**NRC INSPECTION MANUAL** APOB

INSPECTION MANUAL CHAPTER 0609 APPENDIX F ATTACHMENT 8

TABLES AND PLOTS SUPPORTING THE  
PHASE 2 RISK QUANTIFICATION

Effective Date: January 1, 2025

# TABLE OF CONTENTS

Overview of Attachment 8 1

Table/Plot Set A: Vertical and Radial 98th Percentile Heat Release Rate (HRR) Zone of Influence (ZOI) A-1 to A‑17

Table/Plot Set B: Minimum HRR to Create a Damaging Hot Gas Layer (HGL) B-1 to B‑5

Table/Plot Set C: HRR Profiles of Fires Involving Horizontal Cable Trays C-1 to C‑72

Table/Plot Set D: Vertical ZOI and Corresponding Damage Time versus Severity Factor (SF) D‑1 to D‑18

Table/Plot Set E: Radial ZOI and Corresponding Damage Time versus SF E‑1 to E‑18

Table/Plot Set F: Detector Actuation and Sprinkler Activation Times F-1 to F‑70

# Overview of Attachment 8

This attachment consists of a collection of tables and plots that are used in support of a Phase 2 assessment. Various Fire Dynamics Tools (FDTs) from NUREG‑1805 and a new method to calculate the time needed to heat a cable target to damage or ignition referred to as the “heat soak method” were used to generate the data that are presented in the tables and plots. To automate the process, the FDT calculations were implemented in a series of spreadsheets. The assumptions and background for these calculations is discussed in Section 06.03 of IMC 0308, Attachment 3, Appendix F.

A total of five sets of tables and plots (labeled A-F) were developed. The sets are briefly described below.

Table/Plot Set A - Vertical and Radial 98th Percentile Heat Release Rate (HRR) Zone of Influence (ZOI):

Table/Plot set A provides the vertical and radial 98th percentile HRR ZOI for fixed and transient ignition sources, and for confined liquid fuel pool fires and unconfined liquid fuel spill fires. It is used to screen ignition sources that cannot cause damage to various targets ((i.e., thermoset (TS) cables, thermoplastic (TP) cables, and sensitive electronics (SE)) in the fire area and that are not capable of causing fire to spread to secondary combustibles (Step 2.3.2), and to identify the damaged target set for a specified FDS 1 scenario (Step 2.5.1).

Table/Plot Set B - Minimum HRR to Create a Damaging Hot Gas Layer (HGL):

Table/Plot set B provides the minimum HRR that is needed to create damaging HGL conditions for a range of compartment sizes and different target types. It is used to screen ignition sources that are not capable of generating a damaging HGL (Step 2.3.3), and to identify scenarios involving secondary combustibles that can cause development of a damaging HGL in the fire area (Step 2.5.2). The heat soak method was not used in the development of table/plot set B, i.e., a cable is assumed damaged without delay when the plume temperature surrounding the cable or the incident radiant heat flux reaches the damage threshold. Consequently, the minimum HRR to create a damaging HGL given in the tables and plots in set B is lower than if the minimum HRR for the same target type and identical floor area and ceiling height had been calculated using the heat soak method.

Table/Plot Set C - HRR Profiles of Fires Involving Horizontal Cable Trays:

Table/Plot set C provides the combined HRR of an ignition source and a vertical stack of between one and seven horizontal cable trays as a function of time for various ignition source-cable tray configurations. This set is used in conjunction with table/plot set B to determine if and when a fire scenario involving secondary combustibles will cause a damaging HGL in the fire area (Step 2.5.2). The heat soak method was not used in the development of table/plot set C.

Table/Plot Set D - Vertical ZOI and Corresponding Damage Time versus Severity Factor (SF):

Table/Plot set D is used to conservatively estimate the SF for a target or secondary combustible located within the 98th percentile HRR vertical ZOI based on its elevation above the ignition source (Step 2.6.1). To develop table/plot set D, calculations were performed to determine the highest elevation at which a target will be damaged or a secondary combustible will ignite when exposed in the plume of an ignition source fire whose HRR profile corresponds to a specified SF. This elevation is referred to as the vertical ZOI for the specified SF and corresponding HRR profile. Each table and plot provides the elevations corresponding to SFs ranging from 0.02 to 0.75 for one of the fixed or transient ignition sources listed in Attachment 5, located either in the open or in a corner. Table/Plot Set D also provides the time at which the target will be damaged or will ignite. This time is used in the calculation of the non-suppression probability (NSP) (Step 2.7.1).

Table/Plot Set E - Radial ZOI and Corresponding Damage Time versus SF:

Table/Plot set E is used to conservatively estimate the SF for a target or secondary combustible located within the radial ZOI for the 98th percentile HRR, based on its distance from the ignition source (Step 2.6.1). To develop table/plot set E, calculations were performed to determine the longest radial distance at which a target will be damaged or a secondary combustible will ignite when exposed to the thermal radiation from an ignition source fire whose HRR profile corresponds to a specified SF. Each table and plot provides the radial distances corresponding to SFs ranging from 0.02 to 0.75 for one of the fixed or transient ignition sources listed in Attachment 5. Table/Plot Set E also provides the time at which the target will be damaged or will ignite. This time is used in the calculation of the NSP (Step 2.7.1).

Table/Plot Set F - Detector Actuation and Sprinkler Activation Times:

Table/Plot set F consists of three subsets of tables:

* Tables to determine smoke detector actuation time as a function of the ceiling height above the fire and the radial distance between the detector and the fire (Step 2.7.2).
* Tables to determine sprinkler activation time for fixed and transient ignition source fires as a function of the ceiling height above the fire and the radial distance between the sprinkler head and the fire (Step 2.7.3).
* Tables to estimate sprinkler activation time for fires with an unknown HRR profile as a function of the ceiling height above the fire and the radial distance between the sprinkler head and the fire (Step 2.7.3).

# Table/Plot Set A VERTICAL AND RADIAL 98th PERCENTILE HRR ZOI

TABLE OF CONTENTS

Table/Plot Set A: Overview and Assumptions A-2

Table A.01: 98th Percentile ZOIs for Electrical Enclosures A-4

Table A.02: 98th Percentile ZOIs for Motors, Dry Transformers and Transients A-4

Figure A.01: Minimum Volume of Liquid Fuel Spill to Cover a Specified Area A-5

Figure A.02: Vertical ZOI of Confined Diesel Fuel and Fuel Oil Pool Fires A-6

Figure A.03: Vertical ZOI of Confined Lube and Mineral Oil Pool Fires A-7

Figure A.04: Vertical ZOI of Confined Silicone Fluid Pool Fires A-8

Figure A.05: Radial ZOI of Confined Diesel Fuel and Fuel Oil Pool Fires A-9

Figure A.06: Radial ZOI of Confined Lube and Mineral Oil Pool Fires A-10

Figure A.07: Radial ZOI of Confined Silicone Fluid Pool Fires A-11

Figure A.08: Vertical ZOI of Unconfined Diesel Fuel and Fuel Oil Spill Fires A-12

Figure A.09: Vertical ZOI of Unconfined Lube and Mineral Oil Spill Fires A-13

Figure A.10: Vertical ZOI of Unconfined Silicone Fluid Spill Fires A-14

Figure A.11: Radial ZOI of Unconfined Diesel Fuel and Fuel Oil Spill Fires A-15

Figure A.12: Radial ZOI of Unconfined Lube and Mineral Oil Spill Fires A-16

Figure A.13: Radial ZOI of Unconfined Silicone Fluid Spill Fires A-17

## Table/Plot Set A: Overview and Assumptions

Table/Plot set A provides the vertical and radial ZOI for fixed and transient ignition sources, and for confined liquid fuel pool fires and unconfined liquid fuel spill fires. It is used to screen ignition sources that cannot cause damage to various targets the fire area and that are not capable of causing fire to spread to secondary combustibles (Step 2.3.2), and to identify the damaged target set for a specified FDS 1 scenario (Step 2.5.1).

The assumptions and background for the calculations performed to develop the tables and plots in set A are discussed in Section 06.03.01 of IMC 0308, Attachment 3, Appendix F. The principal assumptions are as follows:

1. Ambient air properties: It is assumed that Ta = 77°F. This is the default value in FDT 9.
2. Convective part of the HRR,: A convective fraction () of 0.70 is assumed, which is representative of transient fires and conservative for cable fires. This is the default value in FDT 9.
3. Radiative part of the HRR, : The radiative part of the HRR is equal to , where is the radiative fraction, and is the HRR. Theoretically the sum of the convective and radiative fractions is equal to one, implying that should be equal to 0.3 because  = 0.7.
4. HRR, : Ignition source screening for fixed and transient ignition sources is based on the 98th percentile of the peak HRR, as recommended in the following sources:
   * 1. Electrical Enclosures: Table 7-1 in NUREG-2178, Vol. 1
     2. Motors: Table 8-1 in NUREG-2178, Vol. 2
     3. Dry Transformers: Table 8-1 in NUREG-2178, Vol. 2
     4. Generic Transients: Table 8-1 in NUREG-2233
     5. Transient Combustible Control Location (TCCL) Transients: Table 8-2 in NUREG-2233

The HRR profile parameters were obtained from the following sources:

* + 1. Electrical Enclosures: Section 7-3 in NUREG-2230.
    2. Motors: Section 8.3.1 in NUREG-2178, Vol. 2
    3. Dry Transformers: Section 8.3.2 in NUREG-2178, Vol. 2
    4. Generic Transients: Table 8-3 in NUREG-2233
    5. TCCL Transients: Table 8-4 in NUREG-2233

The 98th percentile peak HRRs for fixed and transient ignition sources are also given in Table A5.1 in Attachment 5. The 98th percentile ZOIs for electrical enclosures are given in Table A.01. The 98th percentile ZOIs for motors, dry transformers and transient combustibles can be found in Table A.02. Tables and plots were also developed that show the ZOI as a function of fire diameter for confined pool fires involving selected liquid fuels. Similar tables and plots were developed for unconfined spill fires that show the ZOI as a function of the volume of the fuel spill.

1. Fire diameter, D: The fire diameter of electrical enclosures is determined based on the assumption that the Froude number is equal to one. This assumption leads to reasonably conservative (i.e., small) fire diameters, as shown in Table 6.3.5 of IMC 0308, Attachment 3, Appendix F. For motors and dry transformers, the diameter is determined based on the applicable Froude number in NUREG‑2178 Vol. 2. For transient combustibles the diameter is calculated based on the Froude number for transients in NUREG‑2233. The process to determine the diameter as a function of time involves two steps. In the first step, the maximum diameter was determined during the peak burning period from the peak HRR and the Froude number for the ignition source. In the second step, the maximum diameter was used to calculate the HRR per unit area (HRRPUA) during the peak burning period and then the diameter at time t during the growth and decay stages was determined from the HRR at time t based on the assumption the HRRPUA is constant for the entire profile.
2. Fire elevation (z = 0): The following guidance is used to determine the elevation of the fire base:
   1. For closed top electrical enclosures (i.e., enclosures without horizontal top vents or openings), the fire base is placed at 1 ft. below the top of the enclosure as determined from a walkdown. For electrical enclosures not sealed at the top, the fire base is placed at the top of the enclosure.
   2. For motors and dry transformers, the fire base is determined from a walkdown following the guidance provided in NUREG‑2178, Vol. 2.
   3. For transients, a height of 0.5 ft. is recommended, and the fire base is at the top.
   4. Confined liquid pool fires and unconfined liquid spill fires are placed on the floor.
3. Fire location effects: Vertical ZOI tables and plots for fixed and transient ignition sources were developed for fires away (> 2 ft.) from walls and corners (referred to as “free-burn” or “open”), and for fires within 2 ft. of a corner.

Table A.01: 98th Percentile ZOIs for Electrical Enclosures.



Table A.02: 98th Percentile ZOIs for Motors, Dry Transformers and Transient Combustibles.



|  |
| --- |
|  |
| Figure A.01**:** Minimum Volume of a Liquid Fuel Spill to Cover a Specified Area |

|  |
| --- |
|  |
| Figure A.02: Vertical ZOI of Confined Diesel Fuel and Fuel Oil Pool Fires |

|  |
| --- |
|  |
| Figure A.03: Vertical ZOI of Confined Lube and Mineral Oil Pool Fires |

|  |
| --- |
|  |
| Figure A.04: Vertical ZOI of Confined Silicone Liquid Pool Fires |

|  |
| --- |
|  |
| Figure A.05: Radial ZOI of Confined Diesel Fuel and Fuel Oil Pool Fires |

|  |
| --- |
|  |
| Figure A.06: Radial ZOI of Confined Lube and Mineral Oil Pool Fires |

|  |
| --- |
|  |
| Figure A.07: Radial ZOI of Confined Silicone Liquid Pool Fires |

|  |
| --- |
|  |
| Figure A.08: Vertical ZOI of Unconfined Diesel Fuel and Fuel Oil Spill Fires |

|  |
| --- |
|  |
| Figure A.09: Vertical ZOI of Unconfined Lube and Mineral Oil Spill Fires |

|  |
| --- |
|  |
| Figure A.10: Vertical ZOI of Unconfined Silicone Liquid Spill Fires |

|  |
| --- |
|  |
| Figure A.11: Radial ZOI of Unconfined Diesel Fuel and Fuel Oil Spill Fires |

|  |
| --- |
|  |
| Figure A.12: Radial ZOI of Unconfined Lube and Mineral Oil Spill Fires |

|  |
| --- |
|  |
| Figure A.13: Radial ZOI of Unconfined Silicone Liquid Spill Fires |

# Table/Plot Set B MINIMUM HRR TO CREATE A DAMAGING HGL

TABLE OF CONTENTS

Table/Plot Set B: Overview and Assumptions B-2

Figure B.01: Minimum HRR to Create a Damaging HGL (TS Targets) B-3

Figure B.02: Minimum HRR to Create a Damaging HGL (TP Targets) B-4

Figure B.03: Minimum HRR to Create a Damaging HGL (SE Targets) B-5

## Table/Plot Set B: Overview and Assumptions

Table/Plot set B provides the minimum HRR that is needed to create damaging HGL conditions for a range of compartment sizes and different target types. It is used to screen ignition sources that are not capable of generating a damaging HGL (Step 2.3.3), and to identify scenarios involving secondary combustibles that can cause development of a damaging HGL in the fire area (Step 2.5.2).

The heat soak method was not used in the development of table/plot set B; therefore, a cable is assumed damaged without delay when the plume temperature surrounding the cable or the incident radiant heat flux reaches the damage threshold.

The assumptions and background for the calculations performed to develop the tables and plots in set B are discussed in Section 06.03.02 of IMC 0308, Attachment 3, Appendix F. The principal assumptions are as follows:

1. An important assumption is that the compartment has openings that are large enough to allow sufficient ventilation to support the fire, which justifies the use of the method of McCaffrey, Quintiere, and Harkleroad (MQH) to calculate the HGL temperature over the methods for closed and mechanically-vented compartments that are described in Chapter 2 of NUREG-1805. In addition, the opening is assumed to be a standard 3 ft. wide, 7‑ft. high open doorway. Several plants transitioning to NFPA 805 made the same assumptions, and the NRC’s review of license amendment requests (LARs) submitted by these plants concluded that these assumptions and the use of the MQH method are acceptable.
2. The ambient air temperature, Ta, is assumed to be 77°F.
3. The minimum HRR to create damaging HGL conditions was calculated for floor areas ranging from 100 to 4900 ft2, and ceiling heights between 10 and 30 ft. It is unlikely that a HGL can develop in a compartment with a floor area and ceiling height outside the upper limit of those ranges.
4. The compartment boundaries (floor, walls, and ceiling) are assumed to be constructed of concrete with thermal properties taken from Table 2‑3 in NUREG‑1805, and a thickness of 1 ft.
5. The heat transfer coefficient, hT, (see Equation 26 in Section 06.03.02 of IMC 0308, Attachment 3, Appendix F) is calculated at t = 1800 s. This is conservative because, for 1 ft.-thick concrete boundaries, hT decreases as a function of time, and the minimum HRR to cause a damaging HGL is usually reached before 30 minutes have elapsed.

|  |
| --- |
|  |
| Figure B.01: Minimum HRR to Create a Damaging HGL (TS Targets) |
|  |

|  |
| --- |
|  |
| Figure B.02: Minimum HRR to Create a Damaging HGL (TP Targets) |
|  |

|  |
| --- |
|  |
| Figure B.03: Minimum HRR to Create a Damaging HGL (SE Targets) |

# Table/Plot Set C HRR PROFILES OF FIRES INVOLVING HORIZONTAL CABLE TRAYS

TABLE OF CONTENTS

Table/Plot Set C: Overview and Assumptions C-4

Figure C.01.a: Table of HRRs of 1.5 ft. Cable Tray Fires C-5

Figure C.01.b: HRR Plots of 1.5 ft. TS Cable Tray Fires C-6

Figure C.01.c: HRR Plots of 1.5 ft. TP Cable Tray Fires C-6

Figure C.02.a: Table of HRRs of 3.0 ft. Cable Tray Fires C-7

Figure C.02.b: HRR Plots of 3.0 ft. TS Cable Tray Fires C-8

Figure C.02.c: HRR Plots of 3.0 ft. TP Cable Tray Fires C-8

Figure C.03.a: Table of HRRs of Class A Motor & 1.5 ft. Cable Tray Fires C-9

Figure C.03.b: HRR Plots of Class A Motor & 1.5 ft. TS Cable Tray Fires C-10

Figure C.03.c: HRR Plots of Class A Motor & 1.5 ft. TP Cable Tray Fires C-10

Figure C.04.a: Table of HRRs of Class A Motor & 3.0 ft. Cable Tray Fires C-11

Figure C.04.b: HRR Plots of Class A Motor & 3.0 ft. TS Cable Tray Fires C-12

Figure C.04.c: HRR Plots of Class A Motor & 3.0 ft. TP Cable Tray Fires C-12

Figure C.05.a: Table of HRRs of Class B Motor & 1.5 ft. Cable Tray Fires C-13

Figure C.05.b: HRR Plots of Class B Motor & 1.5 ft. TS Cable Tray Fires C-14

Figure C.05.c: HRR Plots of Class B Motor & 1.5 ft. TP Cable Tray Fires C-14

Figure C.06.a: Table of HRRs of Class B Motor & 3.0 ft. Cable Tray Fires C-15

Figure C.06.b: HRR Plots of Class B Motor & 3.0 ft. TS Cable Tray Fires C-16

Figure C.06.c: HRR Plots of Class B Motor & 3.0 ft. TP Cable Tray Fires C-16

Figure C.07.a: Table of HRRs of Class C Motor & 1.5 ft. Cable Tray Fires C-17

Figure C.07.b: HRR Plots of Class C Motor & 1.5 ft. TS Cable Tray Fires C-18

Figure C.07.c: HRR Plots of Class C Motor & 1.5 ft. TP Cable Tray Fires C-18

Figure C.08.a: Table of HRRs of Class C Motor & 3.0 ft. Cable Tray Fires C-19

Figure C.08.b: HRR Plots of Class C Motor & 3.0 ft. TS Cable Tray Fires C-20

Figure C.08.c: HRR Plots of Class C Motor & 3.0 ft. TP Cable Tray Fires C-20

Figure C.09.a: Table of HRRs of Class A Dry Transformer & 1.5 ft. Cable Tray Fires C-21

Figure C.09.b: HRR Plots of Class A Dry Transformer & 1.5 ft. TS Cable Tray Fires C-22

Figure C.09.c: HRR Plots of Class A Dry Transformer & 1.5 ft. TP Cable Tray Fires C-22

Figure C.10.a: Table of HRRs of Class A Dry Transformer & 3.0 ft. Cable Tray Fires C-23

Figure C.10.b: HRR Plots of Class A Dry Transformer & 3.0 ft. TS Cable Tray Fires C-24

Figure C.10.c: HRR Plots of Class A Dry Transformer & 3.0 ft. TP Cable Tray Fires C-24

Figure C.11.a: Table of HRRs of Class B Dry Transformer & 1.5 ft. Cable Tray Fires C-25

Figure C.11.b: HRR Plots of Class B Dry Transformer & 1.5 ft. TS Cable Tray Fires C-26

Figure C.11.c: HRR Plots of Class B Dry Transformer & 1.5 ft. TP Cable Tray Fires C-26

Figure C.12.a: Table of HRRs of Class B Dry Transformer & 3.0 ft. Cable Tray Fires C-27

Figure C.12.b: HRR Plots of Class B Dry Transformer & 3.0 ft. TS Cable Tray Fires C-28

Figure C.12.c: HRR Plots of Class B Dry Transformer & 3.0 ft. TP Cable Tray Fires C-28

Figure C.13.a: Table of HRRs of Class C Dry Transformer & 1.5 ft. Cable Tray Fires C-29

Figure C.13.b: HRR Plots of Class C Dry Transformer & 1.5 ft. TS Cable Tray Fires C-30

Figure C.13.c: HRR Plots of Class C Dry Transformer & 1.5 ft. TP Cable Tray Fires C-30

Figure C.14.a: Table of HRRs of Class C Dry Transformer & 3.0 ft. Cable Tray Fires C-31

Figure C.14.b: HRR Plots of Class C Dry Transformer & 3.0 ft. TS Cable Tray Fires C-32

Figure C.14.c: HRR Plots of Class C Dry Transformer & 3.0 ft. TP Cable Tray Fires C-32

Figure C.15.a: Table of HRRs of Generic Transient & 1.5 ft. Cable Tray Fires C-33

Figure C.15.b: HRR Plots of Generic Transient & 1.5 ft. TS Cable Tray Fires C-34

Figure C.15.c: HRR Plots of Generic Transient & 1.5 ft. TP Cable Tray Fires C-34

Figure C.16.a: Table of HRRs of Generic Transient & 3.0 ft. Cable Tray Fires C-35

Figure C.16.b: HRR Plots of Generic Transient & 3.0 ft. TS Cable Tray Fires C-36

Figure C.16.c: HRR Plots of Generic Transient & 3.0 ft. TP Cable Tray Fires C-36

Figure C.17.a: Table of HRRs of TCCL Transient & 1.5 ft. Cable Tray Fires C-37

Figure C.17.b: HRR Plots of TCCL Transient & 1.5 ft. TS Cable Tray Fires C-38

Figure C.17.c: HRR Plots of TCCL Transient & 1.5 ft. TP Cable Tray Fires C-38

Figure C.18.a: Table of HRRs of TCCL Transient & 3.0 ft. Cable Tray Fires C-39

Figure C.18.b: HRR Plots of TCCL Transient & 3.0 ft. TS Cable Tray Fires C-40

Figure C.18.c: HRR Plots of TCCL Transient & 3.0 ft. TP Cable Tray Fires C-40

Figure C.19.a: Table of HRRs of SWGR/LC & 1.5 ft. Cable Tray Fires C-41

Figure C.19.b: HRR Plots of SWGR/LC & 1.5 ft. TS Cable Tray Fires C-42

Figure C.19.c: HRR Plots of SWGR/LC & 1.5 ft. TP Cable Tray Fires C-42

Figure C.20.a: Table of HRRs of SWGR/LC & 3.0 ft. Cable Tray Fires C-43

Figure C.20.b: HRR Plots of SWGR/LC & 3.0 ft. TS Cable Tray Fires C-44

Figure C.20.c: HRR Plots of SWGR/LC & 3.0 ft. TP Cable Tray Fires C-44

Figure C.21.a: Table of HRRs of MCC/BC & 1.5 ft. Cable Tray Fires C-45

Figure C.21.b: HRR Plots of MCC/BC & 1.5 ft. TS Cable Tray Fires C-46

Figure C.21.c: HRR Plots of MCC/BC & 1.5 ft. TP Cable Tray Fires C-46

Figure C.22.a: Table of HRRs of MCC/BC & 3.0 ft. Cable Tray Fires C-47

Figure C.22.b: HRR Plots of MCC/BC & 3.0 ft. TS Cable Tray Fires C-48

Figure C.22.c: HRR Plots of MCC/BC & 3.0 ft. TP Cable Tray Fires C-48

Figure C.23.a: Table of HRRs of Power Inverter & 1.5 ft. Cable Tray Fires C-49

Figure C.23.b: HRR Plots of Power Inverter & 1.5 ft. TS Cable Tray Fires C-50

Figure C.23.c: HRR Plots of Power Inverter & 1.5 ft. TP Cable Tray Fires C-50

Figure C.24.a: Table of HRRs of Power Inverter & 3.0 ft. Cable Tray Fires C-51

Figure C.24.b: HRR Plots of Power Inverter & 3.0 ft. TS Cable Tray Fires C-52

Figure C.24.c: HRR Plots of Power Inverter & 3.0 ft. TP Cable Tray Fires C-52

Figure C.25.a: Table of HRRs of Closed Large Enclosure & 1.5 ft. Cable Tray Fires C-53

Figure C.25.b: HRR Plots of Closed Large Enclosure & 1.5 ft. TS Cable Tray Fires C-54

Figure C.25.c: HRR Plots of Closed Large Enclosure & 1.5 ft. TP Cable Tray Fires C-54

Figure C.26.a: Table of HRRs of Closed Large Enclosure & 3.0 ft. Cable Tray Fires C-55

Figure C.26.b: HRR Plots of Closed Large Enclosure & 3.0 ft. TS Cable Tray Fires C-56

Figure C.26.c: HRR Plots of Closed Large Enclosure & 3.0 ft. TP Cable Tray Fires C-56

Figure C.27.a: Table of HRRs of Open Large Enclosure & 1.5 ft. Cable Tray Fires C-57

Figure C.27.b: HRR Plots of Open Large Enclosure & 1.5 ft. TS Cable Tray Fires C-58

Figure C.27.c: HRR Plots of Open Large Enclosure & 1.5 ft. TP Cable Tray Fires C-58

Figure C.28.a: Table of HRRs of Open Large Enclosure & 3.0 ft. Cable Tray Fires C-59

Figure C.28.b: HRR Plots of Open Large Enclosure & 3.0 ft. TS Cable Tray Fires C-60

Figure C.28.c: HRR Plots of Open Large Enclosure & 3.0 ft. TP Cable Tray Fires C-60

Figure C.29.a: Table of HRRs of Closed Medium Enclosure & 1.5 ft. Cable Tray Fires C-61

Figure C.29.b: HRR Plots of Closed Medium Enclosure & 1.5 ft. TS Cable Tray Fires C-62

Figure C.29.c: HRR Plots of Closed Medium Enclosure & 1.5 ft. TP Cable Tray Fires C-62

Figure C.30.a: Table of HRRs of Closed Medium Enclosure & 3.0 ft. Cable Tray Fires C-63

Figure C.30.b: HRR Plots of Closed Medium Enclosure & 3.0 ft. TS Cable Tray Fires C-64

Figure C.30.c: HRR Plots of Closed Medium Enclosure & 3.0 ft. TP Cable Tray Fires C-64

Figure C.31.a: Table of HRRs of Open Medium Enclosure & 1.5 ft. Cable Tray Fires C-65

Figure C.31.b: HRR Plots of Open Medium Enclosure & 1.5 ft. TS Cable Tray Fires C-66

Figure C.31.c: HRR Plots of Open Medium Enclosure & 1.5 ft. TP Cable Tray Fires C-66

Figure C.32.a: Table of HRRs of Open Medium Enclosure & 3.0 ft. Cable Tray Fires C-67

Figure C.32.b: HRR Plots of Open Medium Enclosure & 3.0 ft. TS Cable Tray Fires C-68

Figure C.32.c: HRR Plots of Open Medium Enclosure & 3.0 ft. TP Cable Tray Fires C-68

Figure C.33.a: Table of HRRs of Small Enclosure & 1.5 ft. Cable Tray Fires C-69

Figure C.33.b: HRR Plots of Small Enclosure & 1.5 ft. TS Cable Tray Fires C-70

Figure C.33.c: HRR Plots of Small Enclosure & 1.5 ft. TP Cable Tray Fires C-70

Figure C.34.a: Table of HRRs of Small Enclosure & 3.0 ft. Cable Tray Fires C-71

Figure C.34.b: HRR Plots of Small Enclosure & 3.0 ft. TS Cable Tray Fires C-72

Figure C.34.c: HRR Plots of Small Enclosure & 3.0 ft. TP Cable Tray Fires C-72

## Table/Plot Set C: Overview and Assumptions

Table/Plot set C provides the combined HRR of an ignition source and a vertical stack of between one and seven horizontal cable trays as a function of time for various ignition source‑cable tray configurations. This set is used in conjunction with table/plot set B to determine if and when a fire scenario involving secondary combustibles will cause a damaging HGL in the fire area (Step 2.5.2).

The assumptions and background for the calculations performed to develop the tables and plots in set C are discussed in Section 06.03.03 of IMC 0308, Attachment 3, Appendix F. The principal assumptions are as follows:

1. The FLASH-CAT model was used to calculate the HRR of vertical stacks of horizontal cable trays. The model is described in Chapter 9 of NUREG/CR-7010, Vol. 1, and in Section 06.03.03 of IMC 0308, Attachment 3, Appendix F. The heat soak method was not used in the creation of table/plot set C.
2. The HRR as a function of time for an ignition source in combination with a vertical stack of cable trays was calculated at 1-minute intervals for the following ignition source-cable tray configurations:
   1. Ignition source-cable tray HRR tables and plots were developed for all fixed and transient ignition sources listed in Table A5.1 of Attachment 5.
   2. In addition, HRR tables and plots were developed for cable tray fires without an ignition source. These tables and plots can be used to determine the HRR of cable trays fires that are ignited by a confined liquid fuel pool fire or an unconfined liquid fuel spill fire by adding the HRR of the confined liquid fuel pool fire or unconfined liquid fuel spill fire. The HRRs of confined liquid fuel pool fires and unconfined liquid fuel spill fires are tabulated in table/plot set A.
   3. HRR tables and plots were developed for cable trays widths of 1.5 and 3 ft. The calculated HRR values for 1.5 ft. wide trays can be used for 1 ft. and 2 ft. wide trays. The calculated HRR values for 3.0 ft. wide trays can be used for single trays and multiple trays side-by-side with a total width greater than 2 ft.
   4. The trays were assumed to be 24 ft. long and ignited at the center to ensure that it would take at least one hour for the flame to spread to the end of the trays.
   5. The assumed spacing between trays was 1 ft.
   6. HRR tables and plots were developed for stacks of one through seven trays filled with TS and TP cables. The HRR tables and plots for TS cables can also be used for Kerite cables.
3. The table/plot set C HRRs for TS cables were calculated assuming 75% of the trays are filled with cables that have the characteristics of cable #16 in NUREG/CR-7010, Vol. 1. This cable was chosen because, of all the TS cables that were tested, it results in the highest amount of active polymer in the trays. The tables and plots for TP cables were developed in the assumption that 75% of the trays are filled with cables that have the characteristics of cable #701 in NUREG/CR-7010, Vol. 1, which was the only true TP cable that was tested. The input parameters for the cable tray fire propagation model calculations are given in Section 06.03.03 of IMC 0308, Attachment 3, Appendix F (see Table 6.2.10).

|  |
| --- |
|  |
| Figure C.01.a: Table of HRRs of 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.01.b: HRR Plots of 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.01.c: HRR Plots of 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.02.a: Table of HRRs of 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.02.b: HRR Plots of 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.02.c: HRR Plots of 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.03.a: Table of HRRs of Class A Motor & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.03.b: HRR Plots of Class A Motor & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.03.c: HRR Plots of Class A Motor & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.04.a: Table of HRRs of Class A Motor & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.04.b: HRR Plots of Class A Motor & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.04.c: HRR Plots of Class A Motor & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.05.a: Table of HRRs of Class B Motor & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.05.b: HRR Plots of Class B Motor & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.05.c: HRR Plots of Class B Motor & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.06.a: Table of HRRs of Class B Motor & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.06.b: HRR Plots of Class B Motor & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.06.c: HRR Plots of Class B Motor & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.07.a: Table of HRRs of Class C Motor & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.07.b: HRR Plots of Class C Motor & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.07.c: HRR Plots of Class C Motor & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.08.a: Table of HRRs of Class C Motor & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.08.b: HRR Plots of Class C Motor & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.08.c: HRR Plots of Class C Motor & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.09.a: Table of HRRs of Class A Dry Transformer & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.09.b: HRR Plots of Class A Dry Transformer & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.09.c: HRR Plots of Class A Dry Transformer & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.10.a: Table of HRRs of Class A Dry Transformer & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.10.b: HRR Plots of Class A Dry Transformer & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.10.c: HRR Plots of Class A Dry Transformer & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.11.a: Table of HRRs of Class B Dry Transformer & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.11.b: HRR Plots of Class B Dry Transformer & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.11.c: HRR Plots of Class B Dry Transformer & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.12.a: Table of HRRs of Class B Dry Transformer & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.12.b: HRR Plots of Class B Dry Transformer & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.12.c: HRR Plots of Class B Dry Transformer & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.13.a: Table of HRRs of Class C Dry Transformer & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.13.b: HRR Plots of Class C Dry Transformer & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.13.c: HRR Plots of Class C Dry Transformer & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.14.a: Table of HRRs of Class C Dry Transformer & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.14.b: HRR Plots of Class C Dry Transformer & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.14.c: HRR Plots of Class C Dry Transformer & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.15.a: Table of HRRs of Generic Transient & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.15.b: HRR Plots of Generic Transient & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.15.c: HRR Plots of Generic Transient & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.16.a: Table of HRRs of Generic Transient & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.16.b: HRR Plots of Generic Transient & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.16.c: HRR Plots of Generic Transient & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C17.a: Table of HRRs of TCCL Transient & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.17.b: HRR Plots of TCCL Transient & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.17.c: HRR Plots of TCCL Transient & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.18.a: Table of HRRs of TCCL Transient & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.18.b: HRR Plots of TCCL Transient & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.18.c: HRR Plots of TCCL Transient & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.19.a: Table of HRRs of Switchgear/Load Center & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.19.b: HRR Plots of Switchgear/Load Center & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.19.c: HRR Plots of Switchgear/Load Center & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.20.a: Table of HRRs of Switchgear/Load Center & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.20.b: HRR Plots of Switchgear/Load Center & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.20.c: HRR Plots of Switchgear/Load Center & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.21.a: Table of HRRs of MCC/Battery Charger & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.21.b: HRR Plots of MCC/Battery Charger & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.21.c: HRR Plots of MCC/Battery Charger & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.22.a: Table of HRRs of MCC/Battery Charger & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.22.b: HRR Plots of MCC/Battery Charger & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.22.c: HRR Plots of MCC/Battery Charger & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.23.a: Table of HRRs of Power Inverter & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.23.b: HRR Plots of Power Inverter & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.23.c: HRR Plots of Power Inverter & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.24.a: Table of HRRs of Power Inverter & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.24.b: HRR Plots of Power Inverter & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.24.c: HRR Plots of Power Inverter & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.25.a: Table of HRRs of Closed Large Enclosure & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.25.b: HRR Plots of Closed Large Enclosure & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.25.c: HRR Plots of Closed Large Enclosure & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.26.a: Table of HRRs of Closed Large Enclosure & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.26.b: HRR Plots of Closed Large Enclosure & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.26.c: HRR Plots of Closed Large Enclosure & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.27.a: Table of HRRs of Open Large Enclosure & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.27.b: HRR Plots of Open Large Enclosure & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.27.c: HRR Plots of Open Large Enclosure & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.28.a: Table of HRRs of Open Large Enclosure & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.28.b: HRR Plots of Open Large Enclosure & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.28.c: HRR Plots of Open Large Enclosure & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.29.a: Table of HRRs of Closed Medium Enclosure & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.29.b: HRR Plots of Closed Medium Enclosure & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.29.c: HRR Plots of Closed Medium Enclosure & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.30.a: Table of HRRs of Closed Medium Enclosure & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.30.b: HRR Plots of Closed Medium Enclosure & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.30.c: HRR Plots of Closed Medium Enclosure & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.31.a: Table of HRRs of Open Medium Enclosure & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.31.b: HRR Plots of Open Medium Enclosure & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.31.c: HRR Plots of Open Medium Enclosure & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.32.a: Table of HRRs of Open Medium Enclosure & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.32.b: HRR Plots of Open Medium Enclosure & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.32.c: HRR Plots of Open Medium Enclosure & 3.0 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.33.a: Table of HRRs of Small Enclosure & 1.5 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.33.b: HRR Plots of Small Enclosure & 1.5 ft. TS Cable Tray Fires |
|  |
| Figure C.33.c: HRR Plots of Small Enclosure & 1.5 ft. TP Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.34.a: Table of HRRs of Small Enclosure & 3.0 ft. Cable Tray Fires |

|  |
| --- |
|  |
| Figure C.34.b: HRR Plots of Small Enclosure & 3.0 ft. TS Cable Tray Fires |
|  |
| Figure C.34.c: HRR Plots of Small Enclosure & 3.0 ft. TP Cable Tray Fires |

# Table/Plot Set D VERTICAL ZOI AND CORRESPONDING DAMAGE TIME VERSUS SEVERITY FACTOR

TABLE OF CONTENTS

Table/Plot Set D: Overview and Assumptions D-2

Figure D.01: Vertical ZOI and Damage Time vs. SF for Class A Motors D-3

Figure D.02: Vertical ZOI and Damage Time vs. SF for Class B Motors D-4

Figure D.03: Vertical ZOI and Damage Time vs. SF for Class C Motors D-5

Figure D.04: Vertical ZOI and Damage Time vs. SF for Class A Dry Transformers D-6

Figure D.05: Vertical ZOI and Damage Time vs. SF for Class B Dry Transformers D-7

Figure D.06: Vertical ZOI and Damage Time vs. SF for Class C Dry Transformers D-8

Figure D.07: Vertical ZOI and Damage Time vs. SF for Generic Transients D-9

Figure D.08: Vertical ZOI and Damage Time vs. SF for TCCL Transients D-10

Figure D.09: Vertical ZOI and Damage Time vs. SF for Group 1 Electrical Enclosures D-11

Figure D.10: Vertical ZOI and Damage Time vs. SF for Group 2 Electrical Enclosures D-12

Figure D.11: Vertical ZOI and Damage Time vs. SF for Group 1 Electrical Enclosures D-13

Figure D.12: Vertical ZOI and Damage Time vs. SF for Closed Large Electrical Enclosures D-14

Figure D.13: Vertical ZOI and Damage Time vs. SF for Open Large Electrical Enclosures D‑15

Figure D.14: Vertical ZOI and Damage Time vs. SF for Closed Medium Electrical Enclosures D‑16

Figure D.15: Vertical ZOI and Damage Time vs. SF for Open Medium Electrical Enclosures D‑17

Figure D.16: Vertical ZOI and Damage Time vs. SF for Small Electrical Enclosures D-18

## Table/Plot Set D: Overview and Assumptions

To develop table/plot set D, calculations were performed to determine the highest elevation at which a target will be damaged or a secondary combustible will ignite when exposed in the plume of an ignition source fire whose HRR profile corresponds to a specified SF. This elevation is referred to as the vertical ZOI for the specified SF and corresponding HRR profile. Each table and plot provides the vertical ZOIs corresponding to SFs ranging from 0.02 to 0.75 for one of the fixed or transient ignition sources listed in Attachment 5, located either in the open (free‑burn fire) or in a corner. Table/plot set D is used to conservatively estimate the SF for a target or secondary combustible located within the 98th percentile HRR vertical ZOI based on its elevation above the ignition source (Step 2.6.1).

The tables also provide the time at which the target will be damaged or will ignite. This time is used in the calculation of the NSP (Step 2.7.1).

The assumptions and background for the calculations performed to develop the tables and plots in set D are discussed in Section 06.03.04 of IMC 0308, Attachment 3, Appendix F. Because these calculations were based on FDT 9 and the heat soak method, the same assumptions were made as in the development of the tables and plots for the vertical ZOI of fixed and transient ignition sources in set A.

|  |
| --- |
|  |
| Figure D.01: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class A Motors |

|  |
| --- |
|  |
| Figure D.02: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class B Motors |

|  |
| --- |
|  |
| Figure D.03: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class C Motors |

|  |
| --- |
|  |
| Figure D.04: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class A Dry Transformers |

|  |
| --- |
|  |
| Figure D.05: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class B Dry Transformers |

|  |
| --- |
|  |
| Figure D.06: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class C Dry Transformers |

|  |
| --- |
|  |
| Figure D.07: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Generic Transients |

|  |
| --- |
|  |
| Figure D.08: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| TCCL Transients |

|  |
| --- |
|  |
| Figure D.09: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 1 Electrical Enclosures (Switchgear and Load Centers) |

|  |
| --- |
|  |
| Figure D.10: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 2 Electrical Enclosures (Motor Control Centers and Battery Chargers) |

|  |
| --- |
|  |
| Figure D.11: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 3 Electrical Enclosures (Power Inverters) |

|  |
| --- |
|  |
| Figure D.12: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 4a Electrical Enclosures (Large Enclosures: > 50 ft3) |

|  |
| --- |
|  |
| Figure D.13: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Open Group 4a Electrical Enclosures (Large Enclosures: > 50 ft3) |

|  |
| --- |
|  |
| Figure D.14: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 4b Electrical Enclosures (Medium Enclosures: > 12 ft3 and ≤ 50 ft3) |

|  |
| --- |
|  |
| Figure D.15: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Open Group 4b Electrical Enclosures (Medium Enclosures: > 12 ft3 and ≤ 50 ft3) |

|  |
| --- |
|  |
| Figure D.16: Vertical ZOI and Corresponding Damage Time vs. Severity Factor for |
| Group 4c Electrical Enclosures (Small Enclosures: ≤ 12 ft3) |

# Table/Plot Set E RADIAL ZOI AND CORRESPONDING DAMAGE TIME VERSUS SEVERITY FACTOR

TABLE OF CONTENTS

Table/Plot Set E: Overview and Assumptions E-2

Figure E.01: Radial ZOI and Damage Time vs. SF for Class A Motors E-3

Figure E.02: Radial ZOI and Damage Time vs. SF for Class B Motors E-4

Figure E.03: Radial ZOI and Damage Time vs. SF for Class C Motors E-5

Figure E.04: Radial ZOI and Damage Time vs. SF for Class A Dry Transformers E-6

Figure E.05: Radial ZOI and Damage Time vs. SF for Class B Dry Transformers E-7

Figure E.06: Radial ZOI and Damage Time vs. SF for Class C Dry Transformers E-8

Figure E.07: Radial ZOI and Damage Time vs. SF for Generic Transients E-9

Figure E.08: Radial ZOI and Damage Time vs. SF for TCCL Transients E-10

Figure E.09: Radial ZOI and Damage Time vs. SF for Group 1 Electrical Enclosures E-11

Figure E.10: Radial ZOI and Damage Time vs. SF for Group 2 Electrical Enclosures E-12

Figure E.11: Radial ZOI and Damage Time vs. SF for Group 1 Electrical Enclosures E-13

Figure E.12: Radial ZOI and Damage Time vs. SF for Closed Large Electrical Enclosures E-14

Figure E.13: Radial ZOI and Damage Time vs. SF for Open Large Electrical Enclosures E‑15

Figure E.14: Radial ZOI and Damage Time vs. SF for Closed Medium Electrical Enclosures E‑16

Figure E.15: Radial ZOI and Damage Time vs. SF for Open Medium Electrical Enclosures E-17

Figure E.16: Radial ZOI and Damage Time vs. SF for Small Electrical Enclosures E-18

## Table/Plot Set E: Overview and Assumptions

To develop table/plot set E, calculations were performed to determine the longest radial distance at which a target will be damaged or a secondary combustible will ignite when exposed to the thermal radiation from of an ignition source fire whose HRR profile corresponds to a specified SF. This target distance is referred to as the radial (or horizontal) ZOI for the specified SF and corresponding HRR profile. Each table and plot provides the radial ZOIs corresponding to SFs ranging from 0.02 to 0.75 for one of the fixed or transient ignition sources listed in Attachment 5. Table/plot set E is used to conservatively estimate the SF for a target or secondary combustible located within the radial ZOI for the 98th percentile HRR, based on its distance from the ignition source (Step 2.6.1).

The tables also provide the time at which the target will be damaged or will ignite. This time is used in the calculation of the NSP (Step 2.7.1).

The assumptions and background for the calculations performed to develop the tables and plots in set D are discussed in Section 06.03.05 of IMC 0308, Attachment 3, Appendix F. Because these calculations were based on the adjusted solid flame radiation model and the heat soak method, the same assumptions were made as in the development of the tables and plots for the radial ZOI of fixed and transient ignition sources in set A.

|  |
| --- |
|  |
| Figure E.01: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class A Motors |

|  |
| --- |
|  |
| Figure E.02: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class B Motors |

|  |
| --- |
|  |
| Figure E.03: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class C Motors |

|  |
| --- |
|  |
| Figure E.04: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class A Dry Transformers |

|  |
| --- |
|  |
| Figure E.05: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class B Dry Transformers |

|  |
| --- |
|  |
| Figure E.06: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Class C Dry Transformers |

|  |
| --- |
|  |
| Figure E.07: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Generic Transients |

|  |
| --- |
|  |
| Figure E.08: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| TCCL Transients |

|  |
| --- |
|  |
| Figure E.09: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 1 Electrical Enclosures (Switchgear and Load Centers) |

|  |
| --- |
|  |
| Figure E.10: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 2 Electrical Enclosures (Motor Control Centers and Battery Chargers) |

|  |
| --- |
|  |
| Figure E.11: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 3 Electrical Enclosures (Power Inverters) |

|  |
| --- |
|  |
| Figure E.12: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 4a Electrical Enclosures (Large Enclosures: > 50 ft3) |

|  |
| --- |
|  |
| Figure E.13: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Open Group 4a Electrical Enclosures (Large Enclosures: > 50 ft3) |

|  |
| --- |
|  |
| Figure E.14: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Closed Group 4b Electrical Enclosures (Medium Enclosures: > 12 ft3 and ≤ 50 ft3) |

|  |
| --- |
|  |
| Figure E.15: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Open Group 4b Electrical Enclosures (Medium Enclosures: > 12 ft3 and ≤ 50 ft3) |

|  |
| --- |
|  |
| Figure E.16: Radial ZOI and Corresponding Damage Time vs. Severity Factor for |
| Group 4c Electrical Enclosures (Small Enclosures: ≤ 12 ft3) |

# Table/Plot Set F DETECTOR ACTUATION AND SPRINKLER ACTIVATION TIMES

TABLE OF CONTENTS

Table/Plot Set F: Overview and Assumptions F-3

Figure F.01: Minimum HRR for Detector Actuation vs. H and R (R Range: 0-15 ft.) F-4

Figure F.02: Minimum HRR for Detector Actuation vs. H and R (R Range: 16-30 ft.) F-5

Figure F.03: HRR Growth Profiles for Class A Motors (SF from 0.02 to 0.35) F-6

Figure F.04: HRR Growth Profiles for Class A Motors (SF from 0.40 to 0.75) F-7

Figure F.05: HRR Growth Profiles for Class B Motors (SF from 0.02 to 0.35) F-8

Figure F.06: HRR Growth Profiles for Class B Motors (SF from 0.40 to 0.75) F-9

Figure F.07: HRR Growth Profiles for Class C Motors (SF from 0.02 to 0.35) F-10

Figure F.08: HRR Growth Profiles for Class C Motors (SF from 0.40 to 0.75) F-11

Figure F.09: HRR Growth Profiles for Generic Transients (SF from 0.02 to 0.30) F-12

Figure F.10: HRR Growth Profiles for Generic Transients (SF from 0.35 to 0.65) F-13

Figure F.11: HRR Growth Profiles for TCCL Transients (SF from 0.02 to 0.30) F-14

Figure F.12: HRR Growth Profiles for TCCL Transients (SF from 0.35 to 0.65) F-15

Figure F.13: HRR Growth Profiles for Group 1 Electrical Enclosures (SF from 0.02 to 0.35) F-16

Figure F.14: HRR Growth Profiles for Group 1 Electrical Enclosures (SF from 0.40 to 0.75) F-17

Figure F.15: HRR Growth Profiles for Group 2 Electrical Enclosures (SF from 0.02 to 0.35) F-18

Figure F.16: HRR Growth Profiles for Group 2 Electrical Enclosures (SF from 0.40 to 0.75) F-19

Figure F.17: HRR Growth Profiles for Group 3 Electrical Enclosures (SF from 0.02 to 0.35) F-20

Figure F.18: HRR Growth Profiles for Group 3 Electrical Enclosures (SF from 0.40 to 0.75) F-21

Figure F.19: HRR Growth Profiles for Group 4a Closed Enclosures (SF from 0.02 to 0.35) F-22

Figure F.20: HRR Growth Profiles for Group 4a Closed Enclosures (SF from 0.40 to 0.75) F-23

Figure F.21: HRR Growth Profiles for Group 4a Open Enclosures (SF from 0.02 to 0.35) F-24

Figure F.22: HRR Growth Profiles for Group 4a Open Enclosures (SF from 0.40 to 0.75) F-25

Figure F.23: HRR Growth Profiles for Group 4b Closed Enclosures (SF from 0.02 to 0.35) F-26

Figure F.24: HRR Growth Profiles for Group 4b Closed Enclosures (SF from 0.40 to 0.75) F-27

Figure F.25: HRR Growth Profiles for Group 4b Open Enclosures (SF from 0.02 to 0.35) F-28

Figure F.26: HRR Growth Profiles for Group 4b Open Enclosures (SF from 0.40 to 0.75) F-29

Figure F.27: HRR Growth Profiles for Group 4c Electrical Enclosures (SF from 0.02 to 0.35) F-30

Figure F.28: HRR Growth Profiles for Group 4c Electrical Enclosures (SF from 0.40 to 0.75) F-31

Figure F.29: Total Lag and Response Time vs. H and R (R Range: 0-15 ft.) F-32

Figure F.30: Total Lag and Response Time vs. H and R (R Range: 16-30 ft.) F-33

Figure F.31: Sprinkler Activation Time for Class A and Class B Motors F-34

Figure F.32: Sprinkler Activation Time for Class C Motors (SF=0.02-0.30) F-35

Figure F.33: Sprinkler Activation Time for Class C Motors (SF=0.35-0.60) F-36

Figure F.34: Sprinkler Activation Time for Class A and Class B Dry Transformers F-37

Figure F.35: Sprinkler Activation Time for Class C Dry Transformers (SF=0.02-0.25) F-38

Figure F.36: Sprinkler Activation Time for Class C Dry Transformers (SF=0.30-0.40) F-39

Figure F.37: Sprinkler Activation Time for Generic Transients (SF=0.02-0.25) F-40

Figure F.38: Sprinkler Activation Time for Generic Transients (SF=0.30) F-41

Figure F.39: Sprinkler Activation Time for TCCL Transients F-42

Figure F.40: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.02-0.15) F-43

Figure F.41: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.20-0.50) F-44

Figure F.42: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.55-0.70) F-45

Figure F.43: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.02-0.20) F-46

Figure F.44: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.25-0.60) F-47

Figure F.45: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.65-0.70) F-48

Figure F.46: Sprinkler Activation Time for Group 3 Electrical Enclosures (SF=0.02-0.15) F-49

Figure F.47: Sprinkler Activation Time for Group 3 Electrical Enclosures (SF=0.20-0.50) F-50

Figure F.48: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.02-0.10) F-51

Figure F.49: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.15-0.35) F-52

Figure F.50: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.40-0.65) F-53

Figure F.51: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.02-0.05) F-54

Figure F.52: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.10-0.15) F-55

Figure F.53: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.20-0.30) F-56

Figure F.54: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.35-0.60) F-57

Figure F.55: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.65) F-58

Figure F.56: Sprinkler Activation Time for Group 4b Closed Enclosures (SF=0.02-0.15) F-59

Figure F.57: Sprinkler Activation Time for Group 4b Closed Enclosures (SF=0.20-0.50) F-60

Figure F.58: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.02-0.10) F-61

Figure F.59: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.15-0.35) F-62

Figure F.60: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.40-0.60) F-63

Figure F.61: Sprinkler Activation Time for Group 4c Electrical Enclosures F-64

Figure F.62: Steady HRR for Sprinkler Activation in 1 Minute vs. H and R F-65

Figure F.63: Steady HRR for Sprinkler Activation in 2 Minutes vs. H and R F-66

Figure F.64: Steady HRR for Sprinkler Activation in 3 Minutes vs. H and R F-67

Figure F.65: Steady HRR for Sprinkler Activation in 4 Minutes vs. H and R F-68

Figure F.66: Steady HRR for Sprinkler Activation in 5 Minutes vs. H and R F-69

Figure F.67: Steady HRR for Sprinkler Activation in 6 Minutes vs. H and R F-70

## Table/Plot Set F: Overview and Assumptions

Table/Plot set F consists of three subsets of tables:

* Tables to determine smoke detector actuation time as a function of the ceiling height above the fire and the radial distance between the detector and the fire (Step 2.7.2).
* Tables to determine sprinkler activation time for fixed and transient ignition source fires as a function of the ceiling height above the fire and the radial distance between the sprinkler head and the fire (Step 2.7.3).
* Tables to estimate sprinkler activation time for fires with an unknown HRR profile as a function of the ceiling height above the fire and the radial distance between the sprinkler head and the fire (Step 2.7.3).

The assumptions and background for the calculations performed to develop the tables in set F are discussed in Section 06.03.06 of IMC 0308, Attachment 3, Appendix F. The primary assumptions are as follows:

1. To determine actuation time, smoke detectors are modeled as sprinkler heads with a response time index (RTI) of 5 (m×s)0.5 and an activation temperature 9°F above ambient (86°F). The assumed RTI and activation temperature are identical to those that are used in the sample FDT 11 calculations in NUREG‑1805.
2. For the sprinkler activation calculations, sprinkler heads were assumed to have an activation temperature of 165°F and an RTI of 130 (m×s)0.5. These values were used in the fire modeling supporting the LAR of several plants transitioning to NFPA 805.

|  |
| --- |
|  |
| Figure F.01: Minimum HRR for Detector Actuation vs. H and R (R Range: 0-15 ft.) |

|  |
| --- |
|  |
| Figure F.02: Minimum HRR for Detector Actuation vs. H and R (R Range: 16-30 ft.) |

|  |
| --- |
|  |
| Figure F.03: HRR Growth Profiles for Class A Motors (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.04: HRR Growth Profiles for Class A Motors (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.05: HRR Growth Profiles for Class B Motors (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.06: HRR Growth Profiles for Class B Motors (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.07: HRR Growth Profiles for Class C Motors (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.08: HRR Growth Profiles for Class C Motors (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.09: HRR Growth Profiles for Generic Transients (SF from 0.02 to 0.30). |

|  |
| --- |
|  |
| Figure F.10: HRR Growth Profiles for Generic Transients (SF from 0.35 to 0.65). |

|  |
| --- |
|  |
| Figure F.11: HRR Growth Profiles for TCCL Transients (SF from 0.02 to 0.30). |

|  |
| --- |
|  |
| Figure F.12: HRR Growth Profiles for TCCL Transients (SF from 0.35 to 0.65). |

|  |
| --- |
|  |
| Figure F.13: HRR Growth Profiles for Group 1 Electrical Enclosures (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.14: HRR Growth Profiles for Group 1 Electrical Enclosures (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.15: HRR Growth Profiles for Group 2 Electrical Enclosures (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.16: HRR Growth Profiles for Group 2 Electrical Enclosures (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.17: HRR Growth Profiles for Group 3 Electrical Enclosures (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.18: HRR Growth Profiles for Group 3 Electrical Enclosures (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.19: HRR Growth Profiles for Group 4a Closed Enclosures  (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.20: HRR Growth Profiles for Group 4a Closed Enclosures  (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.21: HRR Growth Profiles for Group 4a Open Enclosures  (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.22: HRR Growth Profiles for Group 4a Open Enclosures  (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.23: HRR Growth Profiles for Group 4b Closed Enclosures  (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.24: HRR Growth Profiles for Group 4b Closed Enclosures  (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.25: HRR Growth Profiles for Group 4b Open Enclosures  (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.26: HRR Growth Profiles for Group 4b Open Enclosures  (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.27: HRR Growth Profiles for Group 4c Electrical Enclosures (SF from 0.02 to 0.35). |

|  |
| --- |
|  |
| Figure F.28: HRR Growth Profiles for Group 4c Electrical Enclosures (SF from 0.40 to 0.75). |

|  |
| --- |
|  |
| Figure F.29: Total Lag and Response Time vs. H and R (R Range: 0-15 ft.) |

|  |
| --- |
|  |
| Figure F.30: Total Lag and Response Time vs. H and R (R Range: 16-30 ft.) |

|  |
| --- |
|  |
| Figure F.31: Sprinkler Activation Time for Class A and Class B Motors) |

|  |
| --- |
|  |
| Figure F.32: Sprinkler Activation Time for Class C Motors (SF=0.02-0.30) |

|  |
| --- |
|  |
| Figure F.33: Sprinkler Activation Time for Class C Motors (SF=0.35-0.60) |

|  |
| --- |
|  |
| Figure F.34: Sprinkler Activation Time for Class A and Class B Dry Transformers) |

|  |
| --- |
|  |
| Figure F.35: Sprinkler Activation Time for Class C Dry Transformers (SF=0.02-0.25) |

|  |
| --- |
|  |
| Figure F.36: Sprinkler Activation Time for Class C Dry Transformers (SF=0.30-0.40) |

|  |
| --- |
|  |
| Figure F.37: Sprinkler Activation Time for Generic Transients (SF=0.02-0.25) |

|  |
| --- |
|  |
| Figure F.38: Sprinkler Activation Time for Generic Transients (SF=0.30) |

|  |
| --- |
|  |
| Figure F.39: Sprinkler Activation Time for TCCL Transients) |

|  |
| --- |
|  |
| Figure F.40: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.02-0.15) |

|  |
| --- |
|  |
| Figure F.41: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.20-0.50) |

|  |
| --- |
|  |
| Figure F.42: Sprinkler Activation Time for Group 1 Electrical Enclosures (SF=0.55-0.70) |

|  |
| --- |
|  |
| Figure F.43: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.02-0.20) |

|  |
| --- |
|  |
| Figure F.44: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.25-0.60) |

|  |
| --- |
|  |
| Figure F.45: Sprinkler Activation Time for Group 2 Electrical Enclosures (SF=0.65-0.70) |

|  |
| --- |
|  |
| Figure F.46: Sprinkler Activation Time for Group 3 Electrical Enclosures (SF=0.02-0.15) |

|  |
| --- |
|  |
| Figure F.47: Sprinkler Activation Time for Group 3 Electrical Enclosures (SF=0.20-0.50) |

|  |
| --- |
|  |
| Figure F.48: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.02-0.10) |

|  |
| --- |
|  |
| Figure F.49: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.15-0.35) |

|  |
| --- |
|  |
| Figure F.50: Sprinkler Activation Time for Group 4a Closed Enclosures (SF=0.40-0.65) |

|  |
| --- |
|  |
| Figure F.51: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.02-0.05) |

|  |
| --- |
|  |
| Figure F.52: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.10-0.15) |

|  |
| --- |
|  |
| Figure F.53: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.20-0.30) |

|  |
| --- |
|  |
| Figure F.54: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.35-0.60) |

|  |
| --- |
|  |
| Figure F.55: Sprinkler Activation Time for Group 4a Open Enclosures (SF=0.65) |

|  |
| --- |
|  |
| Figure F.56: Sprinkler Activation Time for Group 4b Closed Enclosures (SF=0.02-0.15) |

|  |
| --- |
|  |
| Figure F.57: Sprinkler Activation Time for Group 4b Closed Enclosures (SF=0.20-0.50) |

|  |
| --- |
|  |
| Figure F.58: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.02-0.10) |

|  |
| --- |
|  |
| Figure F.59: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.15-0.35) |

|  |
| --- |
|  |
| Figure F.60: Sprinkler Activation Time for Group 4b Open Enclosures (SF=0.40-0.60) |

|  |
| --- |
|  |
| Figure F.61: Time to Sprinkler Activation vs. H and R (Group 4c Electrical Enclosures) |

|  |
| --- |
|  |
| Figure F.62: Steady HRR for Sprinkler Activation in 1 Minute vs. H and R |

|  |
| --- |
|  |
| Figure F.63: Steady HRR for Sprinkler Activation in 2 Minutes vs. H and R |

|  |
| --- |
|  |
| Figure F.64: Steady HRR for Sprinkler Activation in 3 Minutes vs. H and R |

|  |
| --- |
|  |
| Figure F.65: Steady HRR for Sprinkler Activation in 4 Minutes vs. H and R |

|  |
| --- |
|  |
| Figure F.66: Steady HRR for Sprinkler Activation in 5 Minutes vs. H and R |

|  |
| --- |
|  |
| Figure F.67: Steady HRR for Sprinkler Activation in 6 Minutes vs. H and R |

Attachment 1: Revision History for IMC 0609, Appendix F, Attachment 8

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Commitment Tracking Number | Accession Number  Issue Date  Change Notice | Description of Change | Description of Training Required and Completion Date | Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public) |
|  | ML041700310  05/28/2004  CN 04-016 | IMC 0609, App F, Att 8 “Guidance for Fire Non-Suppression Probability Analysis,” is added to provide guidance for fire non-suppression analysis. |  |  |
|  | ML050700212  02/28/2005  CN 05-007 | IMC 0609, App F, Att 8 “Guidance for Fire Non-Suppression Probability Analysis,” is revised to correct the mathematical signs within the last bullet before Manual fire suppression on page F8-9. |  |  |
|  | ML17089A411  DRAFT  CN 17-XXX | IMC 0609, App F, Att 8 “Guidance for Fire Non-Suppression Probability Analysis,” is moved to IMC 0609, App F, Att 7. Attachment 8 is replaced with sets of pre-solved tables and plots that are used in the revised Phase 2 to replace the use of the Fire Dynamics Tools Spreadsheets.  CA Note sent 7/18/17 for information only, ML17191A681.  Issued 10/11/17 as a draft publicly available document to allow for public comments. | November 2017 | ML17093A189 |
|  | ML18087A413  05/02/18  CN 18-010 | Re-issued with new accession number in order to issue as an official revision after receipt of public comments. | Gap training covering changes to the procedure completed November 2017 | ML17093A189 |
|  | ML24150A358  09/05/24  CN 24-024 | This revision includes updating IMC 0609 Appendix F, its associated attachments, and the basis document to incorporate updated guidance for modeling transient fires per NUREG-2233, high energy arching faults per NUREG-2262, and electrical enclosure, electric motor, dry transformer and main control room fires per NUREG-2178 Volume 2. This revision also implements the heat soak method in the HRR and ZOI calculations used in table/plot sets A, D, and E. As part of the updates, the previous revision’s table/plot sets D and F were combined into table/plot set D and the previous revision’s table/plot sets E and G were combined into table/plot set E. As a result, all the table/plot sets in this attachment have been updated from the previous revision but the data updates in the tables and plots are not tracked for simplicity. |  | ML24155A263 |