

Module 5: Phase 2 Details

Steps 2.1-2.4

Module 5: Phase 2 Details

- We will cover each step and task in Phase 2:
 - Purpose/objective
 - What, why, how
 - Input/output
 - Supporting guidance
 - Some Examples – focus on a step/task

Step 2.1: SSD path first check

- This step involves a course assessment of the designated post-fire safe shutdown path
 - Can we credit SSD path prior to development of scenarios
 - If so, what is appropriate screening CCDP value
- If we can show that the path is independent of any fire scenarios we might develop, we will credit that path right away and for all scenarios
 - Often, we may “attack” the redundant SSD path in one or more scenarios, so we won’t give credit yet
- SSD credit/analysis gets refined after development of scenarios in Step 2.4 and again in Step 2.8
 - This is just a first rough cut

Task 2.1.1: Identify SSD Path

- Path should be documented:
 - Designated SSD path under fire protection program
 - Must have supporting post-fire SSD analysis
 - Must be covered by procedures
- BTW: If the answer to any one of these is no, then you may well have a SSD finding to deal with

Task 2.1.2 – SSD nominal unavailability

- SSD path is assigned a nominal unavailability factor
 - Possible values are limited to:
 - 1.0, 0.1, or 0.01
- 1.0 means no credit – appropriate if there are questions as to adequacy of SSD
 - e.g., given a SSD finding
- Other cases, guidance on Pg F-11

Unavailability factors (cont.)

- Automatic steam-driven (ASD) train ... including a single turbine-driven component to provide 100% of a specified function...
 - $CCDP_{2.1} = 0.1$
- One train made up of a collection of equipment that together provide 100% of a specified function...
 - $CCDP_{2.1} = 0.01$
- Major operator actions required to support SSD...
 - $CCDP_{2.1} = 1.0, 0.1, \text{ OR } 0.01$ depending on actions (complexity, feasibility, etc.)

Task 2.1.3 – SSD path independence

- Independence has special context here:
 - SSD path should not be lost in any of the fire scenarios we might later develop
 - SSD path components/cables are not included in the target set for any of our possible fire scenarios
 - Fire scenarios definition comes later, so this requires a bit of foresight
- If path might be compromised in any one fire scenario, we don't credit the path yet
 - We still want unavailability, because later we may credit for those scenarios where the path does survive
- List of criteria on Pg F-11-13

Independence Criteria:

- These should be assured by virtue of Appendix R compliance:
 - The licensee has identified and analyzed the SSD SSCs required to support successful operation of the SSD path.
 - The licensee has identified and analyzed SSCs that may cause mal-operation of the SSD path (e.g., the required and associated circuits).
 - The licensee has evaluated any manual actions required to support successful operation of the SSD path and has determined that the actions are feasible.

Independence Criteria (cont.)

- This criteria might be an issue for plants taking credit for long term actions after the fire is out:
 - All manual actions take place outside the fire area under analysis
- Implication of this criterion:
 - No operator actions that take place within the fire-affected area will be credited in Phase 2
 - Feasibility of actions will be reconsidered during Phase 3 so make a note of these in your documentation

Independence Criteria (cont.)

- These three relate to circuit analysis:
 - The licensee has conducted an acceptable circuit analysis
 - Should be a given
 - Any known unresolved circuit analysis issues that could adversely impact the operability of the designated SSD path are identified.
 - No known circuit analysis issues (e.g., a known spurious operation issue) for exposed cables should hold the potential to compromise operability of the identified SSD path.

Independence Criteria (cont.)

- “Exposed cables” guidance:
 - Cables within the fire area under analysis are not considered exposed if
 - they are protected by a non-degraded raceway fire barrier with a minimum 3-hour fire endurance rating.
- OR
- they are protected by a raceway fire barrier with a minimum one-hour fire endurance rating, the area is provided with automatic detection and suppression capability, and none of these elements is found to be degraded.

Independence Criteria (cont.)

- “Exposed cables” guidance (cont.)
 - Cables in an adjoining fire area are not considered exposed if the fire barrier separating adjoining fire area from the fire area under analysis is not degraded.
 - If the finding category assigned in Step 1.1 was “Fire Confinement,” cables located in the adjacent fire area are considered exposed unless they are protected by a non-degraded localized fire barrier with a minimum 1-hour fire endurance rating.

Independence Criteria (cont.)

- The features discussed in previous two slides relate directly to Appendix R III.G.2 Separation strategies
- Basically, when we decide if cables are exposed or not exposed for purposes of SDP fire scenarios:
 - We do credit 3 hour separation as long as barrier is not degraded
 - We do credit 1 hour separation with auto detection and suppression as long as these features/systems are not degraded
 - We do not credit spatial separation within the same fire area
 - We do not credit exemptions or remote shutdown at this stage of analysis

Task 2.1.4 – Screening check

- $\Delta CDF_{2.1} = DF \times (F_{Area}) \times CCDF_{2.1}$

Table A1.2 - Phase 2 Screening Step 1 Quantitative Screening Criteria		
Assigned Finding Category (from Step 1.1):	$\Delta CDF_{2.1}$ Screening Value	
	Moderate Degradation	High Degradation
Fire Prevention and Administrative Controls	N/A	1E-6
Fixed Fire Protection Systems	1E-5	
Fire Confinement	1E-5	
Localized Cable or Component Protection	1E-5	
Post-fire SSD	1E-6	

- $\Delta CDF_{2.1}$ is lower than the corresponding value in Table A1.2 - the finding screens to Green and the analysis is complete.
- $\Delta CDF_{2.1}$ is greater than or equal to the corresponding value in Table A1.2. The analysis continues to Step 2.2

Step 2.2 – FDS determination

- The nature of the finding determines which types of fire scenarios MAY be relevant to risk change
 - If nothing about a scenario changes as a result of the degradation, then the scenario is not relevant
- This step is a quick decision process to decide which FDS's need to be considered as you develop fire scenarios
- The most complex part of this step is Task 2.2.2, FDS3 screening

Task 2.2.1: Initial FDS

Assignment

- Simple look up table:

FDS/Finding Category Matrix			
Finding Type or Category:	FDS1	FDS2	FDS3
Fire Prevention and Administrative Controls	Yes	Yes	Yes
Fixed Fire Protection Systems	Yes	Yes	Yes
Fire Confinement	No	No	Yes
Localized Cable or Component Protection			
Given a High degradation	Yes ⁽¹⁾	Yes	Yes
Given a Moderate degradation	No	Yes	Yes
Post-fire SSD	Yes	Yes	Yes

Note 1: For a highly degraded local barrier, the protected components/cables are treated as fully exposed and may be assumed damaged in FDS1 scenarios, depending on their proximity to the fire ignition source.

Task 2.2.2 – FDS3 screening

- We would really like to drop FDS3 if we can – most of the time you will
 - Multi-area scenarios are rarely risk important so long as the barriers are intact
 - FDS3 is the equivalent of the “multi-room” term in the old SDP
- If the inter-area barrier is degraded, you’re stuck
 - This screening task only applies to findings that are not Fire Confinement category
 - We already did an equivalent screening for the Fire Confinement case in Phase 1 (Step 1.3.2) so we do not repeat

FDS3 screening (cont.):

Exposing and Exposed areas

- Given that the finding is anything other than fire confinement, the fire area you are inspecting is always the exposing fire area
 - The fire always starts somewhere in the exposing fire area
- The exposed fire area may be any adjacent fire area – up, down, sideways
 - You will be evaluating the potential risk due to fire spread to an exposed fire area
- You are going to look for a fire in the exposing fire area that is substantial enough to challenge the fire area's boundaries and spread to the exposed fire area causing additional unique damage there

FDS3 screening (cont.):

How it works

- Series of yes/no questions
 - You start in the Exposing fire area – where the finding is
 - Apply the questions looking at each adjacent fire area as a potential Exposed fire area
 - Look for any one area pair that might give you a credible scenario
 - If FDS3 scenarios do not screen out, you will ultimately identify one area to act as the representative exposed fire area
 - Pick the worst case and go with it – usually based on interesting targets (e.g., redundant safe shutdown path)
 - You won't analyze all combinations in detail
- Questions are virtually identical to those in Task 1.3.2
 - Same general intent and basis
 - Only difference is we assume the barrier between the fire areas is not degraded
 - Words relating to fire endurance rating of the barrier “in it's degraded condition” are dropped

You are going to drop FDS3 if:

- Fire area boundaries for the exposing fire area have minimum 2 hour fire performance
 - You may have a mixed bag of barriers – some 2-hour, some not
 - Drop any room combinations that are separated by a 2-hour barrier
 - For the rest of the questions, focus only on those combinations that don't have 2-hour separation
- The exposing fire area has:
 - Non-degraded gaseous suppression, OR
 - No more than moderately degraded full coverage water suppression, OR
 - Partial coverage water system that covers all in-situ fire ignition sources

(Meeting any one of these conditions is enough)

You will drop FDS3 if (cont):

For these three conditions, remember to focus on specific combinations of fire areas that lack 2-hour separation:

- There are no unique targets in any exposed compartment
- Targets in any exposed compartment are at least 20 feet from the separating fire barrier and/or have passive protection with a one-hour fire endurance
- The fire barrier between fire area has at least 20 minutes fire endurance, AND in situ material won't subject barrier to direct flame impingement
 - i.e., Fire ignition sources are well away from the barrier

(Meeting any one of these conditions is enough)

If you end up retaining FDS3 you must have found:

- A somewhat weak barrier to at least one adjacent fire area (less than 2 hours)
- Questionable or non-existent fixed suppression capability in exposing compartment
- Unique and exposed targets in the adjoining exposed fire area
- The potential for fire that can directly challenge that fire barrier element

It's not hard to develop a fire scenario out of that situation!

Step 2.2 – Summary

- At the end of this step you will be left with one, two, or three FDS's to consider in the development of fire scenarios
 - We still need to develop credible fire scenarios, but this step says we will at least look for scenarios corresponding to each retained FDS
- If you drop one or more FDS's, they never come back

Step 2.2 – One Last Point

- Step 2.2 only tells you that you need to consider the possibility of one or more fire scenarios for each FDS retained
- It does NOT say you MUST develop at least one fire scenario for each FDS
 - Some FDS states may simply not be credible
 - e.g., FDS2 in a fire area with inadequate combustibles to create a hot gas layer
- It also does not say every fire ignition source will lead to at least one scenario for each FDS retained
 - Some fire ignition sources might contribute to only one FDS and not to other FDS's even though the other FDS's were retained

Illustrative Example

Finding: A cable tray associated with the Designated Train B SSD path should have been wrapped but was not (licensee wrapped the wrong tray)

- Finding Category: Localized Cable and Component Protection
- Degradation: High
- Task 2.2.1 says nominally retain FDS1, FDS2, FDS3
- To fill out example, let's assume:
 - We know exactly where the train B tray is
 - The train B tray is routed in the first (lowest) tray among a stack of trays directly above a bank of electrical panels
 - There are various other panels and equipment in the fire area, and many train A cable trays
 - FDS3 screened out in 2.2.2

Illustrative Example (cont.)

So lets develop scenarios!

- General Observations: Fire Sources
 - We have several fire sources around the room
 - The row of electrical panels directly below the train B tray are of particular interest, but other more remote sources may also be important

Illustrative Example (cont.)

Scenario development (cont.)

- Second key factor in scenario development is target sets:
- Targets of interest are:
 - Train A cables throughout the room
 - Specifics lacking so we assume they are everywhere
 - Loss of any exposed tray causes loss of Train A
 - The cables in the un-wrapped Train B tray
 - Can cause loss of the post-fire SSD capability
- Implies we might have two target sets:
 - Target set 1: Loss of Train A cables only
 - Target set 2: Loss of both Train A and Train B cables
- Why not target set 3: Train B only?

Illustrative Example (cont.)

- For the bank of electrical panels directly below the unwrapped Train B tray:
 - First exposed cable tray has Train B
 - Any tray gives us loss of Train A
 - FDS1 scenarios get us loss of both Train A and B – Target set 2
 - Do we need FDS2?? Answer: NO
 - FDS2 scenarios can't add anything new
 - We already lost both trains including the SSD train
 - For these sources, FDS1 scenarios are enough to characterize the risk change – Target set 2 applies

Illustrative Example (cont.)

- What about fire sources remote from un-wrapped tray?
 - FDS1 scenarios will not damage train B cables – Target set 1 applies - Train A only
 - Question to ask yourself: Does the lack of a wrap on the train B cable tray change these FDS1 scenarios in any way?
 - Answer in this case: NO – FDS1 is not attacking the train B tray, so lack of thermal protection is irrelevant.
 - Result: Fires leading to loss of train A only are not relevant to the finding against the train B wrap - FDS1 scenarios need not be pursued for these fire ignition sources

Illustrative Example (cont.)

- The remote fire ignition sources (cont.)
 - FDS2 scenarios – fire spreads to overhead cables causing a damaging hot gas layer
 - These scenarios can damage both the Train A and Train B cables
 - Are these scenarios relevant?? **ASOLUTELY!**
 - For the remote fire ignition sources the FDS2 scenarios characterize risk change relevant to the finding
 - We don't need to analyze the FDS1 scenarios in detail for the remote fire ignition sources

Illustrative Example (cont.)

- To summarize:
 - Risk change will be characterized by a combination of FDS1 and FDS2 scenarios
 - For the panels directly under the train B tray, we analyze FDS1 scenarios only
 - For the other remote fire ignition sources, we analyze FDS2 scenarios only
 - For this case, we probably can characterize risk with just two fire scenarios by appropriately grouping the fire ignition sources!

Step 2.3 – Scenario and Ignition Sources

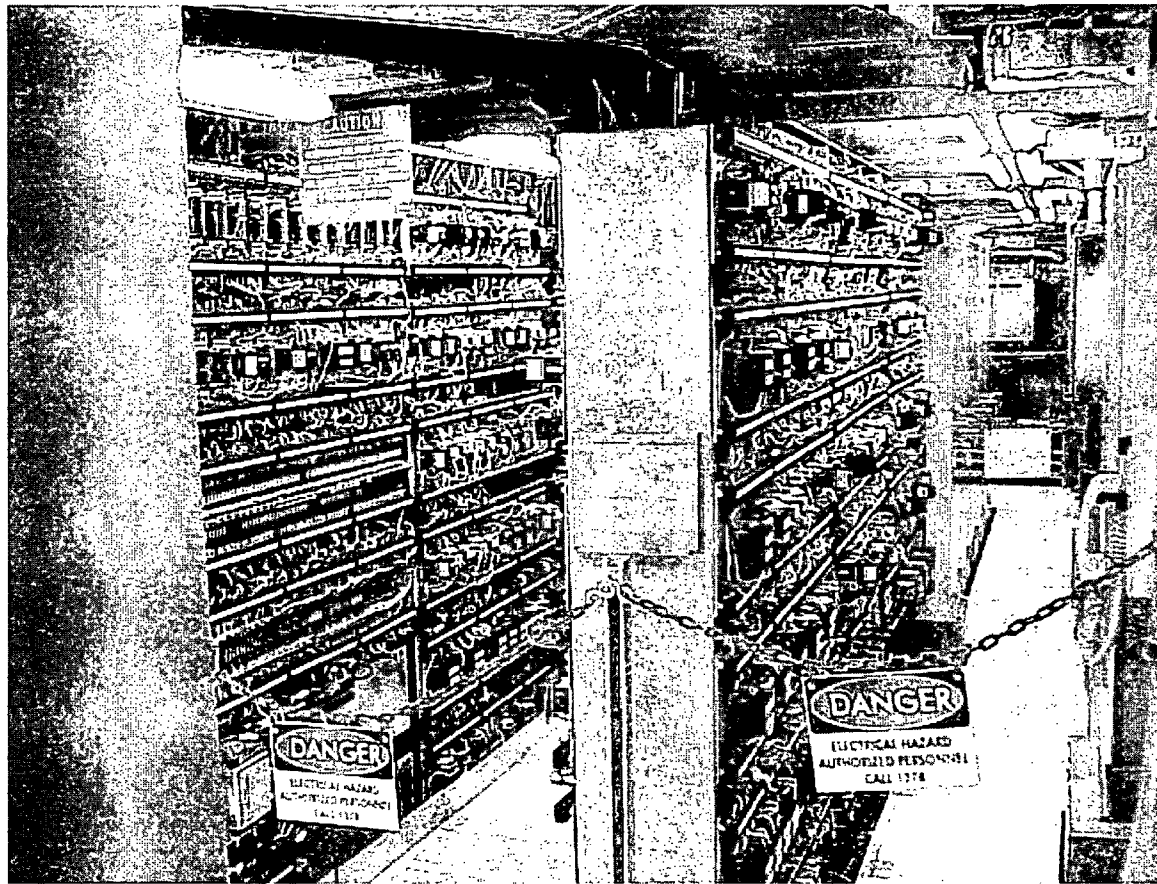
- Purpose of this step is to begin defining fire scenarios
 - That last illustrative example started us on this path!
- First point of focus is to identify fire ignition sources to be retained for further analysis
 - Identify and count fire ignition sources
 - Screen out non-threatening fire ignition sources
 - Revised room fire frequency based on retained fire ignition sources
 - Screening check using new room fire frequency

Task 2.3.1 – Count Sources

- For most cases, we use a component-based fire frequency so first task is to count fire ignition sources
 - If you use spreadsheet, entering counting results automatically updates the fire frequency
- For transients, cables, and hot work fires, the area is ranked as High – Moderate – Low
 - There is ranking guidance provided
 - Intent is to do a relative ranking – how does this fire area compare to other fire areas in the plant?
- Any questions on counting/ranking guidance??

There will be counting challenges

- How many “distinct vertical sections” do you see?



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Counting

- Use your judgment!
- Goal is to get a reasonable estimate of the fire frequency
 - Avoid optimism but also avoid gross conservatism
- For the illustrated relay racks, two possible options are:
 - There are some distinct divisions between sections visible that could be counted as panel divisions
 - Q: how would this weigh against general plant practice and other electrical panels? Does it seem reasonable?
 - You could assume a “typical” panel is about 3 feet wide, and assign the relay racks an equivalent panel count based on the total linear feet of racks

Task 2.3.1 – Special cases

- For some findings, only a specific subset of potential fire ignition sources are considered
 - High degradation finding against combustible material controls – only transient fire ignition sources are relevant
 - High degradation finding against hot work fire watch – only hot work fires are relevant

Focus on what changes

- You want to focus on fire ignition sources where a scenario will change given the finding – example:
 - If a portion of a fire sprinkler is out of service, focus on sources that would normally be covered but now are not
 - Given a lack of detection within a beam pocket, focus on fire ignition sources that are also within/under that same beam pocket
- Use your judgment and limit your search as appropriate
 - No different than what you are already doing

Focus on what might prove to be credible

- Don't waste time worrying about fire ignition sources that will clearly not yield a credible fire scenario – Example:
 - If you have an issue in one corner of a reactor building, and there is a small fire source isolated at the opposite end of the building, Don't waste time worrying about that source
 - If it's obvious that the fire cannot spread enough to create a damaging hot gas layer, then you have no FDS2 and the scenario is not going to be credible
- Document your logic and move on.

Task 2.3.2: Characterize Sources

- We talk about simple and non-simple fire ignition sources
 - Simple: panels, other electrical fires, transformers, engines, heaters, transients
 - Non-simple: self-ignited cable fires, energetic arcing faults, transients that exceed nominal size, hot work fires, liquids, hydrogen
- We are going to talk about simple sources now, we will cover non-simple sources in Module 6 (with examples)

Task 2.3.2 – Simple sources

- For simple sources, pull HRR values from the lookup table for each fire ignition source
- Two values for each source:
 - Lower value represents 90% of fires – the “expected value”
 - Higher value represents upper 10% of fires – the “high confidence value”
- There is some inconsistent terminology here:
 - SDP calls the “expected value” the “50th percentile”
 - Fire Risk Requantification Study uses the exact same “expected value” but calls it the “75th percentile”
 - High confidence value: SDP says “95th percentile”, FRRS says “98th percentile”
 - The HRR values are right, FRRS probably has percentiles right.

Fire Characteristics Table

Mapping of General Fire Scenario Characterization Type Bins to Fire Intensity Characteristics						
Fire Size Bins	Generic Fire Type Bins with Simple Predefined Fire Characteristics					
	Small Electrical Fire	Large Electrical Fire	Indoor Oil-Filled Transformers	Very Large Fire Sources	Engines and Heaters	Solid and Transient Combustibles
70 kW	50 th Percentile Fire				50 th Percentile Fire	50 th Percentile Fire
200 kW	95 th Percentile Fire	50 th Percentile Fire			95 th Percentile Fire	95 th Percentile Fire
650 kW		95 th Percentile Fire	50 th Percentile Fire	50 th Percentile Fire		
2 MW			95 th Percentile Fire			
10 MW				95 th Percentile Fire		

Task 2.3.2 – Simple Sources (cont.)

- Assign a location for the fire origin
 - For general fire ignition sources, place origin on top of the fire source
 - e.g., a motor, transformer, etc.
 - Exceptions:
 - Cabinets/Panels: 1 foot below the top of the panel
 - Pool fires: on floor at center of pool
 - Transients: 2 feet above the floor at desired location
 - Hydrogen fires: at the point of gas release

Tasks 2.3.3 and 2.3.4

- We need to screen ignition sources:
 - If we can ignite or damage any secondary target, we keep the ignition source
 - If we cannot damage/ignite nearest target, we drop that ignition source
- Three considerations:
 - Plume exposure
 - Radiant heating
 - Hot gas layer
- Screening is done in two tasks...

Task 2.3.3 – Nearest target

- In this task you identify the nearest and/or most vulnerable target to each fire source
 - Don't need to define a full target set (yet), just find the one most likely to fail/ignite
- Target can be either a damage or ignition target – it's all the same to this step
 - Target's function does not matter – does not need to be a SSD component for example
- For now, we just want to know if the fire ignition source is capable of either spreading fire to secondary combustibles OR damaging one or more potential targets

Task 2.3.3 – Nearest target (cont.)

- Look for targets directly above fire
 - Plume heating
- Look for targets off to the side
 - Radiant heating target
- If nothing else, you will have some target for hot gas layer exposure
- If you can't find a target, you should not be in that room

Task 2.3.3 (cont.)

- Note target location relative to fire ignition source
 - Height above source
 - Horizontal distance
- Targets are almost always cables
 - For most equipment, cables are the weak spot
 - e.g., A motor will likely fail because the fire damages it's power and/or control cables, not because the fire overheats the motor itself
 - Find out if you are dealing with thermoplastic or thermoset cables
- Integrated circuit components also valid targets
 - IC components are weaker than their cables

Task 2.3.4 – Screening sources

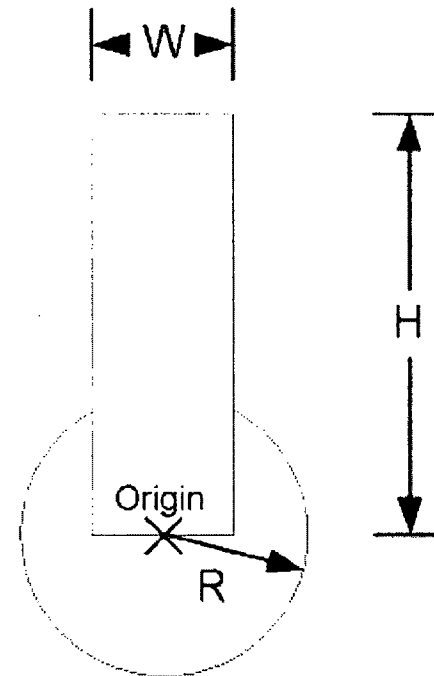
- This task decides if a given fire ignition source can spread fire and/or damage the most vulnerable target
- We do two types of check:
 - Zone of Influence (or Ball and Column)
 - Column = Plume
 - Ball = Radiant heating
 - Hot gas layer temperature

Fire Ignitions Sources and HRR

- You must consider both the expected and high confidence HRR values for each source
 - Check the (lower) expected HRR value first
 - If you retain a source at the expected value, then you clearly keep it at the high confidence value also!
 - If expected value is not enough to retain, then check the (higher) high confidence HRR value
 - If a fire ignition source screens at both HRR values, then it drops out of the analysis entirely
 - No need to track this fire ignition source any further
 - You may retain a source at it's high confidence HRR, and screen it out the expected value
 - That's OK (more later) and probably will be pretty common

Zone of Influence Chart

- Graphical zone of influence chart
 - Height (H) and radius (R) are from look up tables
 - Width (W) corresponds to footprint of the source



Zone of Influence

Typical look-up table

For fires in an open area away from walls or corners:

Calculated Values (in feet) for Use in the Ball and Column Zone of Influence Chart for Fires in an Open Location Away from Walls				
Fire HRR	Thermoplastic Cables		Thermoset Cables	
	H	R	H	R
70 kW	4.8	1.8	3.5	1.3
200 kW	7.3	3.0	5.3	2.1
650 kW	11.6	5.4	8.5	3.8
2 MW	18.2	9.5	13.3	6.7
10 MW	34.7	21.3	25.3	15.0

Calculations are based on the following damage criteria:

Thermoplastic Cables: 400°F (325°F rise above ambient) and 0.5 BTU/ft²sec

Thermoset Cables: 625°F (550°F rise above ambient) and 1 BTU/ft²sec

Zone of Influence (cont.)

- Fire location can make a difference – 3 cases:
 - Fires in the open (away from walls)
 - Fires near a wall
 - Fires near a corner
- What do we mean by “near”?
 - Near = within 2 feet of the wall
 - Near a corner = within 2 feet of both walls
- When near a wall or corner, plume effect is “magnified” (2 for a wall, 4 for a corner)
 - Separate H and R lookup tables for these two cases

Zone of Influence (cont.)

- If there is at least one target within the zone of influence, then:
 - We have the potential for fire spread and/or damage due to plume and radiant heating effects
 - The fire ignition source is retained
- If there are no targets within the zone of influence, then:
 - Fire cannot spread from that particular ignition source to any secondary fuels
 - Plume and radiant heating effect cannot cause damage to any of the potential targets in the room
 - Need to check hot gas layer to determine if source must be retained

Zone of Influence (cont.)

- Essentially, the zone of influence chart is a visual check
 - Have your HRR and H-R lookup tables handy when you do your walkdown
 - You can quickly perform this screening check for most of the sources in the room
 - Ball-park on distances is OK
 - If it looks really close, assume you are right at the threshold and go from there

Zone of Influence (cont.)

- If you are dealing with a HRR value not included in the tables (i.e., any one of the standard values) you will have to re-calculate the H and R values for your fire
- FDT spreadsheets can do this
 - For H – use plume correlation and look for height where plume temperature equals damage threshold
 - Unless it's a pool fire, use a standard fire surface area of 6 square feet
 - For R – use radiant heating correlation and look for distance where flux equals damage threshold
 - Recommend you seek guidance if you are not sure

Task 2.3.4 – Hot gas layer

- If a fire source was retained based on the zone of influence, it is retained – period
 - Only need one condition met to retain
- If a source is already retained, don't bother checking hot gas layer for that source
 - Could save you some time
 - Won't hurt if you check anyway, but it is really a waste of time at this point
- If you did not retain for zone of influence, have to double-check HGL temperature before we drop that source

Hot gas layer (cont.)

- Check the hot gas layer temperature for any fire ignition sources that had no targets within their zone of influence
 - Nothing in the zone of influence means no spread of fire beyond the fire ignition source
 - That means for damage, fire source in and of itself has to be enough to create damaging hot gas layer
- If such sources can create a hot gas layer temperature above the failure threshold of the weakest target, the source is retained
 - This will be rare!
 - Need a pretty big source in a pretty small room

Hot gas layer: Process

- The hot gas layer check requires use of the FDT spreadsheet tool
 - Recommendation: Use the natural ventilation spreadsheet and assume an open door (standard commercial door is 36"x84")
 - Warning: Do not run a zero ventilation case using either natural or forced ventilation spreadsheet – the correlations don't work unless there is some substantial ventilation assumed
- Required inputs:
 - Room dimensions (L-W-H); ventilation conditions; fire HRR
- Record the hot gas layer temperature at 30 minutes
- Compare HGL temperature to target damage threshold
- Fire Ignition Source screens out if HGL temperature is less than damage threshold

Hot gas layer (cont.)

- Fire location makes no difference for hot gas layer
- That means you don't have to repeat the temperature analysis for each and every fire ignition source
- Do the calc once for each unique HRR
- The answer is the same for all fires sources at that particular HRR

Task 2.3.4 – Summary

- You end up with a screening result for each fire ignition source – three outcomes possible:
 - Source may be retained at both the expected and high confidence HRR values
 - Source may be retained only at the high confidence HRR value
 - Source may screen out
- Note that if the source is retained at the expected HRR value, it is also retained (by definition) at its high confidence HRR value

Task 2.3.5 – Screening check

- If no fire ignition sources were retained, then you failed to identify a credible fire scenario
 - In this case you are done – finding is green
- This requires that all sources screened out at both their expected and high confidence HRR values
 - If even one source at one HRR value is retained, you continue to next step

Step 2.4 – Refined fire frequency

- In this step a new refined fire frequency for the fire area is calculated
 - We remove the contribution associated with fire ignition sources screened out in Step 2.3
 - We apply severity factor of 0.1 for those sources retained only at their high confidence HRR value
- Using the refined fire frequency, the quantitative screening check is repeated
 - New information (better fire frequency) may be enough to call a finding green

Task 2.4.1 – Nominal fire freq.

- Enter the results of Task 2.3 into a fire frequency worksheet (or spreadsheet)
 - Counting results for retained fire ignition sources
 - Severity factors as applicable
 - Sources retained only at the high confidence HRR value get a severity factor of 0.1
 - Sources retained at both the expected and high confidence values use severity factor of 1.0 (no severity factor reduction)
 - Sources screened out in 2.3 are not included in the refined fire frequency
 - kind of like a severity factor of 0.0

Task 2.4.2 – Findings that increase fire frequency

- Certain findings result in an increase in the fire frequency being applied
 - High degradation findings against combustible material control programs with low or medium likelihood rating – raise the likelihood rating one level
 - High degradation findings against combustible material control programs with high likelihood rating – multiply nominal transient fire frequency by 3
 - High degradation findings against hot work fire watch – set the hot work fire likelihood to high and multiply by a factor of 3

Task 2.4.3 – Freq reductions

- Two cases where frequency may be reduced:
 - Transients
 - Hot work

Reduction to transient freq.

- Transient fire frequency is reduced by a factor of 3 if verifiable measures are in place to promptly identify and remove transients from the area under analysis
 - If finding is against the combustible controls program this provision will not apply – do not reduce fire frequency

Reductions to hot work freq.

- If it can be verified that no hot work was performed in the fire area during the finding exposure period, the hot work fire frequency may be set to zero
 - That means no hot work fire scenarios
 - If finding is against hot work control requirements (e.g., fire watch) this provision will not apply – do not reduce fire frequency

Task 2.4.4 – Update frequency and screening check

- The fire frequency for the fire area is re-calculated considering
 - Elimination of fire ignition sources that were not retained in Step 2.3
 - Application of severity factors for ignition sources retained only at their higher fire HRR value
 - Adjustment factors as applicable for transients and hot work fires
- May be done using hand worksheet or using an electronic spreadsheet

Task 2.4.4 – screening check

- Screening check is essentially identical to that from Step 2.1, but the updated fire frequency is applied

Screening Criteria for Step 2.4

- $\Delta CDF_{2.4} = DF \times (F_{Area2.4}) \times CCDF_{2.1}$

Table A1.6 - Phase 2, Screening Step 4 Quantitative Screening Criteria		
Assigned Finding Category (from Step 1.1):	$\Delta CDF_{2.4}$ screening value	
	Moderate Degradation	High Degradation
Fire Prevention and Administrative Controls	N/A	1E-6
Fixed Fire Protection Systems	1E-5	
Fire Confinement	1E-5 ¹	
Localized Cable or Component Protection	1E-5 ¹	
Post-fire SSD	1E-6	

¹ This entry applies to both 'Moderate A' and 'Moderate B' findings against a fire barrier.

- $\Delta CDF_{2.4}$ is lower than the corresponding value in Table A1.6 - the finding screens to Green and the analysis is complete.
- $\Delta CDF_{2.4}$ is greater than or equal to the corresponding value in Table A1.6. The analysis continues to Step 2.5