0 %/ft) and concluded that the ion was performing much faster and more reliably. Although ionization may be more sensitive to pyrolyzed material, better detection at an order magnitude less sensitive setting is unusual.

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15	Page 5-26 Figures 5-27 and 5-28	The draft concludes that the ASD were faster performing than the ion, but the SS photo was also faster. This is a major reversal from the previous in-cabinet, no airflow tests. This observation should be further discussed.
16	Page 5-32 Figures 5-34 and 5-35	The SS spot at 0.2 %/ft consistently alerted before the light scattering ASD5 at 0.13 %/ft. Since this was a change from the previous test results, this observation should be further discussed. It may be the result of using XLPE and CPPE wire only, which produced among the largest smoke particles.
17	Page 5-55 Lines 4-6	*The results indicated that, as the ventilation rate increased, the effectiveness of any smoke detector technology in detecting the incipient source decreased.* This was not the case for all conditions; low ventilation rates improved response of light scattering ASD and SS in some cases.
18	Page 6-1 Line 10	Ultimately, the sum of the contributions for all fire scenarios is used to determine a core damage frequency due to fire. However, the number is just one outcome of the fire PRA. The development of risk insights is at least as important as the development of a number.
19	Page 6-2	The discussion of previous quantification approaches in the body of the report may cause confusion. Suggest focusing Part II on the probabilistic modeling approach and move information not relevant to the revised method into an appendix.
20	Page 6-2 Line 84	A reduction in NSP of 0.39 would be realized if there was 0 minutes until target damage (NSP = 0.613 with in cabinet, or NSP = 1). The difference in NSP versus time to target damage looks a bit like this:

Minutes	No In Cabinet Detection NSP	In Cabinet Detection NSP	Diff in NSP
0	1.000	0.613	0.387
5	0.613	0.375	0.237
10	0.375	0.230	0.145
15	0.230	0.141	0.089
20	0.141	0.086	0.055

Comment No.	Document Number Section / Paragraph	Comments / Basis for Comments
21	Page 6-7 Line 239	In addition to simulation, decision trees and expert judgment, time to detection can also be determined via empirical equations; see Milke's correlation and Mowrer's correlation.
22	Page 6-7 Line 242	Crediting a detection or suppression system is anticipated to reduce the calculated fire risk. Typically, event trees are used to evaluate differing end states (fire causes damage to initiating component, fire causes damage to secondary targets, fire causes damage to room (HGL)) and the credit of any detection or suppression system is an element of the conditional probability for these respective damage levels. Suggest this sentence be reworded.
23	Page 6-9	End state of "cabinet damage" may still be overestimated based on a review of fire event experience related to electrical cabinet fires which suggest that even fires in cabinets that have observed flaming tend to stay localized within the cabinet.
24	Page 7-1	It is understood that it is difficult to discern the fraction of fires that exhibit incipient detection from fire event data. The event review focused on fires that exhibited an incipient stage of 30 minutes or greater. Unfortunately, this introduces a bias that assumes fires with an incipient stage less than 30 minutes cannot be suppressed prior to flaming. Some attempt should be made to quantify this time duration / event set.
25	Page 7-2	Were any fires excluded from the review? How were on demand failures during work activities treated?
26	Page 7-4 Lines 22-34	This paragraph discusses events that are in Bin 4 - Main Control Board. This discussion seems out of scope since the focus of this method is on Bin 15.
27	Page 8-1 Lines 11-13	The "cabinet damage" end state seems more consistent with fire severity classification - fires extending beyond the component of origin. Also, it is unclear why suppression activities constitute "cabinet damage".
28	Page 8-4	It may not be appropriate to compare the performance of incipient fire detection systems with conventional detection systems. Roughly 15% of electrical cabinet fires are detected by fixed detection systems. Most of the remaining fires are detected by plant personnel or other control room indications. Therefore, it is likely that the installation of incipient detection systems would increase the number of fires detected by fixed detection systems. There has been significant industry operating experience with respect to incipient detection that suggest early component failures are being detected on a more frequent basis.
29	Page 8-5	How were fire events treated if detected and suppressed by fixed suppression systems in this method?

Comment No.	Document Number Section / Paragraph	Comments / Basis for Comments
30	Page 8-5	The point of Assumption #2 is not clear – there could be an incipient fire that just is not suppressed in time. That doesn't mean that it did not have an incipient stage. For example, in one fairly recent fire event, operators smelled an odor / smoke for days before the event, but a fire still occurred.
31	Page 10-14 Table 10-1	Table 10-1 attempts to justify the 30 minute time window for the fire event review, however it appears from the event timeline that a technician or other plant personnel may be in the location of interest within 7-14 minutes (if not sooner). It is likely that even with a few minutes available, an operator would be able to locate and control an early stage fire regardless of the fire progression (nearing the end of the incipient state or entering flaming (but prior to t-squared) conditions). Again, the thirty minute time window appears to be a severe limitation of this method.
32	Part II General	The quantification of incipient detection requires significantly more analysis than conventional fire detection and suppression methods. This may be warranted as these systems can detect an early fire signature and the human response plays a more pivotal role in a successful end state. Has an attempt been made to benchmark real world operational experience against this method?
33	Section 12	Sections 7-11 describe pieces of the method, but then Section 12 proceeds immediately into illustrative examples. It would be helpful to summarize and provide guidance on parameter selection early in Section 12 and then illustrate the process using examples.
Editorial Comments		
1	Figure 1-1	Earlier in Executive Summary, it is noted that ion spots were faster than 3 of 5 ASD tested. (xviii line 51). There were 5 ASD tested in total, but not all evaluated at the same time; no more than 3 ASD were included in any test series.
2	Page 2-3	Second sentence in Section 2.1.1, replace" probability of occurrence" with "frequency of occurrence".
3	Xviii line 15	*"evaluated both in-cabinet and areawide detector response is a small room."* Change to "in" a small room.
4	Xviii line 27	*"ASD sampling ports and spot-type smoke detectors in to"* Delete "in".
5	Page 1-1	EPRI reports 1011989 and 1016735 should be referenced without the technical report, "TR" designator.

Comment No.	Document Number Section / Paragraph	Comments / Basis for Comments
6	Page 3-1	*"Installed as risk reduction measures to support risk quantification studies"* While each study may have different insights (whether deterministic or probabilistic), fire protection safety studies are performed to identify plant vulnerabilities and generation of insights that can be used to enhance plant safety. It may be misleading to characterize the installation of VEWFDS "as risk reduction measures to support risk quantification studies". It is likely that these systems are installed to prevent or reduce the likelihood of a damaging fire in a critical area of the plant.
7	Page 3-5 Line 32	Suggest spelling out RTGB; it is not a common acronym.
8	Page 3-8 Line 47	*Fewer nuisance alarms were installed than spot detectors.* It appears that this should have read "Fewer nuisance alarms occurred than where spot detectors were installed".
9	Page 4-3 Line 47	Reference is broken (not found).
10	Page 4-9 Line 3	A load cell was used to weight the wire samples before and after each test. Change weight to weigh.
11	Page 54-23 Line 5	*heap-filter air cleaner.* This may be a typo, should it be HEPA-filter?
12	Page 4-50 Line 39	*ASD2 were 0.069 kPa for the first two sampling ports (closest to the detector), and 0.64 kPa* This is a major difference (perhaps a typo); should the second number be 0.064 kPa?
13	Page 7-6 Line 45	There appears to be a typo in the unreliability number.
14	Page 10-6 Tables 10-6 through Tables 10-14	There appears to be a typo in the first footnote to each table - EHP should be HEP.
15	Page 11-2 Line 17	The EPRI report number is incorrect. It should be 3002002936.
16	Page 13-1 Line 32	*largest partial size for the materials tests.* Is this a typo, possibly referring to "particle" size?