

Module III – Fire Analysis

Task 13: Seismic Fire Interactions

**Joint EPRI/NRC-RES Fire PRA
Workshop
August 21-25, 2017**



Task 13 - Seismic Fire Interactions

Scope of this Task

- Task 13 covers the Seismic Fire Interactions review
 - Little has changed compared to the guidance available in the IPEEE days
 - The review remains a qualitative, walk-down based approach to identify and address potential vulnerabilities or weaknesses
 - The procedure does not recommend any quantitative work in this area

The main goal of the outlined methodology is to verify that the the risk associated with seismically induced fires is low.

Corresponding PRA Standard Element

- Task 13 maps to element SF – Seismic Fire
 - SF Objective (per the PRA Standard):
 - To qualitatively assess the potential risk implications of seismic/fire interaction issues

SF HLRs (per the PRA Standard)

- HLR- SF-A: The Fire PRA shall include a qualitative assessment of potential seismic/fire interaction issues in the Fire PRA (5 SRs)
- HLR-SF-B: The Fire PRA shall document the results of the seismic/fire interaction assessment in a manner that facilitates Fire PRA applications, upgrades, and peer review (1 SR)

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Seismically Induced Fires

A severe seismic event may cause fires inside or outside an NPP by damaging . . .

- Pipes and storage tanks containing flammable liquids or gases
- Electrical equipment

An EPRI study and NPPs experiencing earthquakes have demonstrated that these events are rare.

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Background

- Seismic Fire Interactions originated with the Fire Risk Scoping Study (NUREG/CR-5088, 1989)
- The conclusion of that study was:

“It would appear that this is an issue which is more easily corrected than quantified. A series of simple steps was outlined which if implemented on a plant specific basis would significantly reduce the potential impact of such considerations.”

This conclusion remains valid today.

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Key Compartments

- The review should focus on those compartments that house equipment and cables needed to support post-seismic safe shutdown
 - Review your seismic-related procedures and identify key equipment (components and cables) and any required manual actions
 - To the extent possible, map equipment to compartments
 - Identify the associated compartments and focus efforts on these compartments
 - Areas/compartments housing the key equipment (components and cables)
 - Areas where a manual action takes place
 - Access paths for manual actions

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Seismically-Induced Fires

- Potential sources:
 - Unanchored electrical equipment such as that where motion during seismic event might cause a fire
 - Unanchored gas cylinders
 - Flammable gas piping
 - Flammable liquid piping or storage tanks

- If any *significant* sources are identified, consider potential plant modifications to minimize potential hazard.

- **Corresponding PRA Standard SR: SF-A1**

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Degradation of FP Systems and Features

- Review:
 - General plant practice related to seismic restraints for fire protection systems and features
 - Installed systems and features; assess potential for seismic-induced failure

- Assess potential significance of system or feature failure to post-seismic event operations.

- If any potential vulnerabilities are identified, consider fixes to reduce likelihood of failure.

- **Corresponding PRA Standard SR: SF-A2**

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Spurious Detection Signals

- A seismic event will likely trigger activation of various fire detection systems – especially smoke detectors
- Consider how the operators will respond to multiple fire detection signals
 - You can't ignore them even though many may be false
 - Have you identified the issue in your response procedures?
 - Have you (can you) prioritize your response based on the important compartments?
- Consider potential procedural enhancements to recognize and deal with this issue
- **Corresponding PRA Standard SRs: SF-A2 and SF-A3**

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Spurious Suppression Actuation/Release

- Review the fixed fire protection systems in key areas for the potential that they might spuriously operate
 - Got any of those mercury switches left?
 - How about a non-seismic deluge valve?
 - What happens if a sprinkler head is damaged or a pipe breaks?
 - Are storage tanks for gaseous suppressants seismically robust?
- If any potential vulnerabilities are identified, consider fixes to reduce likelihood of spurious suppressant release.
- **Corresponding PRA Standard SR: SF-A4**

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Manual Fire Fighting

- Access pathways to key areas – could something block the path and are there alternative paths?
- Required fire fighting assets – will assets remain available after an earthquake?
 - Especially fire water system and fire hoses
- Do post-seismic response procedures allow for manual fire fighting needs and responsibilities?
- If any potential vulnerabilities are identified, consider fixes
- **Corresponding PRA Standard SR: SF-A5**

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Summary

- Seismic fire interaction is considered a low risk phenomenon
- NPP and other industry experiences partly verify this premise
- A qualitative approach is suggested for verifying that plant specific conditions confirm low risk notion
- Systemic or procedural upgrades are recommended for identified potential vulnerabilities

Mapping HLRs & SRs for the PP Technical Element to NUREG/CR-6850, EPRI 1011989

Technical Element	HLR	SR	6850 Sections	Comments
SF	A	The Fire PRA shall include a qualitative assessment of potential seismic/fire interaction issues in the Fire PRA		
		1	13.3.1 and 13.6.2	
		2	13.3.2, 13.3.3, 13.6.3, 13.6.4, and 13.6.5	
		3	13.3.2,	
		4	13.3.1, 13.3.2, 13.3.3, 13.6.3, 13.6.4, and 13.6.5	Although 6850/1011989 does not explicitly reference seismic response procedures, the suggested guidance implies review of such procedures.
		5	13.3.4 and 13.6.6	
	B	The Fire PRA shall document the results of the seismic/fire interaction assessment in a manner that facilitates Fire PRA applications, upgrades, and peer review		
		1	13.6.7	6850/1011989 provides minimal discussions on documenting SF