# FIRE PROTECTION
# SIGNIFICANCE DETERMINATION PROCESS WORKSHEET

STEP 1: FIRE PROTECTION SDP PHASE 1 WORKSHEET

Step 1.1 - Provide Statement of Fire Inspection Finding

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Step 1.2 - Assign a Fire Finding Category

| Table 1.2.1 – Finding Categories | | |
|---|---|---|
| Finding Category | | Elements Covered by Finding Category |
| O | 1.4.1 Fire Prevention and Administrative Controls | • The plant combustible material controls program<br>• Other administrative controls, such as work permit programs<br>• Hot work fire watches<br>• Roving or periodic fire watches (other than those described in the Fixed Fire Protection Finding Category, 1.4.2, below)<br>• Training programs |
| O | 1.4.2 Fixed Fire Protection Systems | • Fixed fire detection systems<br>• Fixed fire suppression systems (automatic or manual)<br>• Fire watches posted as a compensatory measure for a fixed fire protection system outage or degradation |
| O | 1.4.3 Fire Water Supply | • Fire pumps<br>• Yard loop piping<br>• Water sources |
| O | 1.4.4 Fire Confinement | • Fire barrier elements that separate one fire area from another<br>• Penetration seals<br>• Water curtains<br>• Fire and/or smoke dampers<br>• Fire doors<br>• Spatial separation (e.g., per App. R Section III.G.2) |
| O | 1.4.5 Manual Firefighting | • Hose stations<br>• Fire extinguishers<br>• Fire pre-plans |
| O | 1.4.6 Localized Cable or Component Protection | • Passive physical features installed for the thermal/fire protection of cables, cable raceways, or individual components<br>• Raceways or component fire barriers (e.g., cable wraps)<br>• Radiant heat shields protecting a component or cable |

| Table 1.2.1 – Finding Categories | | |
|---|---|---|
| Finding Category | | Elements Covered by Finding Category |
| O | 1.4.7 Post-fire Safe Shutdown (SSD) | • Systems or functions identified in the post-fire SSD analysis<br>• Systems or functions relied upon for post-fire SSD<br>• Post-fire SSD component list (e.g., completeness)<br>• Post-fire SSD analysis (e.g., completeness)<br>• Post-fire plant response procedures<br>• Operator manual actions<br>• Alternate shutdown (e.g., control room abandonment)<br>• Circuit failure modes and effects (e.g., spurious operation issues) |
| O | 1.4.8 Main Control Room Fires | • Postulated fires occurring in the MCR that affect the habitability, equipment, or controls in the MCR |

Step 1.3 - Low Degradation Deficiencies

Determine if the fire finding can be assigned a low degradation rating using the guidance in Attachment 2.

1.3.1-A Question: Based on the criteria in Attachment 2, is the finding assigned a "Low" degradation rating?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.4.

Basis for degradation rating

_____

_____

_____

Step 1.4 – Qualitative Screening Questions for Individual Fire Finding Categories

Proceed to the step that corresponds to the fire finding category assigned in Step 1.2 and answer the screening questions to determine if the finding is of very low risk significance (Green). There are screening questions for each of the eight finding categories. Only evaluate the finding using the screening questions from the assigned fire finding category. If a question does not apply, skip the question and proceed to the next question for that finding category. If it is the last question in the category, proceed to Step 1.5.

Step 1.4.1: Fire Prevention and Administrative Controls

1.4.1-A Question: Could the fire finding increase the likelihood of a fire, delay detection fo a fire, or result in a more significant fire than previously analyzed such that the credited safe shutdown strategy could be adversely impacted?
O Yes – Continue to next question.
O No – Screen to Green, no further analysis required.

1.4.1-B Question: Does the fire finding adversely affect an area with adequate automatic detection and suppression?
O Yes – Screen to Green, no further analysis required.
O No – Continue to the Step 1.5.

Step 1.4.2: Fixed Fire Protection Systems

1.4.2-A Question: Does the degraded or non-functional detection or fixed suppression system adversely affect the ability of the system to protect any equipment important to safe shutdown?
O Yes – Continue to Step 1.5.
O No – Screen to Green, no further analysis required.

Step 1.4.3: Fire Water Supply

1.4.3-A Question: Would adequate fire water capacity (flow at required pressure) still be available for protection of equipment important to safe shutdown in the most limiting location onsite?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.5 (Phase 2) or Phase 3, as appropriate.

Step 1.4.4: Fire Confinement

1.4.4-A Question: Will the degraded fire confinement element continue to provide adequate fire endurance (including protection from the transmission of flames, smoke, and hot gases) to prevent fire propagation through the fire confinement element, given the combustible loading and location of equipment important to safe shutdown in the fire area of concern?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.4-B Question: Is there an adequate automatic suppression system on either side of the fire confinement element?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.4-C Question: If the fire finding involves an open or degraded fire door, are there any cables or equipment important to safe shutdown in the affected fire areas?
O Yes – Continue to the next question.
O No – Screen to Green, no further analysis required.

1.4.4-D Question: If the fire finding involves failure of a fire door to properly latch, but did not affect the ability of the fire door to close, does the fire door protect an area with a gaseous fire suppression system:
O Yes – Continue to Step 1.5.
O No – Screen to Green, no further analysis required.

1.4.4-E Question: If a fire were to spread from one fire area (the exposing fire area) to another (the exposed fire area) due to the degraded fire barrier, would any additional targets be damaged in the exposed fire area that could impact the credited safe shutdown strategy for the exposing fire area (targets include post-fire safe shutdown components or other plant components whose loss might lead to a demand for safe shutdown (e.g., a plant trip))?
O Yes – Continue to next question.
O No – Screen to Green, no further analysis required.

1.4.4-F Question: If the answer to Question 1.4.4-E is yes, are the additional damage targets sufficiently nearby in the adjoining compartment such that they could be affected by a fire spreading due to the deficiency in the fire confinement element (e.g., a cable that passes through multiple fire areas)?
O No – Screen to Green, no further analysis required.
O Yes – Continue to Step 1.5.

Step 1.4.5: Manual Fire Fighting

1.4.5-A Question: Is the fire finding associated with portable fire extinguishers not used for hot work fire watches?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.5-B Question: Is the fire finding associated with pre-fire plans?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.5-C Question: Is the fire area associated with the fire finding protected by an adequate automatic or manual fire suppression system?
O Yes – Screen to Green, no further analysis required.
O No – Continue to the next question.

1.4.5-D Question: For a finding associated with a degraded hose station(s), was an alternative manual suppression method available to suppress the fire such that equipment important to safe shutdown would not be adversely affected?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.5.

Step 1.4.6: Localized Cable or Component Protection

1.4.6-A Question: Is the area with the degraded fire wrap (cable, cable tray, or component) protected by an adequate automatic detection and suppression system?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.6-B Question: Is the area with the degraded fire wrap (cable, cable tray, or component) protected by an adequate automatic detection system and a fire wrap that would provide sufficient fire endurance to enable suppression of a fire prior to damage to the target?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.5.

Step 1.4.7: Post-fire Safe Shutdown

1.4.7-A Question: For a finding associated with emergency lighting, do operators have adequate alternate lighting (such as flashlights) to perform any necessary time critical/recovery actions?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.5.

1.4.7-B Question: Would the impact of the fire finding be limited to equipment which is not required for the credited safe shutdown success path?
O Yes – Screen to Green, no further analysis required.
O No – Continue to next question.

1.4.7-C Question: Does the fire finding adversely affect the ability to reach and maintain hot shutdown/hot standby or safe and stable conditions using the credited safe shutdown success path?
O Yes – Continue to Step 1.5.
O No – Screen to Green, no further analysis required.

Step 1.4.8: Main Control Room Fires

NOTE: This section only applies if there is no equipment greater than or equal to 440V in the MCR.

1.4.8-A Question: If the finding involves the malfunction (either a spurious operation due to a hot short or the failure to operate due to fire damage) of two or more components located in the main control board (MCB) (MCB includes any panels in the horseshoe area or within the line of sight of the operators), is all of the internal cabinet wiring in the MCB qualified (such as per IEEE-383) and are the components located at least 8.2 feet (2.5 meters) apart?
O Yes – Screen to Green, no further analysis required.
O No – Continue to the next question.

1.4.8-B Question: If the finding involves the malfunction (either a spurious operation due to a hot short or the failure to operate due to fire damage) of two or more components that are not located in the main control board (MCB), are the components located in nonadjacent cabinets?
O Yes – Screen to Green, no further analysis required.
O No – Continue to the next question.

1.4.8-C Question: If the finding involves a single fire scenario in the MCR, did the deficiency exist for 1 hour or less?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Step 1.5.

Step 1.5 - Screen Based on Licensee Fire PRA Results

Step 1.5.1: Screen by Licensee Fire PRA-based Risk Evaluation

1.5.1-A Question: Does the plant have a fire PRA capable of adequately evaluating the risk associated with the finding, as determined by an SRA?
O Yes – Continue to the next question.
O No – Continue to Phase 2 evaluation.

1.5.1-B Question: Does the licensee's risk-based evaluation for this fire finding indicate a ΔCDF of less than 1E-6, and is the evaluation result accepted by an SRA?
O Yes – Screen to Green, no further analysis required.
O No – Continue to Phase 2 or 3 evaluation, as determined by the SRA.

Basis for screening based on licensee's fire PRA-based risk evaluation:

STEP 2: FIRE PROTECTION SDP PHASE 2 WORKSHEET

Step 2.1 – Bounding Risk Quantification

Step 2.1.1: Estimate the Duration Factor (DF)

DF = _____

Step 2.1.2: Estimate Bounding Value of the Fire Ignition Frequency (FIF)

FIF = _____

Step 2.1.3: Estimate Bounding Values of the Ignition Frequency Adjustment Factor (AF)

AF = 1.0

Step 2.1.4: Estimate Bounding Value of the Severity Factor (SF)

SF = 1.0

Step 2.1.5: Estimate Bounding Value of the Non-Suppression Probability (NSP)

NSP = 1.0

Step 2.1.6: Estimate Bounding CCDP

Identify the Designated Post-fire SSD Path

The identified SSD path must meet the following criteria in order to be considered at this stage of the Phase 2 analysis:

- ☐ The SSD path must be identified as the designated post-fire SSD path in the plant's fire protection program.
- ☐ The SSD path must be supported by a documented post-fire SSD analysis consistent with regulatory requirements.
- ☐ Use of the SSD path must be documented and included in the plant operating procedures.

SSD Path:

_____

_____

_____

Assess the Unavailability Factor for the Identified SSD Path

CCDP = SSD Unavailability Factor = _____

Basis for selection/comments:

_____

_____

_____

If CCDP = 1.0, proceed to Step 2.1.7.

Assess Independence of the Identified SSD Path

Criteria satisfied: CCDP = SSD Unavailability Factor
Criteria not satisfied: CCDP = 1.0. Proceed to Step 2.1.7

Basis for criteria not met/comments:

_____

_____

_____

Step 2.1.8: Estimate Bounding Value of ΔCDF

Use the risk quantification worksheet (Table 2.1.8) to obtain a bounding estimate of ΔCDF. Enter the bounding estimates of DF (from Step 2.1.1), FIF (from Step 2.1.2), SF (from Step 2.1.4), NSP (from Step 2.1.5), and CCDP (from Step 2.1.6) in the corresponding cells in the first row of Table 2.1.8. Calculate the bounding ΔCDF according to Equation 2 and enter the result in the last cell in the first row of Table 2.1.8.

If the finding is in the "Fire Confinement" category, complete a separate risk quantification worksheet for each affected area, and calculate the bounding ΔCDF from Equation 3, i.e., as the sum of the bounding ΔCDF values for all affected areas.

ΔCDF = _____

- If ΔCDF is less than 1E-6, the finding screens to Green and the analysis is complete.
- If ΔCDF is equal to or greater than 1E-6, the analysis continues to Step 2.2.

Step 2.2 - Fire Damage State Determination

Step 2.2.1: Initial FDS Assignment

Check all that apply from Appendix F, Table 2.2.1:

☐ FDS1
☐ FDS2
☐ FDS3

Step 2.2.2: Information Gathering

This step involves the gathering of information needed to perform the Phase 2 assessment from walkdowns and other sources. Table 2.2.2a through 2.2.2d are used to facilitate the data collection process. Guidance for completing these tables is provided below:

- Table 2.2.2a: This worksheet is used to record general information about the fire area under evaluation.
    - Complete one worksheet for each area being evaluated. Typically, for findings in the "Fire Confinement" category two areas need to be evaluated (one on each side of the degraded barrier), while for other findings there is usually only one area.
    - Shaded cells contain information that may be needed for a Phase 3 evaluation, but is not required for a Phase 2 assessment.
    - For each area being evaluated enter the fire area ID, and if applicable, the fire zone ID. Provide a brief description of the area and/or zone.
    - Enter room height and floor area.
    - Indicate which target types are present in the compartment that may be damaged as a result of the development of a damaging HGL (FDS2). Note that sensitive electronics in an electrical cabinet can be treated as thermoset targets provided the limitations in FAQ 13-0004 are met:
        - The component is not mounted on the surface of the cabinet; and
        - The presence of louvers or other typical ventilation means does not invalidate the guidance in the FAQ.

      The CCDP is left blank at this stage and can be provided by the SRA when Step 2.5 is completed.
    - Indicate which fire protection systems are present and check the applicable finding category box.
    - Finally, include a list of all ignition sources in the area under evaluation. Assign a unique number to each ignition source, and provide a description consistent with the HRR bins defined in Attachment 5. Indicate whether the source is in the open, within 2 ft. of a wall, or within 2 ft. of a corner.
    - Switchgear and load centers are entered twice, first for non-HEAF scenarios and a second time for HEAF scenarios.
    - Liquid fuel fires are also entered twice, first assuming a spill of 100% of the amount of fuel or oil that can be spilled, and a second time considering a 10% spill. A severity factor (SF) of 0.02 is assigned to the first scenario, and 0.98 is used for the second scenario.
    - Ignition sources with the same HRR characteristics that have an identical effect on a common target set (e.g. multiple switchgear cabinets in a bank that affect a

cable target in a tray that is located above the bank) do not have to be considered individually and can be grouped together. An analysis is performed for the fire scenarios associated with one of the ignition sources, and the resulting ΔCDF is then multiplied by the number of ignition sources in the group.
    - Add another worksheet if the number of ignition sources in the area exceeds the maximum number in the table.
- Table 2.2.2b: This worksheet is used to record detailed information about a fixed ignition source or an oil fire, and all targets that are expected to be within its ZOI.
    - Complete one worksheet for each ignition source.
    - In the top part enter the fire area ID, and if applicable, the fire zone ID. Check the appropriate box to indicate whether the ignition source is a motor, a pump, an electrical cabinet, or an oil fire. For fixed ignition sources enter the dimensions and location, i.e., O(pen), W(all), or C(orner). For electrical cabinets enter the type (MCC, switchgear, large enclosure, etc.) For oil fires, enter the liquid type (diesel fuel, lube oil, etc.), quantity, and dike area for confined fuel area. The remaining cells (nearest target, target set CCDP, ZOI dimensions) are not completed at this stage.
    - The bottom part allows the analyst to record information for 12 targets. Use another worksheet if more than 12 targets are located above or within the radial ZOI of the ignition source (see Attachment 3, Table A3.1 for details on identifying FDS1 targets). For each target note the assigned ID (cable tray number, conduit number, or equipment identifiifcation), type (TS cable, TP cable, or sensitive electronics), distance to the ignition source, and whether the ignition source is located above the ignition source (vertical target) or within a direct line of sight of the ignition source (radial target). If the target is a cable in a horizontal tray above the ignition source or in a vertical tray, check the “Ignition Target?” box. The “Screen?” and CCDP boxes can be filled in Step 2.3 and Step 2.5, respectively. Cable targets protected with a rated barrier are not subject to damage or ignition do not need to be included on the worksheet, unless the wrap is degraded. Cable targets protected with a non-degraded rated barrier only need to be considered for HEAF scenarios. Cable targets in a conduit or in an enclosed cable tray with a solid or Kaowool cover are subject to damage, but not ignition and flame spread. Use the notes/sketch space to document cable protection details.
- Table 2.2.2c: This table is similar to Table 2.2.2b, but is used for transient combustibles. The dimensions do not need to be provided, but can be included if a transient was found during the inspection. This worksheet is also used to record the plausible and critical areas to calculate the weighting factor and likelihood rating (see Attachment 4 for details).
- Table 2.2.2d: This table contains information about secondary combustibles. The worksheet allows the analyst to record information for up to three vertical cable trays that can be ignited by the ignition source, and a vertical stack of up to seven horizontal cable trays. The worksheet is also used to record information needed for the detection/suppression analyses (Step 2.7).

Step 2.3 – Ignition Source Screening and Fire Scenario Refinement

Step 2.3.2: FDS1 Ignition Source Screening

Table 2.3.2 is used to screen ignition sources that are not capable of causing damage to or ignition of a target. One worksheet is completed for each area under evaluation. The ignition source #, description, location, source count is copied from Table 2.2.2a for the area. The 98$^{th}$ percentile

HRR for the ignition source is obtained from Attachment 5 (the 98th percentile HRRs of fixed and transient ignition sources are also provided in Table 2.2.2 in the SDP). The nearest and most vulnerable target, its type and vertical or radial distance from the source can be determined from Table 2.2.2b (for fixed ignition sources and oil fires) or Table 2.2.2c (for transient fires). The critical distance is the ZOI, which is determined from Figures A.01 and A.03 in Attachment 8 based on the 98th percentile HRR and location for fixed and transient ignition sources; from Figures A.04 through A.09 in Attachment 8 based on the fuel type, and effective diameter for confined pool fires; and from Figures A.10 through A.15 in Attachment 8 based on the fuel type, and spill volume for unconfined pool fires. The HRR and critical distance tables for fixed and transient ignition sources can be also be found in the section that describes Step 2.2.2 of the SDP. If the distance of the nearest and most vulnerable target is outside the ZOI, the ignition source is screened. Update Tables 2.2.2b and 2.2.2c to identify the screened ignition targets and ZOI dimensions.

Step 2.3.3: FDS2 Ignition Source Screening

Table 2.3.3 is used to screen ignition sources that, possibly in combination with secondary combustibles, are not capable of causing the development of a damaging HGL. One worksheet is completed for each area under evaluation. At the top of the form, enter the ID of the compartment under evaluation, its floor area and ceiling height, and the type of the targets that will be damaged in the FDS2 scenarios (TS cable, TP cable, or exposed sensitive electronics). For FDS2 screening, the exposed area ID is not applicable and therefore left blank. Usually only one target type needs to be considered, but multiple FDS2 analyses may need to be conducted if risk-significant targets of different types are present in the area. The critical HRR is the minimum HRR needed to create a damaging HGL in the compartment, and is determined from the Table/Plot set B in Attachment 8 as a function of floor area, ceiling height, and target type.

The ignition source #, description, and source count is copied from Table 2.2.2a for the area. For scenarios that do not involve secondary combustibles, the maximum HRR is the 98th percentile HRR for the ignition source and is obtained from Attachment 5 (the 98th percentile HRRs of fixed and transient ignition sources are also provided in Table 2.2.2 in the SDP). Fixed and transient ignition sources are unlikely to release heat at a sufficient rate to cause a damaging HGL, except when the FDS2 target type under consideration is sensitive electronics. Consequently, if the FDS2 target type is thermoplastic or thermoset cables, fire scenarios that are initiated by a fixed or transient ignition source (or a small oil fire) require the involvement of secondary combustibles. The analyst can determine whether an ignition source is capable of involving secondary combustibles based on Table 2.2.2b or 2.2.2c updated in Step 2.3.3. If the ignition source is capable of igniting a secondary combustible (usually a horizontal cable tray in a stack located above the source), detailed information about the secondary combustible can be found from Table 2.2.2d for the source. The maximum HRR in this case can be determine from the tables and plots in set C for the applicable ignition source-cable tray configuration. If the critical HRR exceeds the maximum HRR, the ignition source can be screened for FDS2 scenarios.

Step 2.3.4: FDS3 Ignition Source Screening

Table 2.3.3 is also used to screen ignition sources that, possibly in combination with secondary combustibles, are not capable of causing the development of a damaging HGL in the exposed compartment for findings in the “Fire Confinement” category. In this case the two compartments separated by the degraded barrier are combined into one. The floor area of the combined compartment is the sum of the floor areas of the two compartments. The ceiling height is the lower of the ceiling heights in the two compartments. The target type is that in the exposed compartment, i.e., not the compartment where the fire is postulated. The screening step may

need to be performed twice. The first time one compartment is the fire or exposing compartment, and the compartment on the other side of the barrier is the exposed compartment. The second time the exposing and exposed compartments are reversed.

Step 2.3.5: Screening Check

For findings that are not categorized as "Fire Confinement", include the unscreened ignition source-FDS combinations from Steps 2.3.2 and 2.3.3 in Table 2.1.8, starting at row 2. For findings that are categorized as "Fire Confinement", only include the unscreened ignition source-FDS3 combinations from Step 2.3.4. Enter the source #, ignition source description and location, source count, and FDS. The entry for the latter is 1, 2, or 3 (the latter only for findings in the "Fire Confinement Category". Some ignition sources may not screen for FDS1, but may screen for FDS2. Use additional pages, if all scenarios (ignition source-FDS combinations) do not fit on one page.

Step 2.4 – Final Fire Ignition Frequency Estimates

Step 2.4.1: Nominal Fire Frequency Estimation

Use Table 2.1.8 to record the number of fire ignition sources retained and the fire frequency per counting unit for each unscreened fire ignition source bin. The fire frequency for each fire ignition source bin on a per component basis is provided in Attachment 4.

Step 2.4.2: Findings Based on Increase in Fire Frequency

For findings in the "Fire Prevention and Administrative Controls" category, record any FIFchanges due to likelihood rating changes and any adjustment factors in Table 2.1.8.

Step 2.4.3: Credit for Compensatory Measures

For transient and hot work fires, record any adjustment factors for compensatory measures in Table 2.1.8. However, do not reduce the summed FIF for the fire area below 3E-6.

Step 2.4.4: Screening Check

For each scenario either copy DF, CCDP, SF, and NSP from the first row or, if available, use the most recent value. Calculate the resulting $\Delta CDF_j$ for the scenario using the the FIF for the ignition source from Step 2.4.1 and the adjustment factors from Steps 2.4.2 and 2.4.3. Calculate the total $\Delta$CDF as the sum of the $\Delta CDF_j$ estimates for each of the scenarios.

$\Delta$CDF = _____

- If $\Delta$CDF is less than 1E-6, the finding screens to Green and the analysis is complete.
- If $\Delta$CDF is equal to or greater than 1E-6, the analysis continues to another step in Phase 2, or to Phase 3 if all Phase 2 steps have been completed.

Step 2.5 – Final Conditional Core Damage Probability Estimates

Step 2.5.1: Determine Damaged Target Set and CCDP for FDS1 Scenarios

Use the FDS1 target worksheets for each unscreened ignition source (Table 2.2.2b for fixed ignition sources and oil fires and Table 2.2.2c for transient fires) to determine which systems and components are affected. Convey that information to the SRA, so that the CCDP of the FDS1 target set can be determined.

Step 2.5.2: Determine Damaged Target Set and CCDP for FDS2 Scenarios

Use the FDS2 target worksheets for each area under evaluation (Table 2.2.2a) to determine which systems and components are affected by each FDS2 scenario. Convey that information to the SRA, so that the CCDP of the FDS2 target set can be determined. Depending on the finding, the FDS2 target set may include all or a specified subset of the targets in the area under evaluation.

Step 2.5.3: Determine Damaged Target Set and CCDP for FDS3 Scenarios

Similar to Step 2.5.2, but includes the two compartments on either side of the degraded barrier.

Step 2.5.4: Screening Check

For each scenario in Table 2.1.8, enter the CCDP for the corresponding target set in the appropriate cell (from Step 2.5.3 for findings in the "Fire Confinement Category", and from Steps 2.5.1 and 2.5.2 for the other findings). For each scenario either copy DF, FIF, AF, SF, and NSP from the first row or, if available, use the most recent value. Calculate the resulting $\Delta CDF_j$ for the scenario. Calculate the total $\Delta CDF$ as the sum of the $\Delta CDF_j$ estimates for each of the scenarios.

$\Delta CDF$ = _____

- If $\Delta CDF$ is less than 1E-6, the finding screens to Green and the analysis is complete.
- If $\Delta CDF$ is equal to or greater than 1E-6, the analysis continues to another step in Phase 2, or to Phase 3 if all Phase 2 steps have been completed.

Step 2.6 – Final Fire Severity Factor Estimates

Step 2.6.1: Determine Severity Factors

Complete the severity factor and damage/ignition time worksheet (Table 2.6.1).

For FDS1 scenarios initiated by fixed (non-HEAF) or transient ignition sources, the SF is determined from the tables and plots in sets D and E in Attachment 8. If the nearest and most vulnerable target has a low CCDP, the analyst may choose to determine the SF based on a more risk-significant target in the target set. The time to damage is determined from the tables and plots in sets F and G in Attachment 8. The SF for HEAF scenarios is 1.0, and damage is instantaneous. Two scenarios are considered for liquid fuel spill fires. The first scenario assumes a spill of 100% of the amount of fuel or oil that can be spilled, and the second scenario assumes a 10% spill. A severity factor of 0.02 is assigned to the first scenario, and 0.98 is used for the second scenario.

For FDS2 scenarios that involve secondary combustibles, the SF is based on the HRR required to ignite the secondary combustible. For scenarios initiated by fixed (non-HEAF) or transient ignition sources, the SF is determined from the tables and plots in sets D and E in Attachment 8. The SF for FDS2 scenarios that are initiated by a HEAF is equal to 1.0. The SF for FDS2 scenarios that are initiated by an oil fire is equal to 0.02 (100% spill) or 0.98 (10% spill). The damage time for FDS2 scenarios that involve secondary combustibles is equal to the time for the HRR of the ignition source-cable tray combination to reach the critical HRR. This time can be determined from the tables and plots in set C in Attachment 8.

Step 2.6.2: Screening Check

For each scenario in Table 2.1.8, enter the SF (from Step 2.6.1) in the appropriate cell. For each scenario either copy DF, FIF, AF, CCDP, and NSP from the first row or, if available, use the most recent estimate. Calculate the total $\Delta$CDF as the sum of the $\Delta CDF_j$ estimates for each of the scenarios.

$\Delta$CDF = _____

- If $\Delta$CDF is less than 1E-6, the finding screens to Green and the analysis is complete.
- If $\Delta$CDF is equal to or greater than 1E-6, the analysis continues to another step in Phase 2, or to Phase 3 if all Phase 2 steps have been completed.

Step 2.7 – Final Non-Suppression Probability Estimates

Complete the non-suppression worksheet (Table 2.7). If Step 2.6 has been performed, the damage time for each scenario can be taken from the severity factor worksheet (Table 2.6.1), if Step 2.6 has not been performed yet, the damage time for each scenario can be determined as discussed under Step 2.6.1 above. The process for determining the detection and suppression times, and the fixed and manual NSPs for each scenario is discussed in Steps 2.7.2-2.7.4. The process for calculating the final NSP is described in Step 2.7.5. Additional guidance is provided in Attachment 7.

For each scenario, enter the NSP (from Table 2.7) in the appropriate cell in Table 2.1.8. For each scenario either copy DF, FIF, AF, CCDP, and SF from the first row or, if available, use the most recent estimate. Calculate the total $\Delta$CDF as the sum of the $\Delta CDF_j$ estimates for each of the scenarios.

$\Delta$CDF = _____

- If $\Delta$CDF is less than 1E-6, the finding screens to Green and the analysis is complete.
- If $\Delta$CDF is equal to or greater than 1E-6, the analysis continues to another step in Phase 2, or to Phase 3 if all Phase 2 steps have been completed.

| Table 2.1.8 - Risk Quantification Worksheet (Used in Step 2.1 and Steps 2.3-2.7, One Sheet per Area) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Source # | Ignition Source Description/Location | Source Count | FDS | DF | FIF | AF | SF | NSP | CCDP | ΔCDF |
| N/A | N/A | | N/A | | | 1.00 | | | | |
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| | | | | | | | | | Total ΔCDF: | |

Page ____ of ____ Fire Area ID: Fire Zone ID:

## Table 2.2.2a - Walkdown Forms: General Information (Used in Step 2.2)

Fire Area ID:
Fire Zone ID:
Description:

Compartment Parameters

Room Length (ft):
Room Width (ft):
Room Height (ft):
Room Area ($ft^2$):
Ambient Temperature ($^oF$):

Boundary Parameters

Boundary Material:
Wall Thickness (ft):

Values in cells shaded in light green are not required to complete the Phase 2

Natural Ventilation Parameters

Vent Area ($ft^2$):
Vent Height (ft):
Vent Width (ft):

FDS 2 Target Sets | (Y/N) | CCDP

Thermoplastic
Thermoset
Exposed Sensitive Electronics

Mechancial Ventilation Parameters

Flow Rate (CFM):
Height Above Floor (ft:)

Fire Protection Systems | (Y/N)

Automatic Suppression?
Automatic Detection?

Finding Category

Fire Prevention & Administrative Controls
Fixed Fire Protection
Fire Water Supply
Fire Confinement
Manual Fire Fighting
Localized Cable or Component Protection
Post-Fire Safe Shutdown
Main Control Room Fires

Ignition Source List: Switchgear (non-HEAF), Switchgear (HEAF). Open Large Enclosure, Liquid Fire, etc.

| # | Ignition Source Description | Location | | | Source Count | Ignition Source Plant ID |
|---|---|---|---|---|---|---|
| | | O | W | C | | |
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| Table 2.2.2b - Walkdown Forms: FDS1 Target Information for Fixed Ignition Sources and Liquid Fires (Used in Step 2.2) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fire Area ID: | | Fire Zone ID: | | Nearest Target: | | Target Set CCDP: | | | |
| Fixed Ignition Source Dimensions | | El. Cabinet ☐ Motor ☐ Pump ☐ | | Liquid Fire ☐ | | Zone of Influence (ft) | | | |
| Width (in.) | | El. Cabinet Type: | | Liquid Type: | | Target Type: | Vertical | Radial | |
| Depth (in.) | | Config. (O/C): | | Fuel Volume (gal): | | Thermoplastic | | | |
| Height (in.) | | Location (O/W/C): | | Dike Area ($ft^2$): | | Thermoset | | | |
| | | | | | | Sensitive Electronics | | | |
| TARGET SET INFORMATION | | | | | | | | | |
| Target 1 Info | CCDP: | Target 4 Info | CCDP: | Target 7 Info | CCDP: | Target 10 Info | CCDP: | | |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | | |
| Target ID*: | | Target ID*: | | Target ID*: | | Target ID*: | | | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | | |
| Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | | |
| Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | | |
| Target 2 Info | CCDP: | Target 5 Info | CCDP: | Target 8 Info | CCDP: | Target 11 Info | CCDP: | | |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | | |
| Target ID*: | | Target ID*: | | Target ID*: | | Target ID*: | | | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | | |
| Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | | |
| Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | | |
| Target 3 Info | CCDP: | Target 6 Info | CCDP: | Target 9 Info | CCDP: | Target 12 Info | CCDP: | | |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ | | |
| Target ID*: | | Target ID*: | | Target ID*: | | Target ID*: | | | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | Type (TS/TP/SE): | | | |
| Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | Distance (ft.): | | | |
| Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ | | |

* Cable Tray #, Conduit #, or Equipment Identifier

| NOTES/SKETCH: |
|---|
| |

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## Table 2.2.2c - Walkdown Forms: FDS1 Target Information for Transient Ignition Sources (Used in Step 2.2)

| Fire Area ID: | | Fire Zone ID: | | Nearest Target: | | Target Set CCDP: | |
|---|---|---|---|---|---|---|---|

| Dimensions | | Transient Fires (see guidance in section below) | | | | Zone of Influence (ft) | | |
|---|---|---|---|---|---|---|---|---|
| Width (ft.) | | Pinch-Point Description: | | Plausible Area ($ft^2$): | | Target Type: | Vertical | Radial |
| Depth (ft.) | | | | Critical Area ($ft^2$): | | Thermoplastic | | |
| Height (ft.) | | | | Weighting Factor: | | Thermoset | | |
| | | | | | | Sensitive Electronics | | |

| TARGET SET INFORMATION | | | |
|---|---|---|---|
| Target 1 Info | CCDP: | Target 4 Info | CCDP: |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ |
| Target ID*: | | Target ID*: | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | |
| Vertical Dist. (ft.): | | Vertical Dist. (ft.): | |
| Radial Dist. (ft.): | | Radial Dist. (ft.): | |
| Target 2 Info | CCDP: | Target 5 Info | CCDP: |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ |
| Target ID*: | | Target ID*: | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | |
| Vertical Dist. (ft.): | | Vertical Dist. (ft.): | |
| Radial Dist. (ft.): | | Radial Dist. (ft.): | |
| Target 3 Info | CCDP: | Target 6 Info | CCDP: |
| Ignition Target? ☐ | Screen? ☐ | Ignition Target? ☐ | Screen? ☐ |
| Target ID*: | | Target ID*: | |
| Type (TS/TP/SE): | | Type (TS/TP/SE): | |
| Distance (ft.): | | Distance (ft.): | |
| Vertical Target ☐ | Radial Target ☐ | Vertical Target ☐ | Radial Target ☐ |

**GUIDANCE FOR DETERMINING WEIGHTING FACTOR:**

- Determine where in the area under evaluation transient fuel combustibles might be either temporarily or permanently stored.
  - Exclude normal pathways, designated clear spaces (e.g., in front of electrical distribution panels), or areas that are not accessible.
  - Include locations that might not be intended for the storage of such materials, but might see temporary storage based on convenience (e.g., materials might be pushed under a cable tray to get them "out of the way").
  - Estimate the total floor space where temporary or permanent storage of transient fuel material is considered plausible (the "plausible" floor area).
- The critical floor area for the specified scenario is a subset of the "plausible" floor area.
  - Identify the damage or ignition target for the scenario.
  - Estimate the total floor area where ignition or damage is possible (the "critical" floor area). For example, if the critical target is a cable tray, the critical floor area is equal to the floor area below the tray where it is physically possible to place a transient combustible.
- The weighting factor is the "critical" floor area divided by the "plausible" floor area:

$WF_{transients}$ = (critical floor area, in $ft^2$) / (plausible floor area, in $ft^2$)

* Cable Tray #, Conduit #, or Equipment Identifier

| NOTES/SKETCH: |
|---|
| |

## Table 2.2.2d - Walkdowns: Additional Information (Used in Step 2.2)

| | | | |
|---|---|---|---|
| Fire Area ID: | | Ignition Source ID: | |
| Fire Zone ID: | | Fire Scenario ID: | |

Fire Scenario Sketch/Notes:

Vertical Cable Trays

| # | Tray Label | Radial Distance to Source (in.) | Tray Protection* | Target ID(s) | Tray Width (ft.) | Tray Height (ft.) | Cable Type (TS/TP) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |

Vertical Stacks of Horizontal Cable Trays

| # | Tray Label | Vertical Distance to Source (in.) | Tray Protection* | Target ID(s) | Tray Width (ft.) | Sprinkler? (Y/N) | Cable Type (TS/TP) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |

* rated barrier system (RBS), rated fire wrap (RFW), solid bottom (SB), fully enclosed (FE), or top covered with ceramic fiber (CF)

Detection/Suppression Details

| | |
|---|---|
| Vertical Distance between top of source and compartment ceiling (ft.): | |
| Radial distance between source and nearest detector (ft.): | |
| Radial distance between source and nearest sprinkler head (ft.): | |

Roving fire watch schedule:

| | |
|---|---|
| Discharge delay for gaseous, deluge, pre-action or dry-pipe systems: | |
| Discharge transport time for gaseous, deluge, pre-action or dry-pipe systems: | |

| Table 2.3.2 - FDS1 Ignition Source Screening Worksheet (Used in Step 2.3) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Source # | Source Description/Location | Source Count | 98th % HRR (kW) | Nearest and Most Vulnerable Target | Target Type | Target Distance (ft.) | | Critical Distance(ft.) | | # of Sources Retained |
| | | | | | | Vertical | Radial | Vertical | Radial | |
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Page ____ of ____ Fire Area ID: Fire Zone ID:

## Table 2.3.3 - FDS2 and FDS3 Ignition Source Screening Worksheet (Used in Step 2.3)

Fire Area ID: _____ Floor Area: _____ $ft^2$ Target Type: _____

Exposed Area ID (FDS3): _____ Ceiling Height: _____ ft. Critical HRR: _____ kW

| Source # | Source Description | Source Count | Secondry Combustibles Involved (enter N/A if ignition source only) | Target Type | Maximum HRR (kW) | Critical HRR (kW) | # of Sources Retained |
|---|---|---|---|---|---|---|---|
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| Table 2.6.1 - Severity Factor and Damage/Ignition Time Worksheet (Used in Step 2.6) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Source # | Source Description/Location | Source Count | Scenario (Check one or both) | | Damage and/or Ignition Target | Target Type | Target Distance (ft.) | | Severity Factor | Damage or Ignition Time (min) |
| | | | FDS 1 | FDS2 | | | Vertical | Radial | | |
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Page ____ of ____ Fire Area ID: Fire Zone ID:

| Table 2.7 - Non-Suppression Probability Worksheet (Used in Step 2.7) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Source # | Source Description/Location | Source Count | Scenario (Check one or both) | | Damage Time (min) | Detection Time (min) | Suppression Time (min) | $NSP_{fixed}$ | $NSP_{manual}$ | NSP |
| | | | FDS 1 | FDS2 | | | | | | |
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Fire Zone ID: [ ]

ATTACHMENT 1
Revision History for IMC 0609, Appendix F Attachment 1

| 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) |
|---|---|---|---|---|
| | 02/27/2001<br>CN 01-005 | IMC 0609, App F, Att 1 "Application of Fire Protection Risk-Significant Screening Methodology to Hypothetical Cases," has been revised to update the examples to reflect the change made to Appendix F defining fire scenarios. | | |
| | 09/28/2004<br>CN 04-016 | IMC 0609, App F, Att 1 "Part 1: Fire Protection SDP Phase 1 Worksheet," is revised to provide the qualitative screening approach and the guidance and worksheets for the inspectors to complete a phase 1 screening process of fire protection related findings. | | |
| | 02/28/2005<br>CN 05-022 | IMC 0609, App F, Att 1 "Part 1: Application of Fire Protection SDP Phase 1 Worksheet," is revised to correct the base fire frequency for non-qualified cables, medium loading in Table 2.1.8 on page F1-9. | | |
| | ML13193A044<br>09/20/2013<br>CN 13-022 | This update incorporates an expanded Phase 1. This was created in response to a large number of comments we received from the regional senior reactor analysts (SRAs) via the ROP feedback and the Risk Network initiative. Specific key improvements include: (a) inclusion of additional screening questions for each of the fire finding categories based on review of archived fire SDP items, fire data, and expertise that were not available at the previous release of Appendix F, (b) expansion of initial quantitative screening to include a non-suppression probability term, and (c) addition of an option to rely on licensees' fire PRA assessment of fire findings under appropriate oversight. Incorporated recommendations from ROPFF 0609F1-1796. | None | ML12249A185<br>ML13039A091 |

| 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) |
|---|---|---|---|---|
| | ML17089A418<br>DRAFT<br>CN 17-XXX | Major revision to incorporate substantial changes to Phases 1 and 2.<br>Incorporated recommendations from ROP Feedback Form 0609F1-2168.<br>CA Note sent 7/18/17 for information only, ML17191A681.<br>Issued 10/11/17 as a draft publically available document to allow for public comments. | November 2017 | ML17093A178<br>0609F1-2168 |
| | ML18087A417<br>05/02/18<br>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 | ML17093A178<br>0609F1-2168<br>ML18096A597 |