

## Individual Study Activity

**TOPIC:** Continuing training for inspectors on the revision to Inspection Manual Chapter (IMC) 0609, Appendix A, "Significance Determination of Reactor Inspection Findings for At-Power Situations."

**PURPOSE:** IMC 0609, Appendix A, has been revised: (1) to correct identified problems with the appendix; (2) to provide guidance on evaluating concurrent inspection findings; (3) to simplify the process of accounting for external initiators in characterizing the risk significance of inspection findings; and (4) to incorporate the rules for using the site specific risk-informed inspection notebooks.

**COMPETENCY  
AREAS:**

- Inspection
- Regulatory Framework
- Assessment and Enforcement

**LEVEL OF  
EFFORT:**

6 - 8 hours

**REFERENCES:**

You will need the following references to complete this activity:

- IMC 0609, Appendix A, dated March 18, 2002.

**EVALUATION  
CRITERIA:**

You will demonstrate your level of understanding of IMC 0609, Appendix A by:

1. Completing this activity.
2. Answering all of the questions related to this activity.
3. Recording your answers at the SDP Training website. At the website you will have a chance to "grade" your own test and see which questions you answered incorrectly. **THIS IS NOT A FORMAL, FOR-THE-RECORD TEST**, but rather a chance for you to see which SDP concepts may have been difficult for you to implement.
4. Reviewing the correct answers for all of the questions contained in this activity, but especially those that you did not answer correctly. This review is important because it will reinforce the SDP concepts behind each question and answer.
5. Submitting your questions, as appropriate, to identify specific topics to be covered in the SDP training to be given in the regional offices during the next inspector counterpart meeting.

**TASKS:**

1. Review the change summary.

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2. Review IMC 0609, Appendix A, Attachment 1, "User Guidance for Significance Determination of Reactor Inspection Findings for At-Power Situations."
3. Review IMC 0609, Appendix A, Attachment 2, "Site Specific Risk-Informed Inspection Notebook Usage Rules."

**CAUTION: You must follow the steps in Task 4 in order to be successful in completing the exercises. READ TASK 4 CAREFULLY AND FOLLOW THE INSTRUCTIONS.**

4. Perform each of the exercises in the following manner.
  - Make a hard copy of the Inspection Notebook that is appropriate for the exercise to be worked (e.g., Risk-Informed Inspection Notebook for Generic BWR Nuclear Power Plant).
  - Make a copy of Table 6 from IMC 0609, Appendix A, Attachment 1.
  - Review the scenario. Perform a Phase 2 analysis of the finding described in the exercise by using the guidance in IMC 0609, Appendix A, in a "step-by-step" manner.
  - Following completion of each Phase 2 evaluation, answer the questions for each exercise.
5. Record your answers to the exercise questions at the SDP Training website and complete a review of any questions you answer incorrectly. You access the SDP Training website by doing the following:
  - Open the NRC's internal home page
  - Click on "Employee Training and Development"
  - Select "Self-Paced Learning"
  - Select "Web-based Training"
  - Select "SDP Change Training"
6. Submit questions, as appropriate, to identify specific topics to be covered in the SDP training.

## **Summary of Changes**

### **Objectives**

The objectives for the Reactor Safety Significance Determination Process (SDP) are:

- To characterize the significance of inspection findings in support of the Reactor Oversight Program;
- To provide a basis for assessment and enforcement actions associated with inspection findings;
- To provide all stakeholders an objective and common framework for communicating the safety significance of inspection findings; and
- To provide the staff with plant specific risk information for use in risk-informing the inspection program.

### **Purpose**

Inspection Manual Chapter (IMC) 0609, Appendix A, "Significance Determination of Reactor Inspection Findings for At-Power Situations," provides a simplified risk-informed framework to estimate the increase in core damage frequency during at-power operations due to conditions which contribute unintended risk increases caused by deficient licensee performance. This procedure has been revised to:

- Correct identified problems with the appendix;
- Provide guidance on evaluating concurrent inspection findings;
- Simplify the process of accounting for external initiators in characterizing the risk significance of inspection findings; and
- Incorporate the rules for using the site specific risk-informed inspection notebooks.

### **Expected Benefits**

The expected benefits from this procedure revision include:

- Improve the incorporation of risk insights into planning for the inspection program through greater use of the site specific risk-informed inspection notebooks;
- Improve inspector performance of Reactor Safety Phase 1 and Phase 2 SDP evaluations; and
- Improve efficiency in the characterization of inspection findings in the Initiating Events, Mitigating Systems, and Barrier Integrity Cornerstones.

## Concurrent Inspection Findings

Guidance was added to IMC 0609, Appendix A, Section III, to clarify the treatment of concurrent inspection findings. This guidance specifies that the manner in which concurrent findings are evaluated using the SDP is a function of their cause.

- IF** the concurrent findings resulted from a common cause (e.g., a single inadequate maintenance procedure that directly results in deficient maintenance being performed on multiple components),
- THEN** a single finding will be written and characterized for significance by the total increase in core damage frequency for the time periods during which they existed, using a Reactor Safety Phase 3 analysis.
- IF** independent causes are determined to have resulted in the concurrent findings,
- THEN** separate inspection findings will be written and individually characterized for significance assuming none of the other independent findings existed.

This guidance is expected to be applied in the following manner.

Assume that a finding exists with the A centrifugal charging pump and was characterized as being Green. When a second issue is identified, for example on the B auxiliary feedwater pump, the conditional core damage probability is estimated, in accordance with Management Directive (MD) 8.3, "NRC Incident Investigation Program," to determine whether or not a reactive inspection is appropriate. Because the conditional core damage probability accounts for the existing plant configuration, both components would be considered unavailable for the period of time that they were unavailable, respectively. This conditional core damage probability estimate, without regard to cause, would be one of the inputs used under MD 8.3 guidelines to determine whether or not a reactive inspection was appropriate. In addition, a deterministic factor for determining whether or not there was a casual relationship between the two issues would be incorporated into this decision. Therefore, in the situation provided, a reactive inspection could be performed to obtain the necessary information to make the casual relationship determination, if not already known. If it is determined that a common cause existed, one inspection finding would be characterized at a significance appropriate for both components being unavailable. If a common cause did not exist, each inspection finding would be treated independently.

## Evaluation of the Potential Risk Contribution Due to External Initiating Events

The guidance contained in IMC 0609, Appendix A, Attachment 1, "User Guidance for Significance Determination of Reactor Inspection Findings for At-Power Situations," on evaluating the potential risk contribution due to external initiating events was revised to reduce the burden on the staff. The revised guidance also allows for qualitative or quantitative evaluation of the potential risk contribution due to external initiating events.

Previously, a Reactor Safety Phase 3 analysis was required for all inspection findings to account for the potential risk contribution due to external initiating events. The revised guidance establishes a threshold (Risk Significance Estimation of 7 or less) for inspection findings that are processed using the Phase 2 notebooks, below which external initiators are not required to be evaluated. This threshold was established because the contribution of risk

due to external initiators is not expected to be sufficient to increase the risk significance characterization to greater than Green for inspection findings below this threshold.

The revised guidance also clarifies the screening logic in the Phase 1 Screening Worksheet for evaluating the potential risk significance of inspection findings due to external initiators. Specifically, the Seismic, Fire, Flooding, and Severe Weather Screening Criteria are only evaluated if the finding does not otherwise screen to Phase 2.

### **Incorporation of the SDP Usage Rules**

Attachment 2, "Site Specific Risk-Informed Inspection Notebook Usage Rules," was added to incorporate the rules for evaluating the various types of inspection findings that are expected to be processed using the inspection notebooks. Each of these rules contain a basis and an example describing how the rule is applied. The rules are grouped into three categories (i.e., rules associated with determining the initiating event likelihood, rules associated with determining the remaining mitigation capability, and rules associated with determining the risk significance of inspection findings).

One of these rules (i.e., the counting rule) required that the Phase 2 process be converted from an alpha-numeric to fully numeric scheme. This requires a format change to each of the site specific risk-informed inspection notebooks. Revision 1 to each of the notebooks will incorporate these format changes.

The Risk-Informed Inspection Notebooks provided for use with the accompanying exercises incorporate the Revision 1 format changes. These format changes include:

- Conversion from an alpha-numeric to fully numeric scheme;
- Reordering the columns on the worksheet to coincide with the accident sequences (i.e., initiating event likelihood - remaining mitigating safety functions - recovery credit); and
- Pre-solving each accident sequence. The pre-solved sequence represents the risk of the base case (i.e., the contribution to the core damage frequency for the respective accident sequence within one order of magnitude). It is determined by combining the initiating event likelihood with the full mitigation capability. Because the full mitigation capability exists, recovery credit is not included.

## Exercise 1

### Scenario

Use the Generic BWR Risk-Informed Inspection Notebook for this exercise. During a monthly surveillance to verify the boron concentration in the standby liquid control storage tank, the licensee identified that the boron concentration was substantially less than that required for the system to fulfill its safety function during an anticipated transients without scram (ATWS) event. It was subsequently determined that the cause of the low boron concentration in the tank was the failure to establish the required boron concentration following maintenance on the tank, which had been performed 28 days earlier. If an ATWS had occurred and standby liquid control (SLC) was ineffective in reducing power due to the low boron concentration, the emergency operating procedures would have directed the operators to perform alternate boron injection to reduce reactor power. The operators were trained on the emergency operating procedures, sufficient time was available to perform alternate boron injection before core damage occurred, the equipment was available to perform alternate boron injection and the reactor building environmental conditions would not have been degraded at that point in the event. The Generic BWR Nuclear Plant has a Mark I containment.

**CAUTION: You must have completed the Phase 2 evaluation for this exercise before answering the questions below.**

### Questions

1. (True/False) For this scenario, all of the initiating event worksheets must be evaluated.  
A) False  
B) True
2. The initiating event likelihood that should be used when evaluating the anticipated transients without scram (ATWS) worksheet is:  
A) 4  
B) 5  
C) 6  
D) 7
3. (True/False) All of the sequences on the ATWS worksheet are required to be solved.  
A) False  
B) True
4. (True/False) It is appropriate to give credit for operator recovery actions.  
A) False  
B) True

5. (True/False) The finding is required to be evaluated using Inspection Manual Chapter 0609, Appendix H, "Containment Integrity Significance Determination Process," for its potential risk contribution to large early release frequency (LERF).

A) False  
B) True

## Exercise 2

### Scenario

Use the Generic PWR Risk-Informed Inspection Notebook for this exercise. While performing a complete system walkdown of the high head safety injection (HHSI) system in accordance with Inspection Procedure 71111.04, "Equipment Alignment," an inspector identified that a normally locked open manual valve in the discharge flow path of one train was closed. The valve position for this valve was not indicated in the control room. This valve was also not in the flow path during quarterly surveillance testing of the system. It was subsequently determined that the valve had been out of position since maintenance was last performed on the system ten months prior. The inspectors determined that the criteria for crediting operator recovery of the HHSI train were satisfied and that credit for recovery of the train was appropriate.

**CAUTION:** You must have completed the Phase 2 evaluation for this exercise before answering the questions below.

### Questions

6. For this scenario, which of the initiating event worksheets must be evaluated?
  - A) All
  - B) All except ATWS, LCCW, LODC
  - C) LOOP, SGTR, SORV, SLOCA, MLOCA, LEAC
  - D) All except LLOCA, ATWS, LODC
7. The initiating event likelihood that should be used when evaluating the loss of offsite power with loss of one class 1E 4.16-kV bus (LEAC) worksheet is:
  - A) 2
  - B) 3
  - C) 4
  - D) 5
8. What is the result for Sequence 3 on the SLOCA worksheet?
  - A) 6
  - B) 7
  - C) 8
  - D) 9
9. What is the result for Sequence 3 on the MLOCA worksheet?
  - A) 7
  - B) 8
  - C) 9
  - D) 10



10. (True/False) A Phase 3 analysis of this finding is not required because the risk significance of the finding is Green.

- A) False
- B) True

### Exercise 3

#### Scenario

Use the Generic BWR Risk-Informed Inspection Notebook for this exercise. The "A" instrument air (IA) compressor seized shortly after it was started for periodic rotation of the operating equipment. It was subsequently determined that the compressor seized because of improperly performed preventive maintenance which had been conducted two days prior. The IA system is a normally cross-tied support system. The inspectors determined that the criteria for crediting operator recovery of the IA compressor were not satisfied and that credit for recovery of the compressor was not appropriate.

**CAUTION: You must have completed the Phase 2 evaluation for this exercise before answering the questions below.**

#### Questions

11. For this scenario, which of the initiating event worksheets must be evaluated?
  - A) All
  - B) All except LLOCA
  - C) TRAN, TPCS, SLOCA, IORV, LOOP, ATWS
  - D) LOIA
12. The initiating event likelihood that should be used when evaluating the loss of instrument air (LOIA) worksheet is:
  - A) 1
  - B) 2
  - C) 3
  - D) 4
13. (True/False) All of the sequences on the LOIA worksheet are required to be solved.
  - A) False
  - B) True
14. What is the result for Sequence 3 on the LOIA worksheet?
  - A) 5
  - B) 6
  - C) 7
  - D) 8

15. (True/False) The risk significance of this finding due to internal initiating events is White.

- A) False
- B) True

## Exercise 4

### Scenario

Use the Generic BWR Risk-Informed Inspection Notebook for this exercise. During a quarterly surveillance test, the "A" residual heat removal service water (RHRSW) pump failed to start. It was subsequently determined that the breaker failed to close because the licensee had not performed the specified preventive maintenance on the breaker and had not overhauled the breaker in 30 years. The breaker had been inadvertently omitted from the preventive maintenance program. Operation of the RHRSW pump was last successfully demonstrated 91 days prior. The RHRSW system is a split train support system. The inspectors determined that the criteria for crediting operator recovery (i.e., replacement of the breaker) of the "A" RHRSW pump were satisfied and that credit for recovery of the pump was appropriate.

**CAUTION: You must have completed the Phase 2 evaluation for this exercise before answering the questions below.**

### Questions

16. For this scenario, which of the initiating event worksheets must be evaluated?
  - A) All
  - B) SLOCA, IORV, MLOCA, LLOCA
  - C) All except LLOCA
  - D) MLOCA, LLOCA
17. The initiating event likelihood that should be used when evaluating the medium loss of coolant accident (MLOCA) worksheet is:
  - A) 2
  - B) 3
  - C) 4
  - D) 5
18. (True/False) The result for Sequence 1 on the MLOCA worksheet is 9.
  - A) False
  - B) True
19. What is the dominant accident sequence associated with this finding?
  - A) TPCS - CHR - LI
  - B) LOIA - CHR
  - C) LOSW - CHR
  - D) LOOP - CHR - CV

20. What is the risk significance of this finding due to internal initiating events?

- A) Green
- B) White
- C) Yellow
- D) Red

## Exercise 5

### Scenario

Use the Generic PWR Risk-Informed Inspection Notebook for this exercise. During an 18-month surveillance test, the 24 hour endurance run, the "B" diesel generator catastrophically failed 1.5 hours into the test. It was subsequently determined that the diesel generator failed because of improperly performed maintenance during the last overhaul of the diesel which had been performed during the last refueling outage. The "B" diesel generator successfully completed a 24 hour endurance run 18 months prior. The licensee had performed the required 1 hour monthly surveillance runs of the diesel generator since the last 24 hour endurance run. However, the monthly surveillance tests did not demonstrate that the "B" diesel generator would successfully perform its safety function for its mission time of 24 hours. The inspectors determined that the criteria for crediting operator recovery of the "B" diesel generator were not satisfied and that credit for recovery of the diesel generator was not appropriate.

**CAUTION: You must have completed the Phase 2 evaluation for this exercise before answering the questions below.**

### Questions

21. For this scenario, which of the initiating event worksheets must be evaluated?
- A) All
  - B) All except LLOCA
  - C) LOOP
  - D) LOOP, LEAC
22. The initiating event likelihood that should be used when evaluating the loss of offsite power with loss of one class 1E 4.16-kV bus (LEAC) worksheet is:
- A) 2
  - B) 3
  - C) 4
  - D) 5
23. (True/False) Sequence 2 on the LOOP worksheet (LOOP - AFW - FB) should not be solved when evaluating the LOOP worksheet.
- A) False
  - B) True

24. What is the result for Sequence 5 on the LOOP worksheet?

- A) 10
- B) 9
- C) 8
- D) 6

25. What is the risk significance of this finding due to internal initiating events?

- A) Green
- B) White,
- C) Yellow
- D) Red

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