

NRC INSPECTION MANUAL

ARCB

INSPECTION PROCEDURE 71124 ATTACHMENT 01

RADIOLOGICAL HAZARD ASSESSMENT AND EXPOSURE CONTROLS

Effective Date: January 1, 2022

PROGRAM APPLICABILITY: IMC 2515 App A

CORNERSTONES: Occupational Radiation Safety

INSPECTION BASES: See IMC 0308 Attachment 2

SAMPLE REQUIREMENTS:

Sample Requirements		Minimum Baseline Sample Completion Requirements		Budgeted Range	
Sample Type	Section(s)	Frequency	Sample Size	Samples	Hours
Radiological Hazard Assessment	03.01	Annual*	1 per site	1 per site	42 +/- 4 per site
Instructions to Workers	03.02	Annual*	1 per site	1 per site	
Contamination and Radioactive Material Control	03.03	Annual*	2 per site	2-3 per site	
Radiological Hazards Control and Work Coverage	03.04	Annual*	3 per site	3-5 per site	
High Radiation Area and Very High Radiation Area Controls	03.05	Annual*	2 per site	2-5 per site	
Radiation Worker Performance and Radiation Protection Technician Proficiency	03.06	Annual*	1 per site	1 per site	

* Inspections should be performed during a refueling outage or when radiologically significant work is being performed. When appropriately risk-informed samples are not available for inspection follow completion guidance of IMC 0306 section 06.08.f.3.

71124.01-01 INSPECTION OBJECTIVES

- 01.01 Review and assess licensee performance in assessing the radiological hazards in the workplace associated with licensed activities and the implementation of appropriate radiation monitoring and exposure controls.
- 01.02 Verify that the licensee is properly identifying and reporting Performance Indicators (PIs) for the Occupational Radiation Safety Cornerstone.
- 01.03 To conduct a routine review of problem identification and resolution activities per Inspection Procedure (IP) 71152, "Problem Identification and Resolution."

71124.01-02 GENERAL GUIDANCE

Inspections should be scheduled to coincide with refueling outages or other radiologically significant plant activities so as to maximize the opportunities for the inspector to verify licensee performance through direct observation.

Walk-downs and work activity observations required by the procedure should be performed together, to the extent practical.

Review licensee PIs for the Occupational Radiation Safety Cornerstone. For more information on Performance Indicators, see NEI 99-02, "Regulatory Assessment Performance Indicator Guideline" (ML13261A116) and information on changes in Frequently Asked Questions at <http://www.nrc.gov/reactors/operating/oversight/program-documents.html#pi>.

Review the results of radiation protection program audits and review any condition reports related to occupational radiation safety since the last inspection. The results of the radiation protection program audit (e.g., licensee's quality assurance audits or other independent audits) and condition report reviews should be used to gain insights into overall licensee performance and focus the inspector's inspection activities on areas that are most likely to yield safety-significant results, consistent with the principle of "smart sampling." Annual radiation protection program audits are required by 10 CFR 20.1101(c). NUREG/CR-6204, "Questions and Answers Based on Revised 10 CFR Part 20," (ML12166A179) provides further guidance on annual program audits in Q&A #118, #134, and #380.

Per IP 71152, it is expected that routine reviews of PI&R activities should equate to approximately 10 to 15 percent of the resources estimated for the associated baseline cornerstone procedures, this is a general estimate only based on the overall effort expected to be expended in each strategic performance area. It is anticipated that the actual hours required to be expended may vary significantly from attachment to attachment, depending on the nature and complexity of the issues that arise at the particular facility. Overall, an effort should be made to remain within the 10 to 15 percent estimate on a strategic performance area basis. Inspection time spent assessing PI&R as part of the baseline procedure attachments should be charged to the corresponding baseline procedure.

71124.01-03 INSPECTION REQUIREMENTS

03.01 Radiological Hazard Assessment Sample.

Verify that the licensee is identifying the magnitude and extent of radiation levels; concentrations and quantities of radioactive materials; and is adequately assessing radiological hazards.

Specific Guidance

- a. Survey protocol should consider the current and historical isotopic mix and isotopic percent abundance, including current and historical presence of hard-to-detect radionuclides and potential alpha hazards. See IP 71124.04 for further guidance on source term determination.
- b. Consider if, since the last inspection, there have been changes to plant operations that may result in a significant new radiological hazard for onsite personnel. If a new hazard is identified, consider if the licensee has assessed the potential impact of these changes and has implemented adequate surveys to detect and quantify the radiological hazard.

Changes in plant operations that may result in changes to the scope of radiological hazards include but are not limited to the following:

- 1. Degraded reactor fuel integrity that can result in hot particle contamination, or the presence of transuranic nuclides (or other hard-to-detect radionuclides), for work activities previously unaffected,
 - 2. Changes in reactor water chemistry (e.g., hydrogen injection in a BWR) that can result in significant changes to the in-plant radiation source term,
 - 3. Significant onsite spills, or contamination of uncontaminated systems,
 - 4. Storage of radioactive materials in the owner-controlled area (e.g., remote or satellite RCAs within the plant site).
- c. Consider if the thoroughness and timing of the surveys is appropriate for the provided radiological hazard. The results of the audit and condition report reviews should be used to gain insights into overall licensee performance and focus the inspector's inspection activities on areas that are most likely to yield safety-significant results, consistent with the principle of "smart sampling." An appropriate survey should be of the right type, sensitivity and technique and the survey should enable adequate quantification of the radiological hazard and establishment of protective measures.
 - d. During walkdowns of the radiological control area (RCA)—including temporary radioactive material processing, storage, and handling areas—and other areas of the facility, evaluate material conditions and potential radiological conditions. Other areas to evaluate during walkdowns can include the protected area, restricted area, contaminated tool storage, contaminated machine shops, satellite RCAs, and infrequently accessed HRAs of the plant.

- e. For systems used to monitor and warn of changing airborne concentrations in the plant consider if alarms and set points are sufficient to prompt licensee/worker action to ensure that doses are maintained within the limits of 10 CFR Part 20 and ALARA, and determine whether they are appropriately positioned relative to the radiation source(s) or area(s) they are intended to monitor.

Continuous air monitors positioned throughout the power plant are often used as initial trending indicators of increasing airborne radioactive material levels. While identified increases in airborne levels may not be dose significant (as indicated by the directly measurable beta- and gamma-emitting radionuclides), power plants with known transuranic contamination problems should consider and assess this transuranic component when appropriate. This focus is especially vital during certain maintenance activities in known transuranic-contaminated areas.

General area air samples are typically used by licensees to verify the effectiveness of engineering controls to mitigate airborne radiological hazards at the work site. Breathing zone air samples are necessary when the licensee assigns individual internal doses from airborne concentrations of radioactive material.

- f. **Consider reviewing licensee evaluations of inconsistent or incongruent results from the licensee's intended radiological outcomes for radiologically significant work activities.**

03.02 Instructions to Workers Sample

Verify that workers are instructed in plant-related radiological hazards and the radiation protection requirements intended to protect workers from those hazards.

Specific Guidance

- a. Review radiation work permits (RWPs) and other documentation the licensee uses to control access to radiological hazards and evaluate instructions and controls. Note, the radiological controls (e.g., RWPs) for entry into high radiation areas (HRAs) may be plant specific. Review plant Technical Specifications to determine the requirements for entry and work in HRAs (e.g., authorization to enter into HRAs, electronic alarming dosimeter (EAD) set points, pre-job briefings, continuous job coverage, and stay time limitation).
- b. Consider reviewing survey maps and attending pre-job briefings to observe instructions to workers. Workers should be able to remember their work restrictions established on the RWPs and as instructed in pre-job briefs (i.e., where they are allowed to work, what they are allowed to do and what they are not allowed to do). In addition, workers should be knowledgeable of stop work conditions (e.g., contact HP prior to system breach or worker actions that may cause a change in radiological conditions) and location of low-dose waiting areas.
- c. During tours of the facility and review of ongoing work, evaluate if ambient radiological conditions are consistent with radiological postings.
- d. Consider if the licensee informs workers of changes in plant operations/conditions that could significantly impact radiological hazards.

- e. Select containers holding nonexempt, licensed radioactive materials that may cause unplanned or inadvertent exposure of workers. Consider if they are labeled and controlled in accordance with 10 CFR 20.1904, or meet the requirements of 10 CFR 20.1905(g).

03.03 Contamination and Radioactive Material Control Sample

Verify the licensee controls radioactive material and prevents the spread of contamination.

Specific Guidance

- a. Observe locations where the licensee monitors potentially contaminated material leaving the RCA. Consider if the work is performed in accordance with plant procedures and whether the procedures are sufficient to control the spread of contamination and prevent the unintended release of radioactive materials from the site. 10 CFR Part 20 does not contain release limits for the release of contaminated material to unrestricted areas; thus, the licensee's criteria should be that no detectable licensed radioactive material (radioactive gaseous and liquid effluents excepted) is released for unrestricted use or as waste into an unrestricted area.
- b. Review the licensee's criteria for the survey and release of personal items (e.g., using small article monitors (SAMs)).
- c. Observe workers exiting the RCA and performing contamination monitoring. Consider if the applicable guidance is adequate and if workers are knowledgeable on how to respond to an alarm that indicates the presence of radioactive material. If workers are permitted to frisk personal items on their own, consider observing one or two control points to ensure that workers are complying with applicable guidance and training.
- d. During plant walk-downs, consider background dose rates; they should not excessively interfere with the sensitivity of contamination monitoring equipment (e.g., friskers, personnel contamination monitors). Contamination monitoring equipment for free release of equipment and materials should be in a low background area. The licensee should not have established an artificial release threshold by degrading the instrument's detection sensitivity through such methods as raising the energy discriminator level or locating the instrument in a high-radiation background area.
- e. Evaluate the licensee's physical and programmatic controls for highly activated or contaminated materials (non-fuel) stored within spent fuel pool and other storage pools. Consider if appropriate controls (i.e., administrative and physical controls) are in place to preclude unintended doses from materials stored in pools and the inadvertent movement of these materials.

03.04 Radiological Hazards Control and Work Coverage Sample

Verify the licensee controls radiological hazards during radiological work.

Specific Guidance

- a. Consider if radiological controls are implemented commensurate with the radiological hazard. Adequate radiological controls include performing required surveys (e.g.,

radiation, contamination and airborne), radiation protection job coverage (e.g., audio and visual surveillance for remote job coverage), contamination controls and stop work criteria.

- b. **Consider if the licensee has integrated radiological work controls and ALARA requirements into work packages, work procedures and/or RWP documents.**
- c. Consider if EAD dose and dose rate alarm set points are based on current radiological survey data and plant procedures. Initial EAD set points (e.g., pre-outage) for EAD dose and dose rate alarms are commonly set based on historical data. The EAD alarm set points should be adjusted as needed based on actual dose rates and for changes in radiological conditions (e.g., during an outage).
- d. During job performance observations, consider if personnel radiation monitoring devices are placed on the individual's body consistent with the method the licensee is employing to monitor dose from external radiation sources and applicable regulatory requirements.
- e. If available, evaluate the work controls and dosimetry used for activities where dose rate gradients can be severe (i.e., underwater diving, steam generator entries, work under the reactor head, etc.), thereby increasing the necessity of providing multiple dosimeters and/or enhanced job controls.
- f. When possible, observe work in potential airborne areas, and consider if air samples are representative of the breathing air zone when used to assess dose. As available, review RWPs for work within airborne radioactivity areas to guide inspection scope. Consider airborne radioactivity controls and monitoring, for jobs with the potential for significant airborne levels (e.g., grinding, grit blasting, system breaches, entry into tanks, cubicles, reactor cavities).

When possible, observe work in Alpha Level II and III areas as these areas are more risk significant from an internal exposure perspective. Substantial internal dose may be received from alpha contamination prior to detection by instrumentation designed to detect beta and gamma radiation, which is typically in use. Procedures and work instructions should address if/when contamination surveys and airborne radioactivity surveys require alpha analysis, respiratory protection requirements, internal monitoring requirements, and contamination/airborne radioactivity minimization controls (i.e. grinding in an alpha II area may require more controls than a work evolution not expected to create an airborne hazard and work instructions may require wiping down of the area frequently to prevent buildup of contamination).

03.05 High Radiation Area and Very High Radiation Area Controls Sample

Verify the licensee controls HRAs and VHRAs per applicable requirements.

Specific Guidance

- a. Review the circumstances of Technical Specification High Radiation Area Occurrences, as defined by NEI 99-02. Focus on verifying aspects of the licensee PIs associated with high-risk HRAs (greater than 25 rem in 1 hour at 30 centimeters from the source) and for all VHRAs. Do not repeat this HP inspection requirement during the site wide annual PI verification team inspection.

- b. Inspect posting and physical controls for all VHRAs and for a risk-informed selection of HRAs.
- c. The intent of this limited inspection oversight/requirement is to maintain continued NRC vigilance of the licensee's program and procedural controls and plant staff awareness of these special, accessible areas where the potential for overexposure exists.
- d. Review procedural changes since the last inspection to determine the adequacy of access controls for HRAs/VHRAs, consider if changes to licensee procedures will result in inadequate controls of these areas (i.e., violation of T.S. or site-specific alternate controls requirements).

03.06 Radiation Worker Performance and Radiation Protection Technician Proficiency Sample

Verify adequate radiation worker and radiation protection technician performance with respect to radiation protection requirements.

Specific Guidance

- a. Consider if workers observe applicable radiation protection requirements and are knowledgeable of instructions provided by the licensee (e.g., Part 19 instructions and information relayed during pre-job briefs).
- b. Consider if radiation workers and radiation protection technicians are implementing prescribed ALARA practices during work activities; focus on work activities that present the greatest radiological risk to workers.
- c. Consider if workers are aware of their EAD dose and dose rate set points, and allowable stay times or permissible dose for radiologically significant work under each RWP.
- d. Consider if workers are aware of how to respond to EAD alarms in accordance with plant procedures. Note, some EAD alarms are anticipated (e.g., for workers traversing a high dose rate work area).
- e. Consider if radiation protection technicians are aware of the radiological conditions in their workplace, including applicable RWP controls/limits, and if their performance is consistent with the licensee's training and procedures
- f. Consider if appropriate pre-work and job coverage surveys were performed for radiologically risk significant work activities.
- g. Observe radiation protection technicians performing radiation surveys and consider if the instruments are being used correctly (i.e., survey technique and correct instrument for application). Consider discussing with radiation protection staff (supervisors and technicians) the procedures, equipment, and performance of radiation surveys for both routine and non-routine activities. Technicians should be knowledgeable about when and how to survey areas for:
 - 1. Hot particles,
 - 2. Alpha emitters,

3. Loose surface contamination,
4. Neutron radiation,
5. Airborne radioactivity, including the potential presence of transuranic radionuclides and/or other hard-to-detect radionuclides,
6. Work activities that could suddenly and significantly increase radiological conditions such as in-core detector movement, fuel moved in affected areas of drywell or auxiliary building, movement of irradiated materials in the spent fuel pool, and
7. Severe radiation field dose gradients that can result in non-uniform exposures.

71124.01-04 REFERENCES

RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste"

RG 8.38, "Control of Access to High and Very High Radiation Areas in Nuclear Power Plants"

NRC Information Notice 1985-92, "Surveys of Wastes Before Disposal from Nuclear Reactor Facilities"

NRC Information Notice 1990-33, "Sources of Unexpected Occupational Radiation Exposures at Spent Fuel Storage Pools"

NRC Information Notice 1997-36, "Unplanned Intakes by Worker of Transuranic Airborne Radioactive Materials and External Exposure Due to Inadequate Control of Work"

NRC Circular 1981-07, "Control of Radioactively Contaminated Material"

NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 – Standards for Protection Against Radiation"

NUREG/CR-5569, Revision 1, "Health Physics Positions Data Base," (ML093220108)

NUREG/CR-6204, "Questions and Answers Based on Revised 10 CFR Part 20" (ML12166A179)

NUREG/CR-6204, "Questions and Answers Based on Revised 10 CFR Part 20" (ML12166A179), Question 447

NUREG/CR-6204, "Questions and Answers Based on Revised 10 CFR Part 20" (ML12166A179), Question 448

HPPOS-016, "Applicability of Access Controls for Spent Fuel Pools," (ML103420144)

HPPOS-221, "Lower Limit of Detection (LLD) for Potentially Contaminated Oil," (ML103470158)

HPPOS-245, "Access Controls for Spent Fuel Pools," (ML11192A127)

HPPOS-250, "Monitoring at Nuclear Power Plants for Contamination by Radionuclides that Decay by Electron Capture," (ML11192A132)

HPPOS-333, "Labeling of Radioactive Materials Stored Under Water," (ML15027A277)

Nuclear Energy Institute 99-02, "Regulatory Assessment Performance Indicator Guideline"

END

Attachment 1: Revision History for IP 71124.01

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 Information)
N/A	12/02/09 CN 09-030	Conducted four year search for commitments and found none. This new procedure is being issued as a result of the 2009 ROP IP Realignment. It supersedes inspection requirements in IP 71121 and 71122.	Yes 09/09/2009	ML092810383
N/A	ML15344A189 02/19/16 CN 16-007	Major revisions to the IP 71124.01 procedure attachment were made in response to the 2013 ROP Enhancement Project. The revisions clarified the existing inspection requirements and enhanced the inspection guidance section. The revision also changes how inspection samples are counted. In addition, two feedback forms were incorporated.	N/A	ML15344A245 Closed FBF 71124.01-1636 ML15352A047 Closed FBF 71124.01-2132 ML15352A060
N/A	ML17286A284 12/21/17 CN 17-031	Major editorial revision of IP 71124.01. Added guidance applicable to leak testing radioactive sources. Section 02 was audited and modified to move guidance to Section 03 and concisely state actions necessary to complete each requirement. Added 4 hours to the total hours available to complete this attachment annually. 4 hours were moved from 71124.02.	Verbal discussion of changes during 2017 HP Counterpart meeting, 09/06/2017	ML17300A479

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 Information)
		<p>Added table with inspection resources and sample completion summary to the first page to pilot new IP format in support of future updates to IMC 0040.</p> <p>PI&R was transitioned from an independent sample to a requirement that would be completed as part of each sample. Guidance section updated to reflect resource estimates for routine review of PI&R activities per IP 71152 Section 04.01.</p>		
N/A	ML19253D198 12/23/19 CN 19-042	Major editorial revisions of IP 71124.01 to conform with IMC 0040 formatting guidance	Verbal discussion of changes during 2019 HP Counterpart meeting. 09/04/2019	ML19253D213
N/A	ML21330A044 12/29/21 CN 21-041	Revised IP 71124.01 to include three ALARA inspection activities as a result of retiring IP 71124.02. 6 annual hours were moved from 71124.02. Notified the Commission of this change in accordance with Management Directive 8.13, "Reactor Oversight Process" December 14, 2021 (ML21327A460)	N/A	N/A