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APPLICATIONS OF FIRE PRA IN NFPA 805 FREQUENTLY-ASKED-QUESTIONS PROGRAM[1]

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ABSTRACT

Over the past 5 years, fire probabilistic risk assessment (PRA) has undergone substantial maturation because of the implementation of several programs utilizing fire PRA [1, 2]. Under a memorandum of understanding, the NRC Office of Nuclear Regulatory Research (RES) and the Electric Power Research Institute (EPRI) published comprehensive improvements in fire PRA methods [3] for these programs. Particularly, nuclear power plants transitioning to 10 CFR 50.48(c), which endorses National Fire Protection Association Standard 805, are extensively applying the RES/EPRI fire PRA methodology to perform improved, plant-specific fire PRAs. The NRC has established a frequently-asked-questions (FAQ) program [4] to address issues arising from the licensees' voluntary transition to 10 CFR 50.48(c), including several issues related to the implementation of this RES/EPRI fire PRA methodology report.

This paper will describe the resolutions to these fire PRA issues that RES and EPRI have jointly developed to support the FAQ program. These key fire PRA issues are related to identifying and counting potentially important ignition sources in the fire PRA, assessing fire propagation from electrical cabinets, and expanding the approach to evaluate the significance of high-energy arcing faults. A discussion of the potential risk significance of these clarifications and additions, and their impact on the fire PRA standard, will also be included.

Key Words: Fire PRA, Fire PSA, Fire Protection, Risk, NFPA 805

1 FIRE PRA IN NFPA 805 PILOT TRANSITIONS

Nuclear power plants in the United States are performing fire probabilistic risk assessments (PRAs) to leverage risk insights to address regulatory issues and prioritize activities at their plants. In particular, fire protection inspection findings are being assessed for risk significance, with the complexity of fire PRA tools gradually increasing with the risk significance.

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Furthermore, those plants that have submitted letters of intent to voluntarily transition to Title 10, Section 50.48(c), of the *Code of Federal Regulations* (10 CFR 50.48(c)), the rule endorsing National Fire Protection Association (NFPA) Standard 805 in part, are applying NUREG/CR-6850, "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities," issued September 2005. This methodology, developed by the Office of Nuclear Regulatory Research (RES) of the U.S. Nuclear Regulatory Commission (NRC) and the Electric Power Research Institute (EPRI), describes the performance of a comprehensive, state-of–the-art fire PRA. Fire PRA issues related to the implementation of this methodology are being identified and resolved in the NFPA 805 frequently-asked-questions (FAQ) program. This program was established by the NRC's Office of Nuclear Reactor Regulation to address overall issues related to the transition, including issues related to more traditional fire protection requirements in NFPA 805, as well as those pertaining to fire PRA.

The objective of this paper is to identify highlights to date from the fire PRA FAQs that either have been resolved, or have resolutions to the FAQ program jointly recommended by RES and EPRI. These highlights include a statement of the purpose of the FAQ and key issues and conclusions relevant to its final or recommended resolution. A section on the significance of these FAQ solutions appears after the description of the FAQ program, which is then followed by a summary of the importance of these FAQs to the fire PRA standard. The paper concludes by identifying more recent FAQs proposed primarily by industry that touch on many aspects of the fire PRA methodology. The reader is directed to the entire publicly available FAQ package to read and understand the solutions thoroughly [5–10].

2 GENERAL DISCUSSION OF FIRE PRA FAQS

The fire PRA FAQs consist primarily of two types of questions. The first type clarifies technical guidance related to application of fire frequency in NUREG/CR-6850. In particular, four fire PRA FAQs have been written to address the counting of ignition source components for their contribution to fire ignition frequency. These FAQs relate to the counting of electrical cabinets for their contribution to the fire frequency of thermal fires or to high-energy arcing faults (HEAFs), as well as the counting of miscellaneous ignition sources such as transformers. Also, an FAQ was established to identify cabinets belonging to the main control board (MCB), since a fire frequency and associated risk model were developed specifically for the MCB to establish damage short of failing the entire cabinet. Each of these FAQ resolutions recommended jointly by RES and EPRI has been approved by the FAQ program.

The other type of FAQ relates directly to fire damage. Two FAQ solutions have been proposed in this area. The first proposed solution addresses fire propagation from electrical cabinets and is based on design characteristics related to preventing fire from escaping the cabinet. The second proposed solution suggests an approach to address HEAFs from bus duct fires. Both of these proposed FAQ resolutions related directly to fire damage are under review by the FAQ program.

3 FIRE PRA FAQS ON COUNTING OF IGNITION SOURCES

3.1 General Electrical Cabinets

The purpose of the FAQ resolution on counting general electrical cabinets for fire PRA is to provide further guidance to ensure a consistent approach to developing fire ignition frequency for fire scenarios. The primary feature of the counting guidance is to count "vertical sections" of the cabinets. Ignition sources in cabinets consist of features such as circuit cards, relays, cable terminations, switching equipment, and junctions, rather than cables themselves. Vertical sections are generally established from external inspection of the cabinet, without opening cabinet doors and potentially disrupting safe plant operations. Examining a sample of representative panels will likely prove useful to confirming the estimate of the number of vertical sections; however, the approach recognizes that internal inspection will be possible for only a small sample of panels, at most. The resolution to this FAQ recognizes that vertical sections may vary in width or height. The counting will not be affected by this variation in vertical section size, provided that the general count of ignition sources does not vary dramatically. The presence of internal dividers is also rarely important for counting in this approach since these internal dividers typically do not alter the number of ignition sources per vertical segment. Notably, the presence of internal dividers will affect the spread of the fire within a cabinet and the potential resulting damage, a factor more important to fire PRA.

Fig. 1 below shows an example of selected cabinets from this FAQ and the number of cabinets to be used in counting.

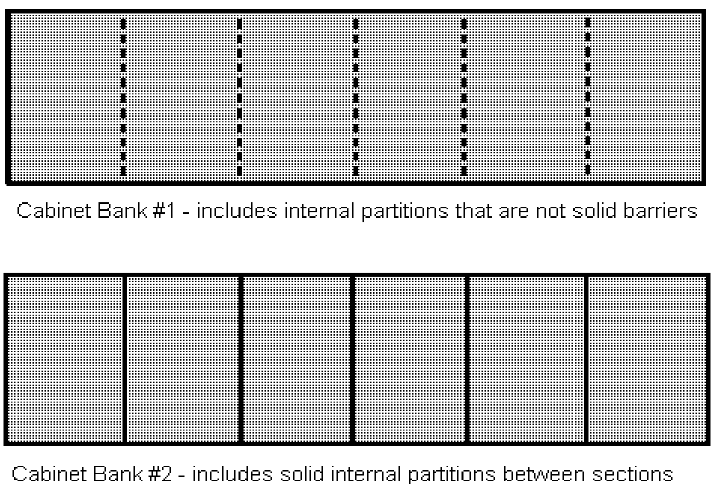

Figure 1. Two similar banks of cabinets with different internal partitions

In the example depicted by the figure, distinct vertical sections are apparent from the outside of cabinet banks 1 and 2, and the two banks are roughly the same overall size. Internal dividers exist in both cabinet banks. However, in bank 1, the partitions are partial barriers only (i.e., there are large openings between sections), whereas in bank 2, the partitions are solid metal barriers with no unsealed openings. Proper counting of each bank indicates that each cabinet bank should be counted as six vertical sections (or six cabinets). Key to this conclusion is that the density of components is not expected to be affected by the internal partitions. The subsequent fire scenario analyses should recognize that fire spread within the cabinet bank may be affected by the fullness of the internal partitions.

A second example described in this FAQ depicts a single stand-alone control cabinet that is 3 meters wide and requires proper guidance for counting. This 3-meter cabinet is much wider than the other 1-meter-wide panels generally used in the plant. No partitioning of this larger cabinet was evident from external examination. Such a cabinet constitutes an outlier with respect to size. Outlier cases are expected to be sharply limited but will occur.

In this second example, proper counting requires some analyst judgment. The FAQ solution recommended that an internal inspection assess the relative density of ignition sources within the 3-meter cabinet and a comparison be performed to other plant electrical cabinets of a similar nature and function. If the density of ignition sources (e.g., switches, relays, circuit cards, and cable terminations) is similar to the density of these other cabinets, then an equivalent cabinet count based on a typical cabinet width can be assigned. For example, if a typical cabinet is 1 meter wide, then the 3-meter-wide cabinet in this example might be counted as equivalent to three vertical sections. However, if the density of ignition sources is very low compared to other cabinets, then the cabinet can be counted as a single vertical section despite its large size. The FAQ solution notes that a basis for the assigned count for outlier cases will need to be documented.

3.2 Main Control Board

The purpose of this FAQ is to clarify the definition of the MCB that is used in Appendix L to NUREG/CR-6850. Identifying the MCB model properly is important since NUREG/CR-6850 contains a special approach to calculate the risk from fire damage to sets of cables and includes appropriate credit for suppression. The overall conclusion from this FAQ is that the MCB is the horseshoe and little else. After all, only the fires from the EPRI fire events database that occurred in the cabinets consistent with this description of the MCB were binned as MCB fires. Minor exceptions to this rule have occurred. For example, at one plant that was acting as a pilot for NUREG/CR-6850, fire events that had occurred within two benchboard consoles located in front of the horseshoe were categorized as MCB panels. These consoles were an essential part of monitoring and controlling the plant. This FAQ solution notes that electrical cabinets in the control room outside of the scope of MCB cabinets are categorized as general electrical cabinets, which is the topic of the FAQ above. Consequently, the MCB definition remains consistent with NUREG/CR-6850, although clarification was warranted.

3.3 Miscellaneous Ignition Sources

The purpose of this FAQ is to provide clarification on those miscellaneous ignition sources that need to be incorporated into fire PRA. Miscellaneous ignition sources identified in this FAQ include electrical motors (including those in ventilation systems), pumps, and transformers. Generally, this FAQ solution places an upper limit on the horsepower (hp) or voltage rating of those components above which a challenging fire scenario cannot occur. An upper limit of 5 hp exists for pumps and electric motors. Regarding transformers, these ignition sources must be divided into dry and oil-filled transformers. Although significant energy could be released in an arc initiating a dry transformer fire, fires in these transformers with a rating of 45 kilovoltamperes or less are not expected to be challenging. In dry transformers, limited combustible material (i.e., varnish on the winding) is present. However, fires starting in any oil-filled transformer, despite the rating, have the potential to be significant because of the presence of oil. In practice, however, smaller indoor transformers generally are not cooled by oil. A particular type of electrical motor that may be screened from fire ignition frequency is a totally enclosed motor-operated valve drive motor. In this case, the enclosed motor does not present the potential for fire spread. However, unlike enclosed motors, ventilated motors do present the potential for fire spread beyond the motor and need to be included as ignition sources in fire PRA.

3.4 Electrical Cabinets Subject to High-Energy Arcing Faults

Fires from HEAFs present an unusual challenge to the plant since fire damage in the immediate vicinity is rapid and cannot be prevented by suppression efforts. In particular, electrical cabinets rated 480 volts (V) and above were assumed to be capable of producing an HEAF in NUREG/CR-6850. The purpose of this FAQ is to distinguish between HEAF fire frequencies for low-voltage cabinets such as 480 V and medium-voltage electrical panels such as 4160 V. Such a distinction is important since the particular damage model in NUREG/CR-6850 was supported primarily by data from cabinets in the medium-voltage range.

Sources of HEAFs are load centers, switchgear cabinets, and motor control centers. Specifically, for motor control centers, only those that contain breakers similar to switchgear are identified as HEAF sources. The HEAF fire damage model assumes that the damage occurs simultaneously with the high-energy arc and extends beyond the cabinet through a zone of influence that extends 5 feet (1.5 meters) above the cabinet and 3 feet (0.9 meters) in front of the cabinet. It is interesting to note that HEAF fires from 480-V cabinets are much more frequent than those from higher voltage cabinets. Reasons for this disparity include the fact that low-voltage cabinets are worked on and operated more frequently; workers have a more casual attitude regarding low-voltage cabinets since the safety threat from a mistake generally is not as great; and medium-voltage cabinets have improved design attributes such as insulated bus bars, barrier protection, and increased creepage distances.

A table of HEAF fire ignition frequencies for low-voltage (480–1000 V) electrical cabinets versus medium-voltage (greater than 1000 V) electrical cabinets follows.[2] This table reflects the fact that most HEAF fires consistent with the damage model in NUREG/CR-6850 arise from medium-voltage fires in the fire event database.

Table I. HEAF ignition frequency for electrical cabinets

Ignition Frequency Per Cabinet Voltage	480–1000 V	>1000 V
Mean	4.8×10^{-4}	1.4×10^{-3}
Variance	1.4×10^{-3}	1.2×10^{-2}
5%	1.6×10^{-5}	3.8×10^{-5}
50%	2.0×10^{-4}	6.2×10^{-4}
95%	1.5×10^{-3}	4.1×10^{-3}

[2] The definition of low and medium voltage is based on the definitions for electrical power systems. It is noted that this electrical power system definition of low and medium voltage differs from that for cable voltages. Furthermore, the lower limit for HEAFs is 440 V, as identified in NUREG/CR-6850, and the frequency for low-voltage cabinets includes 440-V cabinets.

4 FIRE PRA FAQS ON FIRE DAMAGE

Fire damage generally has a larger effect on fire PRA than does fire frequency. Risk increases for damage to trains of internal events systems for core cooling can range from one to two orders of magnitude. It should be noted that damage to such systems from ignition sources is a highly spatial assessment and is dependent on plant-specific considerations. In conclusion, those FAQs related to fire damage have the potential to have a larger impact on risk than those FAQs strictly related to redistribution of fire frequency.

4.1 Fire Propagation from Electrical Cabinets

An FAQ resolution to clarify fire propagation from electrical cabinets was submitted to the FAQ program to address the confusion resulting from conflicting statements in NUREG/CR-6850. This proposal is under review by the FAQ program. NUREG/CR-6850 indicates that only well-sealed cabinets can prevent a fire from propagating beyond the cabinet. NUREG/CR-6850 indicates that a well-sealed cabinet is unvented, is robustly secured, and has no unsealed penetrations. In particular, a robustly secured cabinet is one where all doors and access panels are fully mechanically sealed and will not create openings or gaps from the fire. For example, a panel constructed of sheet metal sides “tackwelded” to a metal frame would not be considered robustly secured since internal heating could warp the side panels and allow fire to escape through the resulting gaps between weld points. In contrast, a weather-tight panel with a door/access panel bolted in place or secured by mechanical bolt-on clamps around its perimeter would be considered well sealed and therefore robustly secured. The ability to prevent a fire from propagating is significant in fire PRA.

As such, the proposed RES/EPRI FAQ resolution maintains the intent of NUREG/CR-6850 and reemphasizes the discussion in Chapter 11. The confusion that resulted from the discussion in Appendix G is resolved. It should be noted that this FAQ solution does not apply to cabinets greater than 440 V, which are subject to breach from HEAFs.

4.2 HEAF Fires from Bus Ducts

A draft FAQ resolution to treating bus ducts as HEAF sources has been developed by RES and EPRI and is being reviewed under the FAQ program. The resolution first classifies the types of bus duct physical configurations as nonsegmented or continuous bus ducts, segmented bus ducts, cable ducts, and isophase ducts. A nonsegmented bus duct consists of a single length of metal bar connecting two end devices with no intermediate junctions, transitions, or terminations along the length of the bus bar. Segmented bus ducts are made up of multiple sections bolted together at regular intervals. Cable ducts use insulated cable as a conducting path instead of metal bus bars. Isophase bus ducts contain bus bars and generally connect the main generator to the main transformer. To identify the significance of these different classifications, a review of the experience base was performed. The review identified that all of the bus duct arc fault events occurred either at the termination point of a duct or at a transition point along the length of a segmented bus duct.

Fire events occurring at the termination points, with the exception of the isophase bus ducts, were captured in the frequency of equipment termination points such as switchgear, load centers, and transformers. As a result, only fires associated with isophase bus ducts needed to be identified and reviewed for fire ignition frequency at termination points. For segmented bus ducts, a number of fire events in the database were identified at bus transition points, rather than at the termination points. Causes of these fire events included loose bolted connections, failed insulators, and debris in the bus duct. Location of the fire origin is important for fire PRA, as the fire is postulated at these locations for purposes of establishing damage in the scenario. As a result, fires for isophase ducts are postulated at the terminations in fire PRA. For segmented ducts, fires are postulated at transition points. According to discussion at a public meeting on this issue, these transition points are easily identified. This conclusion is being discussed as this recommendation moves forward in the public FAQ program.

A separate review of the data reveals that eight events occurred that can be classified as potentially challenging HEAF segmented bus duct fires and four for isophase bus ducts. A zone of influence to establish damage beyond the duct has been postulated. A single fire event is the primary basis for the zone of influence for the segmented bus duct. Essentially, the zone of influence for a segmented bus duct fire assumes that molten metal material will be ejected from the bottom of the bus duct below the fault point and will spread downward in the shape of a cone, as well as spread outward within a sphere of 1.5-foot (0.46-meter) radius otherwise. Cables in open-top cable trays within the zone of influence will be ignited. Cables in covered trays, depending on the cover material, may be ignited. Cabinets, depending on the particular configuration, could allow penetration of the molten material as it is ejected from the bus duct. Auto-suppression, as in HEAF fires from electrical cabinets, is not assumed to prevent damage for the initial fire. Manual suppression is credited similarly as in HEAFs in electrical cabinets.

The voltage/current for an isophase bus is higher than for a segmented bus. The recommended zone of influence for an isophase bus duct fire covers the damage from the fault and from the hydrogen fire resulting from the rupture of the isophase duct. Because of this hydrogen fire, the information leading to the zone of influence for isophase fires is more subjective, since it is harder to distinguish between the initial damage and the ensuing damage from the molten material/hydrogen fire. The postulated zone of influence is a 5-foot sphere. For the case of fires occurring at the main transformer termination points, the potential for involvement of the main transformer and its oil should be considered. For example, failure of the electrical penetration seals could create a path for oil leakage outside the transformer. Also the potential for involvement of additional hydrogen, beyond that released from the bus duct breach, from the hydrogen purge/fill system must be considered.

5 SIGNIFICANCE OF FAQ SOLUTIONS

An average of 750 general electrical cabinets[3] exists per plant. The NUREG/CR-6850 methodology preserves the overall frequency from electrical cabinet fires per plant. As a result, the cabinet count merely distributes the overall fire frequency. A key conclusion to assessing the risk significance of this FAQ resolution is that this new guidance would only prevent analysts from deviating by a factor of 2 when counting electrical cabinets. As a result, such a deviation leading to a low count on general electrical cabinets would only undercount cabinets in some areas by one-half, but since the overall fire ignition frequency for electrical cabinets per plant is preserved by the methodology, other areas will see a comparable increase in fire frequency from electrical cabinets. Such a difference will have a small effect on risk and is well within the uncertainty. Note that fires from electrical cabinets, to which this FAQ is related, may be

[3] Note that this average was taken from the fire protection significance determination process (SDP).

important depending on the cabinet's location in the plant. Furthermore, a switchgear cabinet containing many bundled cables will produce a fire in a switchgear room which is more intense than a cabinet with fewer cables that are in separated bundles.

With respect to MCB cabinets, a plant contains many fewer such cabinets than general electrical cabinets. As a result, a minor deviation in counting MCB cabinets from the guidance is therefore likely to have a larger effect on fire ignition frequency per cabinet. The overall importance of this impact depends on the particular functions of cables found in each cabinet. However, as for the general electrical cabinet, the overall frequency for MCB fires is preserved for a unit. Since the MCB houses significant cables for safe shutdown, fires arising from the MCB are likely to be risk significant. In particular, NUREG/CR-6850 contains a model to evaluate damage to pairs of components in the MCB, including manual suppression, whose purpose is to limit damage to a portion of the entire cabinet (as opposed to general electrical cabinets). As such, identifying the MCB properly is important to attaining realistic results for control room fires. In particular, such a model could refine damage estimates for MCB fires that may lead to control room evacuation and may rely on complicated manual actions.

Miscellaneous ignition sources consist of electric motors, pumps, and transformers. Approximately the same number of pumps and transformers exists in a plant on the average.[4] Many smaller pumps, motors, and transformers exist below the hp or voltage limit and therefore are to be screened from fire frequency. Removing these smaller sources is appropriate since they generally do not produce the fires captured in fire frequency. Small screened pumps use very little if any oil, and the screened dry transformers have very little combustible material and no oil. It is important to remove these components from fire frequency as the events incorporated in fire frequency do not capture the small fires that these components can produce. Failing to remove these small ignition sources would bias the fire frequencies per component towards an unsupportably low frequency. Notably, all oil-filled transformers are retained for the frequency count because of their combustibility. Larger pumps containing oil may produce larger fires and prove risk significant, despite having cables in the vicinity protected by fixed suppression systems.

Regarding the FAQ on counting cabinets for HEAFs, nearly the entire original frequency of HEAFs was redistributed to the medium-voltage cabinets. This is expected since the damage associated with medium-voltage cabinets is much more aligned with the events that have occurred with medium-voltage cabinets. For purposes of looking at the risk impact of this new HEAF frequency distribution, assume that approximately three times as many low-voltage cabinets (less than 1000 V) as medium-voltage cabinets (greater than 1000 V) exist in a typical nuclear power plant. Since the total HEAF fire frequency in NUREG/CR-6850 is approximately equivalent to the newer HEAF fire frequency for medium-voltage cabinets from this FAQ, then the frequency per medium-voltage cabinet will increase by a factor of 4. Since these medium-voltage cabinets exist in places such as switchgear rooms, the importance of this frequency adjustment is combined with the divisional separation, if any. Because of this refinement of HEAF frequency, the HEAF frequency of each low-voltage cabinet now becomes approximately four-tenths of its value from the original frequency in NUREG/CR-6850. So the HEAF frequency of each low-voltage cabinet decreases a little over one-half its value from the original

[4] The average number of pumps and transformers found in a plant, according to the fire protection SDP, is between 50 and 100.

NUREG/CR-6850 HEAF frequencies. Also, under the revision, the frequency of both medium- and low-voltage electrical cabinet HEAF fires is preserved for the plant. As such, medium-voltage HEAF cabinet fires are now more significant than under the original approach in NUREG/CR-6850, which is more aligned with the data.

The FAQ which clarifies well-sealed cabinets applies only to thermal fires. The distinction between well-sealed cabinets and those not well sealed may have an important risk significance, depending on the cabinet's location with respect to cables responsible for mitigating core damage. It must be noted that well-sealed cabinets should not be counted in fire frequency under general electrical cabinets, since these cabinets do not have the potential to produce a challenging fire. The guidance for counting general electrical cabinets directed the analyst not to count these cabinets, and thus, this FAQ does not affect the counting guidance.

On the question of HEAFs in bus ducts, the potential risk significance has not been determined because no case-specific analyses have yet been completed. Since bus ducts route power to higher power electrical distribution and switching equipment, they tend to be limited to specific plant areas. The ignition frequency for these faults is relatively low, and the frequency is distributed to various locations (i.e., the junction and transition points) along the length of the bus duct. The source of the HEAF event is located at the junction and transition points along the length of the bus duct as well. The damage footprint which represents the initial damage from energetic fault is directed downward with a relatively narrow angle of damage to the sides and assumes damage above the fault. From the plant response perspective, the failure of the bus duct itself will result in a loss of power to all equipment powered by that bus, and these failures would likely not be easily recoverable. Furthermore, those areas containing bus ducts house switchgear, motor control centers, and load centers and therefore are important to plant safety. As a result, if a junction or transition point happens to be located directly above or very near redundant safe-shutdown equipment or cables, then the fire scenario could be risk important. Otherwise, HEAFs from bus ducts are expected to be of lower risk significance for many areas within a plant. This conclusion generally holds for the bus duct HEAF from either segmented or isophase bus ducts; however, the approach for the isophase bus duct assumes rapid damage over a much larger region than for the segmented bus duct.

6 IMPACT ON FIRE PRA STANDARD

Each of the FAQ resolutions discussed above provides guidance on how to perform a fire PRA. However, neither FAQ resolution affects the overall performance requirements in the fire PRA standard requiring that fire frequencies or fire damage, including that from HEAFs, be assessed. As a result, the standard will continue to be applied as it was before these FAQs. Yet, these FAQ resolutions affect the implementation of the fire PRA standard. For example, as approaches evolve to address any new failure modes, such as the HEAF bus duct fire, analysts will need to consider it to implement the various requirements in the standard, which typically extend from simple, conservative requirements to more realistic, detailed requirements.

7 RECENTLY IDENTIFIED FIRE PRA FAQS

The RES/EPRI collaboration has expanded to address fire PRA FAQs recently submitted by industry and the NFPA 805 pilots. These FAQs consist of focused technical issues, for the most part, and span fire PRA from fire frequency, to suppression, to fire damage, and spurious actuation duration. In particular, the first set of FAQs involves reexamining the data from which some of the quantitative results in NUREG/CR-6850 were derived. For example, the first FAQ is to examine fire frequency data to assess if some historical data are still relevant. Another FAQ will examine the suppression data to establish if the brigade response time is overestimated in the analysis of some events.

The second set of FAQs involves developing more extended or new approaches. For example, an FAQ has been written to develop an approach to incorporate incipient fire detection systems. NUREG/CR-6850 did not address incipient detection systems. Another FAQ has been written to provide further guidance on realistic treatment of oil fires, such as from the main feedwater pump. A third FAQ in this list has been written to treat hot short duration and spurious actuation circuit dependency in fire PRA. NUREG/CR-6850 did not specifically address this hot short duration or dependency. The fourth FAQ has been written to clarify existing guidance on damage for cable tray fires; this FAQ is not expected to affect the NUREG/CR-6850 method at all but provides additional discussion to aid in its implementation. These FAQ resolutions are currently being drafted, and any change to the fire PRA guidance in these areas has yet to be established.

8 SUMMARY

The NFPA 805 pilot plants are using NUREG/CR-6850 extensively to perform fire PRAs as a part of their transition to NFPA 805. As a result, they have identified fire PRA issues in the NFPA 805 FAQ program that needed additional clarification during their implementation of this methodology. These issues relate to the counting of ignition sources for fire frequency, fire propagation from electrical cabinets, and bus duct HEAFs. Generally speaking, issues related to the counting of cabinets are less important from a risk perspective than issues related to predicting fire damage. While damage of automatically actuated trains affects the fire risk on the order of 10–100, variations in fire frequencies are expected to have less of an impact. The issues being addressed in the fire PRA FAQs generally will not affect the fire PRA standard itself but will affect the implementation of the standard in performing fire PRA. Finally, as a result of further use of NUREG/CR-6850, the industry has initiated new FAQs on fire PRA to focus on particular areas that may produce conservative results. These newer FAQ solutions by RES and EPRI are under development at this time.

9 ACKNOWLEDGMENTS

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