

# Module 4: Phase 1 Details

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D-16

# Phase 1 Details

- We will cover each step and task in Phase 1:
  - Purpose/objective
  - What, why, how
  - Input/output
  - Supporting guidance

# Phase 1- Step 1.1

- Assign a finding category
  - A convenient way to bin (classify) findings
- Later decisions will depend on the assigned category:
  - Degradation ratings
  - Quantitative screening criteria
  - The types of fire scenarios that are relevant
- Look for the underlying issue leading to a finding and assign category accordingly

# And the categories are...

- Cold Shutdown
- Fire Prevention and Administrative Controls
- Fixed Fire Protection Systems
- Fire Confinement
- Localized Cable or Component Protection
- Post-Fire Safe Shutdown

# Cold Shutdown Findings

- Findings associated with systems and features only required to support or achieve cold shutdown
- Examples:
  - An issue related to RHR so long as:
    - RHR is not needed/relied upon to support post-fire hot shutdown
    - Spurious operation of RHR component(s) cannot compromise the hot shutdown capability

# Fire prevention and administrative controls

- Findings relating to combustible control programs, training, permit processes, activity specific fire watches, etc.
- Examples:
  - Violation of combustible control limits
  - Failure to follow hot work permitting requirements
  - Failure to properly execute hot work fire watches
  - Deficiencies in fire-protection related training
  - Records keeping issues

# Fixed fire protection systems

- Findings related to fixed fire detection and suppression systems or a fire watch posted as a compensatory measure for a degraded fixed fire detection or suppression system
- Examples: Sprinklers, deluge, room flooding gas systems, smoke or heat detectors, etc.
- Exclude fire separation features
  - Passive features such as fire barriers, doors, dampers, seals, wraps
  - Water curtains (as a fire barrier element)

# Fire Confinement

- Findings related to fire barriers and barrier elements that separate fire areas
  - Walls/floors/ceilings
  - Penetration seals
  - Doors
  - Dampers
  - Water curtains when used as a separation element



# Localized Cable or Component Protection

- Passive fire protection features meant to protect cables and/or components from fire damage given fires within the same fire area
  - Cable and raceway fire wraps
  - Radiant energy shields
  - Spatial separation
  - Fire barriers between fire zones within a fire area

# Post-Fire Safe Shutdown (SSD)

- Findings that directly impact systems or functions identified in the post-fire SSD analysis
  - Circuit analysis related issues (e.g., spurious operation)
  - Completeness of the post-fire SSD equipment list or post-fire SSD analysis
  - Post-Fire safe shutdown procedures
  - Manual actions
  - Remote/alternate shutdown

# Fire Barriers versus Safe Shutdown

- Example: A hole in a raceway fire barrier (made during maintenance) was not properly sealed upon completion of maintenance activities. The barrier protects a cable associated with the designated post-fire safe shutdown path.
  - This one should be obvious - a localized cable or component protection issue

## Barriers versus safe shutdown (cont.)

- Example 2: The licensee committed to providing fire-wraps for certain post-fire safe shutdown cables. In one case, the wrong cable tray was wrapped, and the correct tray was left un-protected
  - This is a Localized Fire Barrier issue
  - The underlying issue is failure to provide the barrier that was committed to
  - Treat as highly degraded raceway fire barrier

## Barriers versus Safe Shutdown (cont.)

- A cable associated with the designated post-fire safe shutdown path is found to be exposed (with no fire wrap) in a fire area where it is required to support safe shutdown. Further review reveals that the licensee failed to identify the cable as a required component.
  - This is a Safe Shutdown Finding – failure to identify a required component is the underlying issue.

## Barriers versus Safe Shutdown (cont.)

- It is determined that spurious operation on a particular circuit could compromise the designated post-fire safe shutdown path (open a diversion path) for the area being inspected. A cable that could cause the spurious operation is found to be exposed (with no fire wrap) in the fire area being inspected. The licensee did not identify the circuit as an associated circuit, hence, the cable is not on the post-fire SSD component list.
  - This is a Safe Shutdown Finding – failure to identify an associated circuit is the underlying issue.

# Finding Categories (cont.)

- Category assigned ‘maps’ to elements of the analysis process:
  - Fire prevention and administrative controls → changes in fire frequency
  - Fixed Fire Protection → longer time to fire suppression
  - Fire Confinement → focus on FDS3 Scenarios
  - Localized Cable or Component Protection → Focus on scenarios that damage protected component
  - Post-Fire Safe Shutdown – changes in CCDP

# Finding Categories – a final note

- Once assigned, category does not change



# Phase 1 – Step 1.2

- Assign a degradation rating
  - In general pick one: High – Moderate – Low
  - Exceptions:
    - No Moderate for Fire Prevention and Administrative Controls (call it either high or low)
    - For Fire Confinement and Localized cable and Component Protection (fire barriers) Moderate is split into “Moderate A” and “Moderate B”
- Degradation rating criteria depend on finding category (from Step 1.1)
  - See Attachment 2

# Questions on the degradation rating guidance?

- Don't intend to cover Attachment 2 guidance in detail, but open to questions and/or discussion

# Degradation Rating – final note:

- Once set, degradation rating doesn't change

# Phase 1 – Step 1.3

- Initial Qualitative Screening
  - Based on a series of yes/no questions
  - Questions are phrased so that a “yes” will mean screen to green
    - wording is a tad awkward in some cases
- Two Tasks:
  - Task 1.3.1 applies to all findings
  - Task 1.3.2 applies to only Fire Confinement findings

# Phase 1, Task 1.3.1

- Two Question only
- Any finding Screens to Green if:
  - Degradation rating is LOWOR
  - Finding only effects the ability to achieve and maintain COLD SHUTDOWN
    - Example: RHR system issue so long as RHR is not required for post-fire hot shutdown

# A note on Low and Green

- A finding does not have to be rated LOW degradation to be GREEN
  - If degradation is Low, finding is Green, but...
  - Even if degradation is greater than Low, finding may still be Green
- Even a high degradation may be Green
  - Moderate and High degradation findings will generally pass forward to Phase 2
    - Some exceptions for moderate fire confinement
  - Phase 2 may still conclude that finding is Green
  - We don't re-assign the degradation rating to Low just because Phase 2 screens the finding to Green

# Phase 1, Task 1.3.2

- Applies to Fire Confinement findings with Moderate degradation only
  - Recall: fire confinement = fire area boundaries
- Screen to green if inter-area fire scenarios will not be risk significant even given the degradation
  - No unique targets in adjacent room
  - Low likelihood of fire barrier failure:
    - Adequate performance time even given degradation
    - DID – fire suppression capability
    - DID – additional passive fire protection
  - No substantive fire hazards present
    - cannot challenge barrier

# Fire Confinement – a note on terminology

- PRA practice is a bit loose on terminology here
- You may see reference to:
  - Inter-area fires, inter-compartment fires, room-to-room fires, multi-room fires
- They all mean basically the same thing
  - Watch “fire area” versus “fire compartment” definitions
  - By fire area, we mean the Appendix R context (RG01-189):
    - “The term “fire area” as used in Appendix R means an area sufficiently bounded to withstand the hazards associated with the area and, as necessary, to protect important equipment within the area from a fire outside the area..
- For SDP Fire Confinement relates only to the fire barriers that separate one fire area from another



# Exposing versus Exposed Compartment

- Remember: Fire confinement findings always involve two fire areas
  - “Exposing compartment” is fire area where you will assume that fire starts
  - “Exposed compartment” is the fire area on the other side of the degraded fire barrier
- Remember to look both ways...
  - You will pick one orientation for actual analysis
  - Generally pick orientation where fire in exposing compartment will create greatest challenge to the degraded fire barrier

# Exposing versus Exposed (cont.)

- Indicators for choosing exposing compartment:
  - More challenging fire ignition sources
    - Higher intensity (e.g., a source of big oil fires makes for an obvious choice)
  - Fire ignition sources adjacent to degraded barrier
  - Lacks automatic fire suppression coverage
- Point is that you need to develop a fire scenario leading to spread through the degraded barrier so you need a significant fire source in the Exposing compartment

# Task 1.3.2, Question 1

Q: Will the barrier in its degraded condition provide a 2-hour or greater fire endurance rating?

- If Yes – Screen to Green, no further analysis required
  - If No – Continue to next question
- Degraded fire endurance rating is based on degradation rating and nominal rating
  - Moderate A means 66% of nominal rating
  - Moderate B means 33% of nominal rating
  - High means no credit or zero endurance rating
- This one won't help very often
  - Mod. A on a 3 hour barrier gives equivalent of 2 hours
  - A non-rated barrier that you judge to be equivalent to 2 hours

## Task 1.3.2, Question 2

Q: Is there a non-degraded automatic gaseous room-flooding fire suppression system in the exposing compartment?

- If Yes – Screen to Green, no further analysis required
- If No – Continue to next question
- We are crediting Defense In Depth measures
- Gaseous systems must be non-degraded – no performance issues
- We are looking at a feature that will disrupt the initial fire growth

## Task 1.3.2, Question 3

Q: Is there a non-degraded or no more than moderately degraded automatic full area water-based fire suppression system in the exposing compartment?

- If Yes – Screen to Green, no further analysis required
  - If No – Continue to next question
- Again, a defense in depth credit
- For water-based system, we do allow credit given a moderate degradation
  - System works, but has some performance issues
- Again, looking for something that disrupts initial fire growth

## Task 1.3.2, Question 4

Q: Can it be determined that the exposed compartment contains no potential damage targets that are unique from those in the exposing fire area (damage targets may 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))?

- If Yes – Screen to Green, no further analysis required
- If No – Continue to next question
- Wording is awkward – we wanted ‘yes = green’
- Point is you need unique targets in exposed area to make an inter-area fire scenario significant
  - If all possible targets are also in the exposing fire area, spread across boundary adds nothing new

# Task 1.3.2, Question 5

Q: Are all potential damage targets in the exposed fire area (as described in question 4) provided with passive fire barrier protection with no more than a moderate degradation that will provide a minimum of 20 minutes fire endurance?

- If Yes – Screen to Green, no further analysis required
- If No – Continue to next question
- Credit for passive fire barrier elements as a DID element so long as barrier is good for at least 20 minutes
  - Fire would need to breach two passive barriers with no more than moderate degradation – both barriers will get some credit
  - Starts to look pretty unlikely

## Task 1.3.2, Question 6

Q: Is a non-degraded or no more than moderately degraded partial-coverage automatic water based fire suppression system installed in the exposing compartment and are all the fixed or *in-situ* fire ignition sources included within the zone of coverage for this system?

- If Yes – Screen to Green, no further analysis required
- If No – Continue to next question
- A lot like Question 3, but we relax full coverage requirement
  - As long as all fixed fire sources are covered by the suppression system, we give DID credit



## Task 1.3.2, Question 7

Q: Does the degraded barrier provide a minimum of 20 minutes fire endurance protection and are the fixed or *in situ* fire ignition sources and combustible or flammable materials positioned such that, even considering fire spread to secondary combustibles, the degraded barrier or barrier element will not be subject to direct flame impingement?

- If Yes – Screen to Green, no further analysis required
- If No – Continue to Step 1.4
- We relax the performance requirement on the degraded barrier if we won't have direct flame impingement on the barrier

# Phase 1 – Step 1.4

- Initial Quantitative Screening
- Uses two factors:
  - Duration factor (DF)
  - Room fire frequency ( $F_{\text{area}}$ )
- If product of these two is “low enough”, screen to green
- In practice, this is unlikely to happen
  - Fire area fire frequencies are pretty conservative
  - Screening criteria are still pretty stringent
  - We’ll need DF and  $F_{\text{area}}$  for Phase 2, so do this Step anyway, just don’t expect to screen
  - Step had more meaning in previous iteration, may come back into play in the future

# Task 1.4.1 – Duration Factor

## **Duration of the Degradation**

< 3 days

3 - 30 days

> 30 days

## **Duration Factor (DF)**

0.01

0.1

1.0

- same as it ever was

# Task 1.4.2 – Area Fire Frequency

- $F_{\text{area}}$  Directly from look-up table – see Pg F-8,9
- Intended to be somewhat conservative, but this won't be universally true
  - If a fire area contains a particular concentration of fire ignition sources, the component-based fire frequency for the full fire area as calculated in Phase 2 may be higher!
- Differences should be minor
  - You need to cross an order of magnitude boundary for difference to be significant
  - You may use the Phase 2 approach if table value does not fit your case - use your judgment

# Possible revision (pending)

- If finding is against hot work program, only hot work fires are relevant
- If finding is against transient combustible controls, only transients fire are relevant
- We may give you an upper bound estimate of fire area hot work and transient fire frequency values to use in this step rather than the full room fire frequency

## Task 1.4.3

- Task 1.4.3 sets Phase 1 quantitative screening criteria
- Screening criteria imply an implicit level of risk credit for non-impacted DID elements
  - Criteria depend on the finding category assigned in Step 1.1
  - Remember, if you ever get below  $1\text{E-}6$ , finding is green so no screening criteria is ever more stringent than  $1\text{E-}6$

# Task 1.4.3 – Screening Check

- $\Delta(\text{CDF})_{1.4} = \text{DF} * F_{\text{area}}$

Table A1.1 - Phase 1 Quantitative Screening Criteria		
Assigned Finding Category (from Step 1.1):	$\Delta\text{CDF}_{1.4}$ Screening Criteria	
	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	