FAQ Number 16-0011 **FAQ Revision** 1

FAQ Title **Cable Tray Ignition**

Plant:	Harris	Date:	June 2, 2016
Contact:		Phone:	(919) 546-4570
	Harold Stiles	Email:	Harold.Stiles@Duke-Energy.com
	Robert Cavedo		Robert.Cavedo@ExelonCorp.com
	Francisco Joglar		FJoglar@jensenhughes.com
	Kyle Christiansen		Chris1K@Westinghouse.com
	Young Jo		ygjo@southernco.com

Distribution: *(NEI Internal Use)*

☒ FPRA TF ☐ 805 TF ☐ FPWG ☐ RATF ☐ RIRWG ☐ BWROG ☐ PWROG

Purpose of FAQ:

This FAQ clarifies the guidance in NUREG/CR-6850 associated with damage and ignition of cables subjected to fire-generated conditions in order to provide a more realistic characterization of fire propagation in stacks of cable trays. Specifically, this FAQ establishes guidance for identifying the conditions necessary for cable tray ignition and propagation through an arrangement of cable trays (i.e. the bulk ignition of the cable tray), at which point the cable tray fire will begin to contribute significantly to the heat release rate (HRR) of a fire scenario. Once bulk cable/tray ignition has occurred, existing guidance will be followed to determine the timing of subsequent fire growth.

This FAQ updates, in part, the guidance available in Chapters 8, 11 and Appendices H and R of NUREG/CR-6850 and NUREG/6850 Supplement 1, Chapter 9 (FAQ 08-0049). The guidance provided by this FAQ is not intended to be applicable to Section R.4.2.2 of NUREG/CR-6850 on fire propagation through a cable tray stack after ignition of the first tray or for cable tray ignition under high energy arcing fault scenarios in Appendix M of NUREG/CR-6850.

Is this Interpretation of guidance? [Yes] / No

Proposed new guidance not in NEI 04-02? [Yes] / No

Details:

NRC document needing interpretation (include document number and title, section, paragraph, and line numbers as applicable):

The guidance in NUREG/CR-6850 (e.g., see Section 8.5, Appendix H, and Appendix R) conservatively assumes that cable ignition and cable damage occur simultaneously. This assumption is based in part on testing of energized cables for investigating electrical shorts between conductors. These shorts can create the spark (i.e. the ignition source) necessary to ignite the heated cables. At the same time, relatively recent testing of de-energized cable tray fires suggests that further characterization for the process of cable tray ignition and promoting fire propagation to nearby cable trays is necessary as a relatively strong sustained fire near the cable tray arrangement is necessary for generating fire propagation through a cable tray stack (e.g. NUREG/CR-7010). Therefore, differentiating between cable damage and ignition, and the conditions necessary for a cable tray fire to propagate through a stack (i.e. the bulk ignition of the cable tray) is necessary to add realism to the scenarios included in the Fire PRA.

Circumstances requiring interpretation of guidance or new guidance:

The guidance in NUREG/CR-6850 associated with damage or ignition of cables needs clarification for two reasons. First, in some instances it assumes that the damage criteria and ignition criteria are the same. At the same time, the guidance suggest that these are distinctly different events. For example,

- Section 8.5.1.2 states, "For cables, the ignition and damage criteria can be assumed to be the same. Heat flux and temperature criteria for damage and/or ignition are provided in Table 8-2. More detail on damage criteria is provided in Appendix H." Although Table 8-2 is entitled "damage criteria", the heading includes the word "ignition". The table is reproduced here for completeness purposes:

  Table 8-2
  Damage Criteria for Cables

Screening Criteria to Assess the Ignition and Damage Potential of Electric Cables		
Cable Type	Radiant Heating Criteria	Temperature Criteria
Thermoplastic	6 kW/m^2 (0.5 BTU/ft^{2}s)	205°C (400°F)
Thermoset	11 kW/m^2 (1.0 BTU/ft^{2}s)	330°C (625°F)

  This information is repeated in Appendix H which states, "For cables, the ignition and damage criteria will be assumed to be the same. Generic heat flux and temperature criteria for damage and/or ignition are identified in Table H-1." Like Table 8-2, Table H-1 is entitled "damage criteria" but includes the word "ignition" in both a subtitle and heading. It should be noted that both of these tables (i.e., Table 8-2 and Table H-1) cite Appendix F of Inspection Manual Chapter 0609 as the source of the damage criteria.

- Second, there is no guidance in NUREG/CR-6850, Supplement 1 to NUREG/CR-6850, or applicable FAQs describing the conditions necessary to propagate a fire in a stack of cable trays. Consequently, current Fire PRAs conservatively assume that if a cable is ignited it will be capable of propagating through a cable tray stack. Under this current approach, the time between cable ignition and growth through the first cable tray to a size that can sustain and promote propagation is not credited in the analysis. The practical implication of this approach is that any cable exposed to elevated gas temperatures generated by a fire is assumed to be capable of propagation at the time it takes for heating the cable to its damage or ignition temperature.

Detail contentious points if licensee and NRC have not reached consensus on the facts and circumstances:

None

Potentially relevant existing FAQ numbers:

None

Response Section:

Proposed resolution of FAQ and the basis for the proposal:

This section primarily describes the proposed criteria for determining if a cable tray will ignite and propagate through a cable tray stack and the corresponding technical basis supporting the criteria.

Definitions

For clarity purposes, the following terms are defined first:

- Cable damage: refers to a cable no longer able to perform its function due to exposure to fire generated conditions. In this context, a “damaged cable” can have localized ignition. A cable that is damaged or has localized ignition does not contribute to the heat release rate in the compartment where the fire is postulated. In practice, a damaged cable in the Fire PRA produces a functional equipment failure.

- Cable ignition: for the purposes of this FAQ, cable ignition refers to “localized ignition” of a cable or adjacent cables subjected to fire generated conditions. This localized ignition is assumed to be triggered by sparks generated by shorts between conductors once the cable jacket and/or insulation are damaged by the fire. Under this definition, “cable damage” and “cable ignition” have the same practical effects in the Fire PRA analysis. The cables produce a functional equipment failure but do not contribute to the heat release rate in the compartment where the fire is postulated as the heat contribution is assumed to be negligible given that ignition is localized. Heat release from cable ignition may be capable of promoting limited flame spread among adjacent cables within a tray but is incapable of promoting fire propagation or flame spread beyond a small region around the energetic failure without an external heat exposure such as the one generated by an ignition source.

- Bulk cable/tray ignition: for the purposes of this FAQ, the term "bulk cable/tray ignition" refers to ignition of a full section of a cable tray. Under this definition:
    1. Bulk cable/tray ignition capable of sustaining a fire and promoting propagation requires a sustained exposure from the ignition source as localized cable ignition alone will not provide enough energy to trigger the fire propagation process through secondary combustibles.
    2. All the cables in the cable tray section are already damaged or ignited for the purposes of Fire PRA modeling,
    3. It represents a fire large enough to be capable of propagating to other intervening combustibles (e.g., propagate to nearby cable trays), and
    4. All the cables within the cable tray along the length that is on fire are contributing to the combined heat release rate in the compartment. The length and width of the initial cable tray ignited used to calculate the heat release rate contribution should be determined following the guidance in Appendix R of NUREG/CR-6850 and/or NUREG/CR-7010 volumes 1 and 2.
- Fire Propagation: refers to the process of fire growth through sequential ignition of separate (i.e., individual) secondary combustibles. For example, fire propagation through cable trays refers to ignition of different cable trays (i.e., sequential ignition of cable trays in a stack of horizontal cable trays).

- Flame spread: for the purposes of this FAQ, flame spread refers to a continued set of ignitions generating fire growth within the same combustible (e.g., fire growth/spread along a tray).

Proposed Resolution

This FAQ proposes the following clarifications to the existing guidance for determining if fire propagation through a cable tray arrangement needs to be postulated in a Fire PRA:

FAQ Number	16-0011	FAQ Revision	1
FAQ Title	Cable Tray Ignition		

1. The existing guidance in Appendix H of NUREG/CR-6850 refers to both "cable damage" and "cable ignition" as defined earlier in this FAQ. That is, the assumption that both processes happen at the same time is appropriate as it is based on experimental observations where cables exposed to fire conditions can spark and generate the ignition source necessary to generate flames. The time at which damage or ignition occurs is dependent on the thermal exposure and can be calculated using fire modeling tools as is recommended in existing guidance (e.g., using Tables H-5 through Table H-8 in NUREG/CR-6850 or other analytical heat transfer methods).

2. "Bulk cable/tray ignition" is necessary to promote fire propagation throughout an arrangement of cable trays. This guidance supplements the damage criteria available in Appendix H of NUREG/CR-6850 by establishing the conditions governing fire propagation among cable trays. The guidance is specifically applicable to fire scenario configurations involving cable trays relatively near an ignition source (i.e. that could be ignited in bulk per the criteria in Table 1). Recall that the term bulk cable/tray ignition represents a relatively large established fire in a cable tray section with enough energy to sustain propagation. It is assumed that all the cables routed in the cable tray section are ignited at the time of bulk cable/tray ignition as the cables have exceeded the cable tray ignition temperature. It should be noted that the time for cable damage or ignition occurs before bulk cable/tray ignition that triggers propagation to other secondary combustibles.

In practice, two methods of determining bulk cable/tray ignition are proposed. The first method (Method 1), valid in all plant locations, is to assume bulk cable/tray ignition based on the bounding radiant heat and temperature criteria in Table 1. The second method (Method 2) assumes bulk cable/tray ignition occurs if the tray is located below the flame tip of the ignition source fire. This method is valid only in locations where the ambient temperature does not exceed 46˚C.

The following table summarizes the criteria for cable damage, cable ignition, and cable tray ignition and is proposed as a replacement for Tables 8-2 and H-1 in NUREG/CR-6850. The basis for the cable tray ignition criteria is provided in the technical basis section of this FAQ.

Table 1: Cable Damage/Ignition and Bulk Cable/Tray Ignition Criteria

	Cable Damage/Ignition Criteria		Bulk Cable/Tray Ignition Criteria*	
Cable Type	Radiant Heating	Temperature	Radiant Heating	Temperature
Thermoplastic	6 kW/m^2	205°C	25 kW/m^2	500˚C
Thermoset	11 kW/m^2	330°C		

* Alternatively, per the approved regulatory precedent (ADAMS Accession No. ML15344A346 and ML14308A048), bulk cable/tray ignition need only be assumed when the tray is subject to flame impingement. Use of the flame impingement alternative is also only acceptable for locations with an ambient temperature of 46˚C or less. Bulk cable tray ignition assumes the bulk of cable insulation within the cable tray is ignited and contributes to the heat release rate as a secondary combustible for room heating (e.g. hot gas layer temperature calculations) calculations. In cases, where the alternative criteria of flame impingement is not used and the radiant heat or temperature thresholds are reached or exceeded, bulk cable/tray ignition occurs. Below these criteria, ignition is assumed to be localized, is not contributing to the overall heat release rate within the compartment, and is not initiating fire propagation or flame spread within the cable trays.

The following sequence provides a conceptual representation of the proposed scenario development for FPRA modeling purposes:

1. Ignition: Fire starts at ignition source generating a zone of influence affecting nearby cables in cable trays or conduits.
2. Cables in cable trays are damaged when exposed to thermal conditions exceeding the cable damage and ignition criteria listed in Table 1. Localized ignition of cables can occur due to shorts; however, the exposures are insufficient to sustain a significant heat release rate (e.g. is a measurable fraction of the ignition source heat release rate). Assume cables are damaged by localized ignition regardless of their location within a cable tray/conduit arrangement if the thermal conditions at the location of the cable tray exceed the cable damage and ignition criteria listed in Table 1.
3. If the analysis is applying the bulk cable/tray ignition criteria in Table 1 (Method 2), or if the analysis is conservatively assuming bulk cable/tray ignition using the bounding thresholds listed in Table 1 (Method 1), and the temperature or heat flux criteria for the applied method is exceeded, then, the resulting pyrolysis rates are sufficient that the entire length and width of the cable tray ignited begins to make a measurable contribution to the heat release rate of the ignition source. The length and width of the initial cable tray ignited used to calculate the heat release rate contribution should be determined following the guidance in Appendix R of NUREG/CR-6850 and/or NUREG/CR-7010 volumes 1 and 2.
4. Subsequent fire propagation and flame spread through a cable tray stack arrangement consistent with the guidance in NUREG/CR-7010, Vol 1.

The above sequence is recommended for growing fires only. The sequence is not applicable for high energy arcing fault fire scenarios. Figure 1 provides a pictorial representation of the recommended sequence.

FAQ Number	16-0011	FAQ Revision	1
FAQ Title	Cable Tray Ignition		

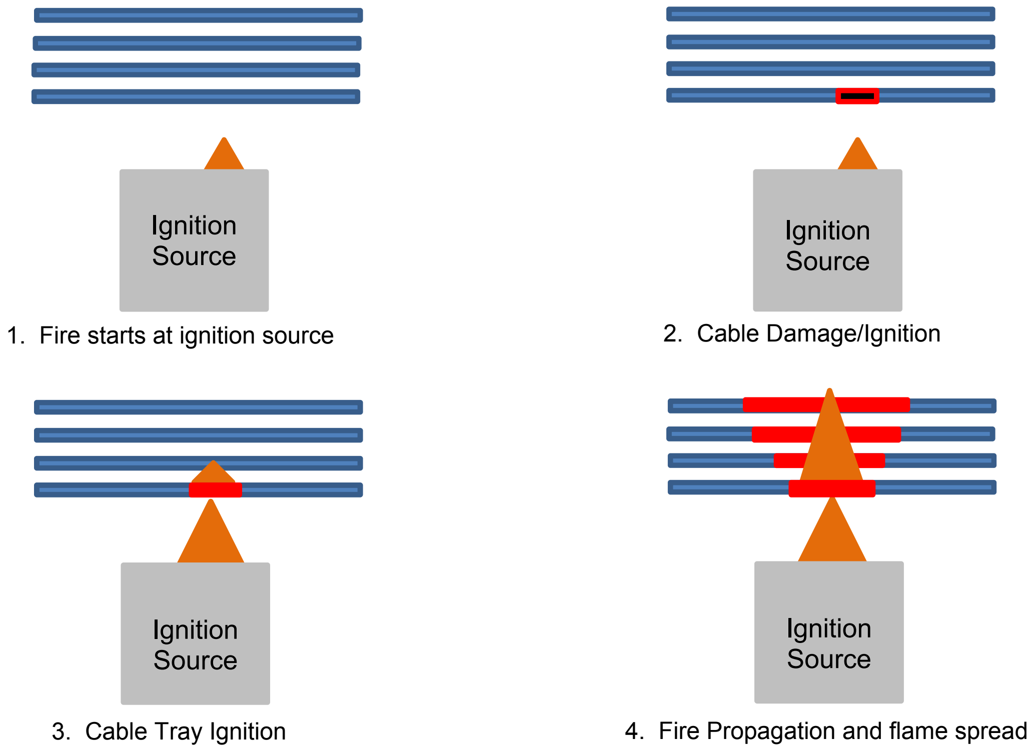

Figure 1:Pictorial representation of the fire scenario development including cable damage/ignition, cable tray ignition and fire propagation. Figure is not drawn to scale and is not intended to replace guidance on flame spread and fire propagation available in Appendix R of NUREG/CR-6850 and/or NUREG/CR-7010 volumes 1 and 2.

NOTE: Modeling of fire propagation in vertical trays should follow the guidance in Appendix R of NUREG/CR-6850 and/or NUREG/CR-7010, Vol 2.

Technical Basis

The available full scale test data that supported the empirical fire propagation model for cable tray fires, as described in NUREG/CR-6850 and validated in NUREG/CR-7010, are documented in EPRI-NP-1881 (Sumitra tests), NUREG/CR-0381 (Klamerus tests) and NUREG/CR-7010, Volume 1 (NIST tests). These reports document the results of about thirty-five to forty open configuration, unprotected cable tray fire tests. The cables in trays were not energized. In all cases, the ignition source for the lowest cable tray within a stack was a gas burner or liquid fuel pan fire that causes flame impingement on the lowest cable tray in the stack. Further, the reports presented no case where thermal plume above the flame tip alone was sufficient for igniting a cable tray.

A quantitative indication of the conditions necessary for fire ignition and surface spread is also provided in Section 3.4.7 of NUREG/CR-5384. Burn mode evaluations for both thermoplastic and thermoset cables are presented, and indicate that, for thermoplastic cables, which bound the results for thermoset cables, a surface temperature of 538˚C and an internal fuel temperature of 577˚C are necessary for surface flames to develop.

Based on cone calorimeter tests summarized in NUREG/CR-7010, Volume 1, Section 10.2, a heat flux exposure of 25 kW/m^2 (2.2 Btu/s-ft^2) is the minimal practical exposure sufficient to cause ignition for all types of cables considered, including the thermoplastic cables which bound the results of thermoset cables. Testing indicated that very few cables ignite with sustained burning at 25 kW/m^2. Furthermore, for those few tests where ignition occurred, the times to ignition were approximately 10 minutes which is longer than the peak duration of most ignition sources of interest. At lower fluxes, ignition would be increasingly unlikely and have yet longer times to ignition. Therefore, 25 kW/m^2 establishes a threshold that can be assumed for critical heat flux to postulate ignition of cable trays capable of propagating to other secondary combustibles.

Figure 4.11 in "Enclosure Fire Dynamics" (Karlsson & Quintiere, Enclosure Fire Dynamics, CRC Press, 2000) conveniently describes fire generated conditions at and near the flames. This figure consists of a plot of flame and fire plume temperature data forming the basis for the McCaffrey fire plume temperature correlation. These data suggest turbulent flame temperatures in the continuous flame zone in the order of 800 ^{o}C, which is higher than the temperatures identified in NUREG/CR-5384 as necessary for surface flames to develop. This is an indication that fire plume conditions outside the flames may be capable of cable tray ignition.

At the same time, temperatures in the order of 500^{o}C can be experienced in the "intermittent" region of the fire plume, which is the region above the flames where broken flames may extend/exist for brief periods of time. This characterization suggests that cable tray ignition needs to be postulated when cable trays are exposed to either flame impingement, or a region in close proximity (i.e. that could be ignited in bulk per the criteria in Table 1) to the flames. In order to define the specific thermal conditions, a heat balance equation is formulated assuming a critical heat flux for cable tray ignition of 25 kW/m^2 as follows:

$$\dot{q}''_{crit} = \dot{q}''_{rad} + \dot{q}''_{con}$$

Where the critical heat flux includes radiative and convective contribution as the cable tray may be in the fire plume region near the flames. The equation above is expanded as follows:

$$25 = \epsilon\sigma T_{plume}^4 - \epsilon\sigma T_{amb}^4 + h\left(T_{plume} - T_{amb}\right)$$

Where ε is the emissivity assumed as 1.0, σ is the Stefan-Boltzmann constant (5.67E-11 kW/m^{2}K^4), h is the convective heat transfer coefficient assumed as 0.01 kW/m^{2}K (see Chapter 2 NUREG/CR-6931 Vol. 3), T_{amb} is the ambient temperature assumed as 20^{o}C (293 K), and T_{plume} is the plume temperature. Notice that this is the same external heat flux equation used in NUREG/CR-6931 Vol. 3 for the development of the THIEF model. Solving numerically for T_{plume}, a value of 503^{o}C is obtained, which is similar to the values observed in NUREG/CR-5384, discussed earlier in the FAQ, between 500 and 600^{o}C. Conservatively, a temperature criterion of 500^{o}C is selected for cable tray ignition. It is noted that a temperature of this magnitude is typically associated with unpiloted ignition; however, as previously discussed there are significant delays to sustained burning at this level of exposure. Electrical failure of the cable would occur quickly (within 1 minute based on NUREG/CR-6850) and piloted ignition would unreasonably require minutes of active sparking without the intervention of circuit protection.

It can be shown using the Heskestad flame height correlation, the Heskestad virtual origin correction, and the Heskestad plume centerline temperature correlation that the temperature at the flame tip does not exceed 538°C where the ambient temperature does not exceed 46°C (131°F). As the flame tip temperature under these conditions is lower than the minimum temperature needed for either deep seated burning or for surface flame spread, the flame tip location bounds the cable tray ignition zone of influence. The Heskestad flame height correlation is given as follows per Chapter 13 of the *SFPE Handbook of Fire Protection Engineering:*

$$L_f = -1.02D + 0.235\dot{Q}^{2/5}$$

Where L_f is the flame height (m), D is the effective fire diameter (m), and $\dot{Q}$ is the total heat release rate of the ignition source (kW). The Heskestad plume centerline temperature correlation is given as follows per Chapter 13 of the *SFPE Handbook of Fire Protection Engineering*:

$$T_c = T_\infty + 9.1\left(\frac{T_\infty}{g c_p^2 \rho_a^2}\right)^{1/3} Q_c^{2/3} (Z - z_0)^{-5/3}$$

Where g = 9.81 m/s^2, c_p = 1.0 kJ/kg-K, ρ_a = 1.18kg/m^3 and $Q_c = 0.7\dot{Q}$ reduces to:

$$T_c = T_\infty + 3.8{T_\infty}^{1/3} 0.78\dot{Q}^{2/3} (Z - z_0)^{-5/3}$$

Where T_c is the plume centerline temperature (°C) at an elevation Z (m) above the fire base, T_∞, is the initial temperature (°C), and z_0, is the height of the virtual origin below the fire base (m). The virtual origin height is given by the following equation per Chapter 13 of the *SFPE Handbook of Fire Protection Engineering:*

$$z_0 = -1.02D + 0.083\dot{Q}^{2/5}$$

Where all terms have been defined. At the flame tip, the height above the fire origin Z, is equal to the flame height L_f. Combining the equations above results in the following:

$$T_c = T_\infty + 3.8{T_\infty}^{1/3}0.78\dot{Q}^{2/3}(23.1)\dot{Q}^{-2/3} = T_\infty + 69{T_\infty}^{1/3}$$

Where all terms have been defined. The plume centerline temperature is thus independent of both the fire diameter and the heat release rate at the flame tip and is equal to 478°C (892°F) for an ambient temperature of 20°C (68°F). Repeating this derivation for a higher ambient air temperature and a lower density in the Heskestad plume temperature equation, shows that for ambient air temperatures that exceed 46°C (131°F), the plume centerline temperature at the flame tip is no longer bounding as the plume temperature will exceed 532°C at that point.

The methodology for determining cable tray ignition only for trays that are at or below the flame tip location has been reviewed by the staff as part of ADAMS Accession No. ML14135A395 and ML14073A053. The methodology was explicitly approved for use in ADAMS Accession No. ML15344A346 and ML14308A048.

Implementation

The cable damage/ignition criteria are applicable for determining if cables are postulated damaged or ignited in the Fire PRA. The criteria in this FAQ however are recommended for determining bulk cable/tray ignition and propagation to secondary combustibles. The time to cable damage or cable ignition can be calculated with currently available fire modeling tools. For cases where cables in trays are exposed to cable damage/ignition criteria, all the cables in the trays will be assumed damaged and ignited. Under this assumption, cable ignition means that sparks generated from shorts can start a localized fire that will not immediately spread through a cable tray leading to flame propagation and bulk cable/tray ignition.

The bulk cable/tray ignition criteria should be used for determining if bulk cable/tray ignition, and subsequent fire propagation is possible. In addition,

- Direct flame impingement will generate conditions that meet the criteria for cable tray ignition and fire propagation.
- Fire plume, flame radiation, and hot gas layer conditions at the location of the cable trays need to be evaluated using fire modeling tools to determine if the criteria for cable tray ignition are exceeded. Cables exposed to the cable damage/ignition

criteria are assumed failed regardless of location within a cable tray or conduit arrangement.

- No bulk cable/tray ignition would be postulated for qualified cables protected by solid bottom cable trays for both open and obstructed fires. Consistently, the guidance in Appendix Q of NUREG/CR-6850 associated with solid bottom trays is not affected by the information in this FAQ.
- The guidance provided in Section R.4.2.2 of NUREG/CR-6850 would still be used to determine the timing of cable tray ignition above the first cable tray and fire propagation to adjacent trays once the lowest tray is ignited, unless additional fire modeling can show those fire conditions at the location of the cable trays do not meet the cable tray ignition criteria.

If appropriate, provide proposed rewording of guidance for inclusion in the next Revision:

Revisions to NUREG/CR-6850

<u>In Section 8.5.1.2</u>

Replace: "For cables, the ignition and damage criteria can be assumed to be the same."

With: " For cables, the ignition and damage criteria can be assumed to be the same. Additional criteria is available for determining cable tray ignition to support fire propagation through cable tray arrangements."

Replace: "More detail on damage criteria is provided in Appendix H."

With: "More detail on cable damage and ignition as well as cable tray ignition is provided in Appendix H."

Replace: Table 8-2 with:

Table 8-2

	Bounding Cable Damage/Ignition Criteria		Bulk Cable/Tray Ignition Criteria*	
Cable Type	Radiant Heating	Temperature	Radiant Heating	Temperature
Thermoplastic	6 kW/m^2	205°C	25 kW/m^2	500˚C
Thermoset	11 kW/m^2	330°C		

* Alternatively, per the approved regulatory precedent (ADAMS Accession No. ML15344A346 and ML14308A048), bulk cable/tray ignition need only be assumed when the tray is subject to flame impingement. Use of the flame impingement alternative is also only acceptable for locations with an ambient temperature of 46˚C or less. Bulk/Cable Tray Ignition assumes the bulk of cable insulation within the cable tray

is ignited and contributes to the heat release rate as a secondary combustible for room heating (e.g. hot gas layer temperature calculations) calculations. In cases, where the alternative criteria of flame impingement is not used and the radiant heat or temperature thresholds are reached or exceeded bulk cable/tray ignition occurs. Below these criteria, ignition is assumed to be localized and is not contributing to the overall heat release rate within the compartment.

In Appendix H

Replace: "For cables, the ignition and damage criteria will be assumed to be the same."

With: "For cables, the damage criteria may be assumed for both damage and ignition, or separate criteria may be used for cable tray ignition and damage."

Replace: Table H-1 with:

Table H-1

	Bounding Cable Damage/Ignition Criteria		Bulk Cable/Tray Ignition Criteria*	
Cable Type	Radiant Heating	Temperature	Radiant Heating	Temperature
Thermoplastic	6 kW/m^2	205°C	25 kW/m^2	500˚C
Thermoset	11 kW/m^2	330°C		

* Alternatively, per the approved regulatory precedent (ADAMS Accession No. ML15344A346 and ML14308A048), bulk cable/tray ignition need only be assumed when the tray is subject to flame impingement. Use of the flame impingement alternative is also only acceptable for locations with an ambient temperature of 46˚C or less. Bulk/Cable Tray Ignition assumes the bulk of cable insulation within the cable tray is ignited and contributes to the heat release rate as a secondary combustible for room heating (e.g. hot gas layer temperature calculations) calculations. In cases, where the alternative criteria of flame impingement is not used and the radiant heat or temperature thresholds are reached or exceeded bulk cable/tray ignition occurs. Below these criteria, ignition is assumed to be localized and is not contributing to the overall heat release rate within the compartment.

In R.2

Replace: "If trays are stacked, calculate the flame height, plume temperature, and heat flux at the height of the above tray. Assume ignition of the above tray if it is immersed in flames, or the plume temperature or heat flux are higher than the levels required for ignition."

With: "If trays are stacked, calculate the flame height, plume temperature, and heat flux at the height of the above tray. Assume cable tray ignition and fire propagation if it is immersed in flames, or, alternatively, if the plume temperature or heat flux are higher than the levels required for cable tray ignition."

FAQ Number 16-0011 **FAQ Revision** 1

FAQ Title **Cable Tray Ignition**

In R.4.1.1

For the material properties for PVC cables,

Replace: T_{ig} = 218˚C

With: T_{ig} = 205˚C for the purposes of flame spread calculations within one cable tray (i.e., no propagation through different cable trays). See Table 8-2 or H-1 for criteria on full cable tray ignition.

For the material properties for XPE cables are:

Replace: T_{ig} = 330˚C

With: T_{ig} = 330˚C for the purposes of flame spread calculations within one cable tray (i.e., no propagation through different cable trays). See Table 8-2 or H-1 for criteria on full cable tray ignition.

In Table R-2

For Ignition temperature[C]

Replace: 330

With: 330. See Table 8-2 or H-1 for criteria on bulk/cable tray ignition. .

In Table R-3

For Ignition temperature[C]

Replace: 205

With: 205. See Table 8-2 or H-1 for criteria on bulk cable/tray ignition.

In R.4.2.2

Replace: "Exposure source to first tray: tray ignites at time to damage/ignition using the plume temperature correlation"

With: "Exposure source to first tray: cables are damaged or ignited at time to damage using the plume temperature correlation. Bulk cable/tray ignition for propagation up the stack at flame immersion or, alternatively, the plume temperature or heat flux are higher than the levels required for cable tray ignition."

===