

# NRC INSPECTION MANUAL

ARCB

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## INSPECTION PROCEDURE 71124 ATTACHMENT 05

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### RADIATION MONITORING INSTRUMENTATION

INSPECTABLE AREAS: Radiation Monitoring Instrumentation

CORNERSTONES:	Occupational Radiation Safety	80%
	Public Radiation Safety	20%

EFFECTIVE DATE: April 1, 2016

INSPECTION BASIS: Protection of personnel involved in plant operations or work activities associated with transient high and very high radiation areas, or areas with airborne radioactivity, depends on the accuracy, operability, and proper use of radiation monitoring instruments. Title 10 of the Code of Federal Regulations (10 CFR) Part 20, "Standards for Protection Against Radiation," Subpart F, "Surveys and Monitoring," requires, in part, that surveys be made as necessary to comply with 10 CFR Part 20; are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels and concentrations or quantities of residual radioactivity; and the potential radiological hazards. In addition, paragraph (b) of Subpart F requires that instruments and equipment used for quantitative radiation measurements be calibrated periodically for the radiation measured.

Monitoring for radioactivity that may be released from normal operations, including anticipated operational occurrences, and postulated accidents is required, in part, by Criterion 64, "Monitoring Radioactivity Releases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." Proper operation of these monitoring systems ensures adequate protection of members of the public against an unmonitored, unanticipated, and unplanned discharge of radioactive material to the environment. This inspectable area verifies aspects of the Radiation Protection Program for which there are no indicators to measure performance.

LEVEL OF EFFORT:        Inspect Biennially

#### 71124.05-01    INSPECTION OBJECTIVES

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. 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.

#### 71124.05-02    INSPECTION REQUIREMENTS

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.

##### 02.01    Inspection Planning.

- a.    Review the plant final safety analysis report (FSAR) to identify radiation instruments associated with monitoring area radiological conditions including airborne radioactivity, process streams, materials/articles, and workers. Additionally, identify instrumentation and associated technical specification requirements for post-accident monitoring instrumentation, including those instruments used for remote emergency assessment.

Review FSAR descriptions and technical specification requirements for these instruments. If the post-accident sampling system has been eliminated from the technical specifications as required instrumentation, its review is not necessary.

- b.    Obtain a listing of in-service survey instrumentation including air samplers and small article monitors (SAMs), along with instruments used for detecting and analyzing workers' external contamination (personnel contamination monitors (PCMs)) and workers' internal contamination (portal monitors (PMs), whole body counters (WBCs), etc.), as well as neutron monitoring instrumentation. Review the list to determine whether an adequate number and type of instruments are available to support operations.
- c.    Obtain 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). Review the reports for insights into the licensee's program and to aid in selecting areas for review ("smart sampling").
- d.    Obtain copies of the procedures that govern instrument source checks and calibrations. Focus on instruments used for monitoring transient high radiological conditions, including instruments used for underwater surveys. Review the calibration and source check procedures for adequacy and as an aid to smart sampling in preparation for the onsite inspection.

- e. Review the area radiation monitor (ARM) alarm set point values and set point bases as provided in the technical specifications and the FSAR in preparation for the onsite inspection.

02.02 Walk Downs and Observations. (1 sample)

- a. Select 5 to 10 portable survey instruments in use or available for issuance. Check calibration and source check stickers for currency, and assess instrument material condition and operability.
- b. Observe licensee staff performance as the staff demonstrates source checks for various types of portable survey instruments. Determine whether high-range instruments are source checked on all appropriate scales. Select at least three different types of portable survey instruments for the source check demonstration.
- c. Walk down five to seven ARMs and continuous air monitors (CAMs) to determine whether they are appropriately positioned relative to the radiation source(s) or area(s) they are intended to monitor. Selectively compare monitor response (via local or remote indication) with actual area conditions for consistency.
- d. Select three to five PCMs, PMs, and SAMs. Verify that the periodic source checks are performed in accordance with the manufacturer's recommendations and licensee procedures.

02.03 Calibration and Testing Program. (1 sample)

- a. Laboratory Instrumentation.
  - 1. Select one of each type of laboratory analytical instruments used for radiological analyses (e.g., gross alpha, gross beta, proportional counters, gamma spectroscopy (including germanium-lithium, high purity-intrinsic germanium) and liquid scintillation counters). Verify that daily performance checks and calibration data indicate that the frequency of the calibrations is adequate and there are no indications of degraded instrument performance.
  - 2. As part of the problem identification and resolution review below, verify that appropriate corrective actions are implemented in response to indications of degraded instrument performance.
- b. Whole Body Counter.
  - 1. Review the methods and sources used to perform WBC functional checks before daily use of the instrument. Determine whether check source(s) are appropriate and align with the plant's isotopic mix.
  - 2. Review WBC calibration reports completed since the last inspection to verify that calibration sources were representative of the plant source term and that

appropriate calibration phantoms were used. Look for anomalous results or other indications of instrument performance problems.

c. Post-Accident Monitoring Instrumentation.

1. Select at least one of the drywell/containment high-range monitors and review the calibration documentation since the last inspection.
2. Verify that 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. Determine 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 to verify conformity with the licensee's calibration and test protocols.

d. PMs, PCMs, and SAMs.

1. Select one to two of each type of these instruments used on site, and verify that the alarm set point values are reasonable under the circumstances to ensure that licensed material is not released from the site.
2. Review calibration documentation for each instrument selected in (1) above, and discuss the calibration methods with the licensee to determine consistency with the manufacturer's recommendations.

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

1. Review calibration documentation for at least one of each type of instrument (minimum of four instruments total). For portable survey instruments and ARMs, review detector measurement geometry and calibration methods, plus have the licensee demonstrate use of its instrument calibrator (if applicable). Conduct comparison of instrument readings versus an NRC survey instrument if problems are suspected.
2. As available, select one to four portable survey instruments that did not meet acceptance criteria during calibration or source checks (including at least one portable hand-held survey instrument and one personal monitoring device, such as an electronic alarm dosimeter, breathing-zone air sampler, etc.). Verify that the licensee has taken appropriate corrective action for instruments found significantly out of calibration (greater than 50 percent). Verify that the licensee has evaluated the possible consequences of instrument use since the last successful calibration or source check.

f. Instrument Calibrator.

1. Review as applicable the current output values (tables, spreadsheets, etc.) for the licensee's portable survey and ARM instrument calibrator unit(s). Verify that the licensee periodically measures calibrator output over the range of the instruments used through measurements by ion chamber/electrometer (or equivalent measuring devices).
2. Verify that the measuring devices have been calibrated by a facility using NIST traceable sources and that correction factors for these measuring devices were properly applied by the licensee in its output verification.

g. Calibration and Check Sources.

Review the licensee's 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," source term to determine if the calibration sources used are representative of the types and energies of radiation encountered in the plant. If scaling factors are used for calibrations, the 10 CFR Part 61 data may be used as a reference to determine if the licensee is properly scaling (e.g., for hard-to-detect radionuclides).

02.04 Problem Identification and Resolution. (1 sample)

Verify that problems associated with radiation monitoring instrumentation are being identified by the licensee at an appropriate threshold and are properly addressed for resolution in the licensee corrective action program. See Inspection Procedure 71152, "Identification and Resolution of Problems," for additional guidance. In addition to the above, verify the appropriateness of the corrective actions for a selected sample of problems documented by the licensee that involve radiation monitoring instrumentation.

71124.05-03 INSPECTION GUIDANCE

03.01 Inspection Planning.

- a. The review of occupational radiation safety instrumentation should include the following:
  1. fixed instrumentation including ARMs, criticality monitors, and the WBC.
  2. in-plant airborne monitors including CAMs and portable air samplers.
  3. portable survey instruments, particularly those used to identify changing radiological conditions (gamma, neutron, and alpha measuring instrumentation) and for diving operations such that actions to prevent an overexposure may be taken.
  4. PCMs, PMs, and SAMs.

Note: Focus should be on portable instrumentation used for monitoring transient high gamma and neutron radiological conditions; air monitors associated with work generating airborne radioactivity; ARMs used to monitor conditions associated with in-core instrumentation, containment sump areas, and radwaste resin transfers; and for determining worker external and internal contamination.

5. Post-accident monitoring and containment isolation instrumentation consists of the high-range containment/drywell radiation monitors.

Note: Do not repeat any NRC inspection activity for any radiation monitor instrumentation that is included under the Maintenance Rule program.

- b. No inspection guidance.
- c. No inspection guidance.
- d. Guidance on instrument calibrations and source checks is provided in American National Standards Institute (ANSI) N323A-1997 and ANSI N323D-2002, "American National Standard for Installed Radiation Protection Instrumentation," for portable and fixed radiation monitoring instruments, respectively. Guidance for laboratory instrumentation used for onsite isotopic and effluent analyses (e.g., gamma spectroscopy equipment) is contained in ANSI N42.14-1991, "Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides."
- e. No inspection guidance.

#### 03.02 Walk Downs and Observations.

- a. 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. Teledose, remote alarming ARMs, and survey and dose alarm devices used for diving activities should be high-priority items for inspection.
- b. For instruments and equipment used for radiological controls for diving, evaluate the adequacy of the licensee's calibration of the underwater radiation monitoring instruments and equipment to ensure adequate detection and measurement of dose (e.g., shifts in gamma energy levels, neutron exposure).
- c. ANSI 323-1978, "Radiation Protection Instrumentation Test and Calibration," and ANSI 323A-1997, "Radiation Protection Instrumentation, Test and. Calibration, Portable Survey Instruments," provide additional guidance on instrument source checks.
- d. No inspection guidance.

- e. 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.

### 03.03 Calibration and Testing Program.

#### a. Laboratory Instrumentation.

1. Guidance on periodic efficiency calibrations for a spectroscopy system is provided in ANSI N42.14-1991, "American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides."
2. No inspection guidance.

#### b. Whole Body Counter.

No inspection guidance.

#### c. Post-Accident Monitoring Instrumentation.

Refer to the licensee's FSAR 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 PARs, ensure that the regional EP staff is aware of any monitoring issues that could impact the monitors' function.

#### d. PMs, PCMs, and SAMs.

Guidance on the minimum sensitivity and alarm set points for PCMs, SAMs, and PMs is provided in Office of Inspection and Enforcement Circular 81-07, "Control of Radioactively Contaminated Material," dated May 14, 1981, and Information Notice 85-92, "Surveys of Wastes Before Disposal from Nuclear Reactor Facilities," dated December 2, 1985. The alarm set points should also align with more restrictive industry standards to ensure that significant variability does not exist between sites.

#### e. Portable Survey Instruments, ARMs, and Air Samplers/CAMS.

No inspection guidance.

#### f. Instrument Calibrator.

No inspection guidance.

#### g. Calibration and Check Sources.

No inspection guidance.

#### 03.04 Problem Identification and Resolution.

No inspection guidance.

#### 71124.05-04 RESOURCE ESTIMATE

For planning purposes, it is estimated to take 32 hours, on average (with a range of 28 to 36 hours) to perform the requirements of this attachment.

#### 71124.05-05 COMPLETION STATUS

Inspection of the minimum sample size will constitute completion of this procedure in the RPS. The minimum sample size for this attachment is three, defined as the sum of all the inspection requirements.

If any of the sample inspection requirements cannot be completed, the procedure should be closed in accordance with IMC 0306, "Planning, Tracking and Reporting of the Reactor Oversight Process (ROP)." For example, if certain steps could not be completed due to sample unavailability, the procedure attachment should be declared "Complete – full sample not available" with a comment addressing the specific steps or activities that could not be completed.

#### 71124.05-06 REFERENCES

10 CFR Part 20, "Standards for Protection Against Radiation,"

10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste,"

American National Standards Institute (ANSI) N323-1978, "Radiation Protection Instrumentation Test and Calibration,"

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

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

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

Enforcement Circular 81-07, "Control of Radioactively Contaminated Material,"

Information Notice 85-92, "Surveys of Wastes Before Disposal from Nuclear Reactor Facilities,"



IMC 0306, "Planning, Tracking and Reporting of the Reactor Oversight Process (ROP)," and  
NUREG-0737, "Clarification of TMI Action Plan Requirements."

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 and Feedback Resolution Accession Number (Pre-Decisional, Non-Public)
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	ML092810406
N/A	ML15344A508 04/01/16 CN 16-010	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.  The revision changes how inspection samples are counted.	N/A	IP revised only to include new sample sizes. There is no valid comment resolution at this time.

Issue Date: 04/01/16  
Effective Date: 04/01/16

Att1-1

71124.05