

# NRC INSPECTION MANUAL

ARCB

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## INSPECTION PROCEDURE 71124 ATTACHMENT 05

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### RADIATION MONITORING INSTRUMENTATION

Effective Date: March 30, 2020

PROGRAM APPLICABILITY: IMC 2515 App A

CORNERSTONES: Public Radiation Safety (33 percent)  
Occupational Radiation Safety (67 percent)

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
Walkdowns and Observations	03.01	Biennial	5 per site	5-10 per site	38 +/- 4 per site
Calibration and Testing Program	03.02	Biennial	10 per site	10-15 per site	
Effluent Monitoring Calibration and Testing Program Sample	03.03	Biennial	2 per site	2-3 per site	

#### 71124.05-01 INSPECTION OBJECTIVES

- 01.01 To verify that the licensee is ensuring the accuracy and operability of radiation monitoring instruments that are used to monitor areas, materials, and workers to ensure a radiologically safe work environment and detect and quantify radioactive process streams and effluent releases. The instrumentation subject to this review includes equipment used to monitor radiological conditions related to normal plant operations, including anticipated operational occurrences, and conditions resulting from postulated accidents.
- 01.02 To conduct a routine review of problem identification and resolution activities per Inspection Procedure (IP) 71152, "Problem Identification and Resolution."

## 71124.05-02 GENERAL GUIDANCE

To the extent possible, perform in-office preparation before the onsite effort, as indicated below and complete the remaining inspection planning and follow-up actions during the onsite aspects of the inspection.

Review the plant final safety analysis report (FSAR) to identify radiation instruments associated with monitoring radiological conditions including airborne radioactivity, process streams, materials/articles, and workers. The review of portable and stationary instrumentation should consider the following: 1) instruments used for monitoring transient high gamma and neutron radiological conditions, 2) air monitors associated with work generating airborne radioactivity, 3) area radiation monitors (ARMs) used to monitor conditions associated with in-core instrumentation, containment sump areas, and radwaste resin transfers, and 4) instruments that determine worker external and internal contamination. Additionally, consider small article monitors/tool equipment monitors (SAMs/TEMs) and instruments used for underwater surveys.

Identify radioactive effluent monitor operability issues reported by the licensee as provided in effluent release reports. Review these issues during the onsite inspection, as warranted, given their relative significance. Determine if the issues were entered into the corrective action program and adequately resolved.

Identify instrumentation and associated technical requirements for high range effluent radiation monitoring instrumentation, including those instruments used for remote emergency assessment. Review FSAR commitments and technical specification requirements for these instruments.

Identify instrumentation and associated technical specification requirements for post-accident monitoring instrumentation, including those instruments used for remote emergency assessment. Post-accident monitoring and containment isolation instrumentation consists of the high-range containment/drywell radiation monitors. If the post-accident sampling system has been eliminated from the technical specifications, this review is not necessary. In this case, review the licensee's post-accident sampling method. Post-accident monitoring instrumentation includes high range effluent monitors (Particulate Iodine and Noble Gas (PING)) and any other effluent or process monitors that are relied on by the licensee in its Emergency Operating Procedures (EOPs), or to issue protective action recommendations (PARs) during an accident.

Do not repeat any NRC inspection activity for aspects of radiation monitoring instrumentation that have been reviewed under the Maintenance Rule program and reviewed under other corresponding baseline inspection procedures.

Review copies of licensee and third-party (independent) evaluation reports of the radiation monitoring program since the last inspection, including audits of the licensee's offsite calibration facility (if applicable) for insights into the licensee's program and to aid in selecting areas for review ("smart sampling").

For each sample, conduct a routine review of problem identification and resolution activities using Inspection Procedure (IP) 71152, "Problem Identification and Resolution." Per IP 71152, it is expected that routine reviews of Problem Identification and Resolution (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.

## 71124.05-03 INSPECTION REQUIREMENTS

### 03.01 Walkdowns and Observations Sample

**Verify, using walkdowns and observations, that a radiation detection instrument in use, or available for use, can fulfill its intended function.**

#### Specific Guidance

- a. Review the list of in-service survey instrumentation to select a radiation detection instrument that is available and used to support operations.
- b. Instrument selection should include portable instruments used for radiation and contamination surveys, ARMs, instrumentation used to release personnel and equipment (i.e. PCMs and SAMs), and instrumentation used to screen for intakes (PMs).
  1. For portable survey instruments, in use or available for issuance, check calibration and source check stickers are up-to-date, and assess instrument material condition and function. Observe licensee staff perform a source check for the instrument. Determine whether high-range instruments are source checked on all appropriate scales. Risk-informed insights should be a key factor in the selection of which instruments are examined by the inspector. For example, instruments used in areas of high dose rates should be of higher priority than personal friskers.
  2. For in-field ARMs, determine if they are appropriately positioned and, if possible, compare monitor response (via local or remote indication) with actual area conditions for consistency. Review ARM alarm set point values and set point bases as provided in the technical specifications, the FSAR, or plant procedures.
  3. For in-field continuous air monitors (CAMs) determine whether they are appropriately positioned relative to the radiation source(s) or area(s) they are intended to monitor.
  4. For personnel contamination monitors (PCMs), portal monitors (PMs), and SAMs/TEMs, consider if the periodic source checks are performed in accordance with the manufacturer's recommendations and licensee procedures. Verification of instrument operability should be done by inspector observation of licensee source checks. If no opportunity for observation is available, verification can be made by reviewing the source check documentation.

## 03.02 Calibration and Testing Program Sample

**Verify that the calibration and testing of a radiation detection instrument is adequate.**

### Specific Guidance

a. Laboratory Instrumentation

Consider evaluating the methodology and results of calibrations and performance checks. Review the results of the inter-laboratory comparison program to assess the quality of the sample analyses, and that the inter-laboratory comparison program includes hard-to-detect isotopes as appropriate.

b. Whole Body Counting (WBC)

1. Consider reviewing the methods and sources used to perform WBC functional checks before use of the instrument and consider whether check source(s) are appropriate for the plant's source term.
2. Consider reviewing WBC calibration reports and consider whether calibration sources were appropriate for the plant source term and if appropriate calibration phantoms were used. Look for anomalous results or other indications of instrument performance problems.

c. Post-Accident Monitoring Instrumentation

1. For technical specification (T.S.) drywell/containment high-range monitors observe calibration if available, or review calibration documentation if observations are not feasible.
2. Consider if an electronic calibration was completed for all range decades above 10 rem/hour and that at least one decade at or below 10 rem/hour was calibrated using an appropriate radiation source.
3. Consider if the calibration acceptance criteria are reasonable, accounting for the large measuring range and the intended purpose of the instruments.
4. As available, observe electronic and radiation calibration of these instruments consider if the observation reflects conformity with the licensee's calibration and test protocols.

For observations, consider whether the calibration is being performed in accordance with plant procedures. Calibrations for containment high-range area monitors should use a fixed, reproducible, source-to-detector geometry (e.g. using a calibration source with a rigid hanger). If they do not, then the methods should be evaluated to ensure the licensee has not introduced additional errors in instrument read out. If direct observations are limited, consider discussing in-situ isotopic calibration methodologies with the responsible licensee staff.

Refer to the licensee's T.S., FSAR, Approved Emergency Action Level (EAL) Scheme and NUREG-0737, "Clarification of TMI Action Plan Requirements," issued November 1980, for guidance on post-accident monitoring instrumentation.

Note: Since these monitors may be used for EALs and protective action recommendations (PARs), ensure that the regional EP staff is aware of any monitoring issues that could impact the monitors' function.

d. PMs, PCMs and SAMs/TEMs

1. For selected PMs, PCMs and SAMs/TEMs consider if the alarm set point values are reasonable under the circumstances to ensure that licensed material is not released from the site.
2. Consider observing calibration of or reviewing calibration documentation for each instrument selected for review and evaluate inconsistencies between the licensee's method of calibration and the manufacturer's recommendations.

e. Portable Survey Instruments, ARMs, and Air Samplers/CAMs

1. Consider observing calibration of or reviewing calibration documentation for each selected instrument. For portable survey instruments and ARMs, that are calibrated at the site, consider reviewing detector measurement geometry and calibration methods and observing the licensee demonstrate use of its instrument calibrator.

Consider, if the licensee periodically measures calibrator output over the range of the instruments used through measurements by ion chamber/electrometer (or equivalent measuring devices and if these measuring devices have been calibrated by a facility using National Institute of Standards and Technology (NIST) traceable sources and that correction factors for these measuring devices were properly applied by the licensee in its output verification.

Consider conducting a comparison of instrument readings versus an NRC survey instrument if problems are suspected.

2. For portable survey instruments that did not meet "as found" acceptance criteria during calibration or source checks consider if the licensee has taken appropriate corrective action for instruments found significantly out of calibration (greater than 50 percent). Also consider if the licensee has evaluated the possible consequences of instrument use since the last successful calibration or source check.
3. Consider if the licensee's calibration of instruments used during diving activities is adequate (e.g., accounts for differences in attenuation between water and air), as necessary.

h. Electronic Alarming Dosimeters

Consider if routine calibrations are being performed according to manufacturer's recommendations and evaluate any differences. Routine calibrations should be

performed to verify dose rate points and dose integration accuracy. Commonly, irradiations are performed using a Cs-137 source over a dose range of intended use (e.g., from 1 mrem to 1 rem).

### 03.03 Effluent Monitoring Calibration and Testing Program Sample

**Verify effluent monitoring and flow measurement instrumentation are appropriately calibrated and/or tested and that monitor alarm set points are established consistent with applicable procedures.**

#### Specific Guidance

- a. Select at least one of each type of effluent monitor instrumentation (such as gaseous, liquid, etc.), focus on point of discharge effluent monitors. Review that (a) the licensee calibrates its monitors with NIST traceable sources; (b) if a primary calibration, it adequately represents the plant nuclide mix/source term; (c) if a secondary calibration, it verifies the primary calibration; and (d) the channel calibrations encompass the instrument's alarm set points.

If an instrument is not calibrated correctly, review the licensee's assessment of the potential impact on public doses, and assess the impact with respect to radiological control or emergency preparedness. Notify regional EP inspector if any issues are found with effluent monitors found in the licensee's approved emergency action level scheme.

- b. For changes to effluent monitor set points, evaluate the basis for changes to ensure that an adequate justification exists. Consider if the set points are based on an appropriate effluent radionuclide (noble gas) mix so as not to exceed the effluent dose limits in 10 CFR Part 20 and the design constraints in 10 CFR Part 50, Appendix I. The radionuclide mix used in the calculation should be the same as or more conservative (lower average energy) than the licensee's actual source term mix.
- c. Review the methodology the licensee uses to determine the effluent stack and vent flow rates. Consider differences between assumed and actual stack and vent flow rates and if the results of the projected public doses are affected. If available, review historical trends in vent/stack flow rates to determine if substantial variability exists, potentially indicating flow restrictions in the measuring device or fan motor problems.
- d. Review surveillance test results for effluent discharge ventilation systems. Consider the standby gas treatment system for BWRs and the containment/auxiliary building ventilation system for PWRs. Coordinate with the resident inspectors before inspecting safety-related ventilation systems to avoid duplication of effort.
- e. Consider if the licensee has the capability to collect and analyze high-range, post-accident iodine and particulate effluent samples and if high-range effluent monitors are calibrated and available. Note: Inform regional emergency preparedness staff of issues that impact monitors credited in licensee emergency preparedness plans.
  1. Focus reviews on high-range effluent monitors or other effluent/process monitors that are relied on by the licensee in its emergency operating procedures (EOPs) as a basis for triggering emergency action levels (EALs) and subsequent

emergency classifications, or to make protective action recommendations (PARs) during an accident. Refer to site-specific licensing basis information (e.g., FSAR, T.S. etc.) and NUREG-0737 for information on post-accident monitoring and instrumentation.

- (1) Review licensee's methodology for calculating EAL thresholds (e.g. instrument response factor determination) associated with system modifications since the last inspection. A detailed review of EAL threshold calculations is not intended, nor desired. Inspectors should interview plant personnel who conduct, or are responsible for, these calculations to qualitatively review the licensee's performance in this area. Significant questions or issues in this area should be referred to the program office for further guidance.
- (2) As feasible, observe electronic and radiation calibration of these instruments and consider if the calibrations conform with the licensee's calibration and test protocols.
- (3) Consider if monitor operation is appropriate for the setpoint value (e.g., the setpoint is not affected by the monitor switching from mid-range to high-range or a purge function that actuates upon shifting of ranges).

#### 71124.05-04 REFERENCES

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

Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)"

Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) -- Effluent Streams and the Environment"

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

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

IMC 0306, "Planning, Scheduling, Tracking and Reporting of the Reactor Oversight Process (ROP)"

NRC NUREG-0737, "Clarification of TMI Action Plan Requirements"

ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration"

ANSI N42.14-1991, "Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides"

ANSI 323A-1997, "Radiation Protection Instrumentation, Test and Calibration, Portable Survey Instruments"

ANSI N323D-2002, "American National Standard for Installed Radiation Protection Instrumentation"

END

Attachment 1: Revision History for  
IP 71124.05

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
N/A	12/02/09 CN 09-030	<p>Conducted four year search for commitments and found none.</p> <p>This new procedure is being issued as a result of the 2009 ROP IP Realignment. It supersedes inspection requirements in IP 71121 and 71122.</p>	Yes 09/09/2009	ML092810406
N/A	ML15344A508 04/01/16 CN 16-010	<p>Revisions to the IP 71124.05 procedure attachment were made in response to the 2013 ROP Enhancement Project. This change moved some items and added samples but did not change the content of the IP.</p> <p>The revision changes how inspection samples are counted.</p>	N/A	IP revised only to include new sample sizes. There is no valid comment resolution at this time.
N/A	ML17286A289 12/21/17 CN 17-031	<p>Major editorial revision of IP 71124.05. Section 02 was audited and modified to move guidance to Section 03 and concisely state actions necessary to complete each requirement</p> <p>Added requirement and guidance to perform inter-lab comparison from IP71124.06.</p> <p>PI&amp;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&amp;R activities per IP 71152 Section 04.01.</p>	Verbal discussion of changes during 2017 HP Counterpart meeting, 09/06/2017	ML17300A474

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
N/A	ML19253C958 03/04/20 CN 20-014	Major editorial revisions of IP 71124.05 to conform with IMC 0040 formatting guidance.  Moved Effluent Monitoring Calibration and Testing Program Sample from IP 71124.06 to IP 71124.05 along with 6 inspection hours. Notified the Commission of this change in accordance with Management Directive 8.13, "Reactor Oversight Process" January 31, 2020 (ML19317D673 [Non-public])	Verbal discussion of changes during 2019 HP Counterpart Meeting. 09/04/2019	ML19253C971