

**Clarification to guidance for fire propagation from electrical cabinets
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RES/EPRI position prepared by: Steve Nowlen, Bijan Najafi

Issue:

The guidance provided in Appendix G of NUREG/CR-6850, EPRI TR 1011989 for the screening of fire propagation from “un-vented” electrical cabinets appears to conflict with the guidance provided in Chapters 6 and 11 of the main body. Clarification is needed.

Resolution:

The wording provided in Appendix G relative to the potential for fire spread beyond the boundaries of an un-vented cabinet should be disregarded. The wording provided in Chapter 11 relative to fire propagation from electrical cabinets is the intended and correct guidance. (Specific citations are provided below.)

Discussion:

Portions of the text in Appendix G, Section G.3.3 were an unintended carryover from the original *Fire PRA Implementation Guide* (EPRI TR 105928) and were not modified to reflect the EPRI/RES team’s consensus. The alternate discussion provided in Chapter 11 represents the consensus positions.

Appendix G (Section G.3.3) provides a general discussion of the effects of venting on fire development and fire propagation for electrical cabinets. In most regards, the discussions are correct and valid. In particular, cabinet venting is important to the development of fires in an electrical cabinet. The point where the discussion deviates from the team consensus developed as a part of the methodology development is where it discusses the potential for fire propagation outside the cabinet for a cabinet that is not vented.

Specifically, those portions of the second paragraph in Section G.3.3 that read as follows should be disregarded:

“Electrical cabinets that are not vented do not propagate a fire. ... It is assumed that in the absence of other ventilation (*other than those listed in Table G.3*), penetrations will not allow sufficient air exchange to replace oxygen consumed by the fire, and an incipient fire will self-extinguish when there is no longer enough oxygen to support combustion.” (Italics added for clarity.)

Also, the final sentence of the third paragraph in Section G.3.3., which reads as follows, requires some clarification:

“... Therefore, air exchange through the top penetrations for typical NPP cabinet configurations listed above is not expected to be sufficient to support combustion.”

This latter discussion is correct but incomplete. The fundamental factor not addressed by the wording in both of these citations is that once a fire starts inside an electrical cabinet, uneven heating of the cabinet side/top panels and door(s) will take place. This uneven heating can cause these elements to warp unless they are “robustly secured” as discussed in Chapter 11. Warping will in turn create new openings for the passage of air into and out of the cabinet. The observation of this behavior and its impact on fire growth behavior was a major finding of the Mangs/Keski-Rahkonan (VTT Finland) tests which are also discussed (and cited) in Appendix G.

In lieu of the wording from Appendix G, analysts should screen electrical cabinets for fire propagation potential based on the following guidance from Chapter 11 (Section 11.5.1.7.3, Step 7.a.3):

“In the case of electrical panels, the panel ventilation configuration and the latching configuration of the doors are important. If the panel contains open vents, either at the top or bottom of the pane, or if penetrations into the top or sides of the panel are not fire-sealed, fires can be assumed to be capable of spreading out of the panel to secondary combustibles. However, for un-vented cabinets, fire spread may be less likely. Fire spread out of the panel may still occur, unless the panel doors are attached and anchored at multiple points. Simple twist-handle style top-and-bottom door latches are not sufficient to contain a fire within a panel. Substantial warping of the door face may occur due to the heat of the fire. This can allow gaps to open in an otherwise un-vented panel. In contrast, fire spread is not considered likely given a weather-tight or waterproof cabinet construction where multiple mechanical fasteners secure panel access plates and where all penetrations into the panel are sealed.”

As a point of clarification, it should be noted that in the above description on penetrations, the term “fire-sealed” was not intended to imply “fire-rated.” Rather the intent was that penetrations into a cabinet would be sealed such that they would not readily allow for the passage of air.

Importantly, this clarification should have **no impact whatsoever on the counting of electrical cabinets as fire ignition sources**. The impact is only on the assessment of fire propagation potential for those cabinets that were counted as ignition sources. To clarify, Chapter 6, Section 6.5.6 on Bin 15 Electrical Cabinet count directs the analyst to *exclude* “well sealed” electrical cabinets from the Bin 15 Electrical Cabinet count as follows:

“-Well-sealed electrical cabinets that have robustly secured doors (and/or access panels) and that house only circuits below 440V should be excluded from the counting process, ...

In this context, the term “well-sealed” means there are no open or unsealed penetrations, there are no ventilation openings, and potential warping of the sides/walls of the panel would not open gaps that might allow an internal fire to escape. “Robustly secured” means that any doors and/or access panels are all fully and mechanically secured and will not create openings or gaps due to warping during an internal fire. For example, a panel constructed of sheet metal sides “tackwelded” to a metal frame would not be considered well-sealed because internal heating would warp the side panels allowing fire to escape through the resulting gaps between weld points. A panel with a simple twist-handle latch mechanism would not be considered robustly secured because the twist handle would not prevent warping of the door under fire conditions. In contrast, a water-tight panel whose door/access panel is bolted in place or secured by mechanical bolt-on clamps around its perimeter would be considered both well-sealed and robustly secured. Also note that panels that house circuit voltages of 440V or greater are counted because an arcing fault could compromise panel integrity (an arcing fault could burn through the panel sides, but this should not be confused with the high energy arcing fault type fires).”

This guidance on excluding “well sealed” electrical cabinets from Bin 15 counts stands, and is not impacted by the clarification on Appendix G noted above.

Potential impact on the analysis:

This clarification has the potential to impact the preliminary fire modeling and screening analysis for fire propagation from electrical cabinets (fire ignition source Bin #15). If the potential for fire propagation outside any given cabinet was dismissed based on the guidance provided in Appendix G, then the screening results for these cabinets, and these cabinets only, should be reconsidered based on the guidance provided in Chapter 11.

This clarification *should not* require any reconsideration of the original fire ignition source counting results provided the guidance in Chapter 6 was followed.