

# NRC INSPECTION MANUAL

ARCB

---

## INSPECTION PROCEDURE 71124 ATTACHMENT 02

---

### OCCUPATIONAL ALARA PLANNING AND CONTROLS

INSPECTABLE AREA: ALARA Planning and Controls

CORNERSTONE: Occupational Radiation Safety

EFFECTIVE DATE: January 1, 2016

INSPECTION BASIS: Title 10 of the Code of Federal Regulations (10 CFR) Section 20.1101(b) requires that licensees use, to the extent practical, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses that are as low as is reasonably achievable (ALARA). Performance in this area is judged on whether the licensee has taken appropriate measures to track, and if necessary, to reduce exposures and not on whether each individual exposure and dose represent an absolute minimum, or whether the licensee has used all possible methods to reduce exposures. The stochastic risk effect of exposure is based on the linear nonthreshold exposure model. Increasing individual or collective exposures equates to increased risk of cancer or genetic effects. Licensees are required to manage these risks to ALARA levels. This inspectable area verifies aspects of the Occupational Radiation Safety Cornerstone for which there are no indicators to measure performance.

LEVEL OF EFFORT: Inspect Biennially

PROGRAM APPLICABILITY: 2515 Appendix A

#### 71124.02-01 INSPECTION OBJECTIVE

01.01 Assess licensee performance with respect to maintaining individual and collective radiation exposures ALARA. This inspection will determine whether the licensee's ALARA program, including administrative, operational, and engineering controls, is effectively maintaining occupational exposure ALARA.

Issue Date: 03/02/16  
Effective Date: 01/01/16

## 71124.02-02 INSPECTION REQUIREMENTS

### 02.01 Inspection Planning.

- a. Inspectors should perform most of this attachment during an outage, in order that the inspector can directly observe the licensee's ALARA process activities; including planning, implementation of radiological work controls, execution of work activities, and ALARA review of work-in-progress. The remainder of this attachment is inspected as a post-outage review.
- b. Inspectors should assess the licensee's ALARA performance and exposure challenges by reviewing pertinent information regarding overall collective exposure history, current exposure trends, current source term (e.g., average contact dose rate measurements on reactor coolant piping), and ongoing or planned work activities.
- c. Inspectors should review the licensee's annual collective dose histories, three-year rolling averages (TYRA), and quartile rankings.
- d. Inspectors should review site-specific procedures associated with maintaining occupational exposures ALARA, including a review of the processes used to estimate and track exposures from specific work activities.
- e. Inspectors should review the licensee's previous post-outage ALARA review, paying particular attention to problems identified with the planning and execution of work activities as they relate to ALARA outcomes (e.g., dose overruns).

### 02.02 Radiological Work Planning. (1 Sample)

- a. Obtain from the licensee a list of work activities (e.g., radiation work permits) ranked by actual or estimated exposure that are in progress or were completed during the last outage, and select three to five work activities of the highest exposure significance, preferably those activities projected to result in a dose of 5 person-rem or greater, or that involve work in high dose rate areas.
- b. Review the radiological work planning ALARA evaluations, initial and revised exposure estimates, and exposure mitigation requirements. Determine if the licensee has reasonably grouped the radiological work into work activities, based on historical precedence, industry norms, and/or special circumstances.

- c. Verify that the licensee's planning identified appropriate dose reduction techniques; considered, commensurate with the risk of the work activity, alternate reduction features; and defined reasonable dose goals.

Verify that the licensee's ALARA assessment has taken into account decreased worker efficiency from use of respiratory protective devices and/or heat stress mitigation equipment (e.g., ice vests).

Determine if the licensee's work planning considered the use of remote technologies (such as teledosimetry, remote visual monitoring, and robotics) as a means to reduce dose and the use of dose reduction insights from industry operating experience and plant-specific lessons learned. Verify the integration of ALARA requirements into work procedure and/or radiation work permit (RWP) documents.

- d. Compare the results achieved (dose rate reductions, person-rem used) with the intended dose established in the licensee's ALARA planning for these work activities.

Compare the person-hour estimates provided by maintenance planning and other groups to the radiation protection group with the actual work activity time results, and evaluate the accuracy of these time estimates. Determine the reasons (e.g., failure to adequately plan the activity, failure to provide sufficient work controls) for any inconsistencies between intended and actual work activity doses.

- e. Determine if post-job (work activity) reviews were conducted to identify lessons learned. If lessons learned were identified, verify that they were entered into the licensee's corrective action program.

#### 02.03 Verification of Dose Estimates and Exposure Tracking Systems. (1 Sample)

- a. Review the assumptions and basis for the current annual collective exposure estimate for reasonable accuracy. Review source term reduction effectiveness, and applicable procedures to determine the methodology for estimating exposures from specific work activities and the intended dose outcome.
- b. Select three to five ALARA work planning documents and review the assumptions and bases (including dose rate and work hour estimates). Verify for the selected work activities that the licensee has established measures to track, trend, and if necessary to reduce, occupational doses for ongoing work activities.
- c. Evaluate the licensee's method of adjusting exposure estimates, or re-planning work, when unexpected changes in scope or emergent work are encountered. Verify that dose threshold criteria are established to prompt additional reviews and/or additional ALARA planning and controls.

Determine whether the frequency of these adjustments call into question the adequacy of the original ALARA planning process. Determine if adjustments to exposure estimates (intended dose) are based on sound radiation protection and ALARA principles or if they are just adjusted to account for failures to control the work. Determine if there is sufficient station management review and approval of adjustments to exposure estimates and that the reasons for the adjustments are justifiable.

- d. Review three to five licensee's evaluations of inconsistent or incongruent results from the licensee's intended radiological outcomes (e.g., failure to adequately plan work activities, failure to provide sufficient management oversight of in-plant work activities, failure to conduct the work activity without significant rework, failure to implement radiological controls as planned, etc.).

#### 02.04 Implementation of ALARA and Radiological Work Controls. (1 Sample)

- a. Select two to four radiologically significant outage or on-line maintenance work activities scheduled during the inspection period for a detailed review. (These may be the same or different work activities than those selected in sections 02.02 or 02.03).

Review the radiological administrative, operational, and engineering controls planned for the work activities and review the integration of radiological work controls and ALARA requirements into work packages, work procedures and/or RWP documents.

- b. During observation of in-plant work activities, verify the licensee has effectively integrated the planned administrative, operational, and engineering controls into the actual field work to maintain occupational exposure ALARA.

Observe pre-job briefings, and determine if the planned controls are discussed with workers.

Evaluate the in-plant placement and use of shielding, contamination controls, airborne controls, RWP controls, and other engineering work controls against the licensee's ALARA plans.

- c. Review licensee activities associated with work-in-progress. Verify the licensee is tracking doses, performing timely in-progress reviews, and, when jobs are not trending as expected, verify the licensee appropriately communicates to workers, supervisors, and radiation protection technicians additional methods to be used to reduce dose.

Verify HP and ALARA staff are involved with the management of radiological work control if/when in-field activities deviate from the planned controls (e.g., RWP, ALARA plans, work order instructions, radiological hold points, stop work criteria, etc.).

Verify the Outage Control Center and station management provide sufficient support for ALARA re-planning as needed.

- d. Verify ALARA staff are involved with emergent work activities during outage or on-line maintenance. Specifically, ALARA activities should involve evaluation and implementation of in-field dose reduction strategies and not limited to dose estimating activities.

When possible, attend in-progress review discussions, outage status meetings, and/or ALARA committee meetings.

- e. Compare the radiological results achieved (individual radiological exposures, collective radiological exposures, personnel contamination events, radiological intakes / uptakes, electronic dosimeter alarms, etc.) with the intended radiological outcomes.

Verify that the licensee captures lessons learned for use in the next outage.

02.05 Radiation Worker Performance. (1 Sample)

- a. Observe radiation worker and radiation protection technician performance during work activities being performed in radiation areas, airborne radioactivity areas, or high radiation areas. Concentrate on work activities that present the greatest radiological risk to workers. (This review can be performed in concert with the inspection of exposure controls and work coverage in Inspection Procedure 71124.01).

Determine if workers demonstrate the ALARA philosophy in practice (e.g., workers are familiar with the work activity scope and tools to be used, workers use ALARA low-dose waiting areas) and follow procedures (e.g., workers are complying with work activity controls). Also, observe radiation worker performance to determine whether the training and skill level is sufficient with respect to the radiological hazards and the work involved.

- b. Interview individuals from selected work groups (craft personnel, supervisors, managers, radiation safety staff) to assess their knowledge and awareness of planned and/or implemented radiological and ALARA work controls.

02.06 Problem Identification and Resolution. (1 Sample)

- a. Review self-assessments and/or audits performed of the ALARA program since the last ALARA inspection. Determine if the licensee's reviews are identifying problems and areas for improvement.
- b. Verify that problems associated with ALARA planning and controls, are being identified by the licensee at an appropriate threshold and are properly addressed for resolution in the licensee corrective action program. This includes issues identified during self-assessments, audits, work-in-progress reviews, post-job ALARA reviews, etc.

## 71124.02-03 INSPECTION GUIDANCE

### 03.01 Inspection Planning.

- a. For inspection activities that require comparison of planned vs. actual ALARA goals, it is acceptable to review the results from the most recently completed outage if there are no completed activities to review during the current outage.
- b. The overall collective exposure performance will be used as an input to establish the resources required to complete this inspection attachment and to provide a perspective on significance for any resulting inspection finding assessment. Factors such as the noted trends in performance and the scope of upcoming radiological work may be considered in determining the level of inspection resources (see Section 71124.02-04, Resource Estimate).
- c. The Office of Nuclear Reactor Regulation will calculate and disseminate to the regions on an annual basis the annual collective dose histories, TYRA, and plant quartile information for both pressurized-water reactors (PWRs) and boiling-water reactors (BWRs). The quartile standing of the licensee's TYRA is used as another input to assess the current level of challenge to the licensee's program.

Plant annual collective exposures, along with the TYRA collective exposure and quartile rankings for each operating commercial nuclear plant, are also contained in NUREG-0713. The inspector should use the most recent annual collective exposure data available. If the licensee has recently submitted its 10 CFR 20.2206(c) report for the previous year, the inspector should use these data to calculate the TYRA collective exposure instead of the NUREG-0713 data.

- d. Licensee must incorporate measures in site-specific procedures to track and, if necessary, reduce exposures to ALARA.
- e. Problems with planning and execution of work as related to ALARA outcomes should be entered into the licensee's corrective action program for a determination of whether these dose overruns were avoidable, and the appropriate licensee organization(s) should be held accountable for these breakdowns in work execution vs. planning.

Although 10 CFR Part 20, "Standards for Protection against Radiation," does not require licensees to make every possible effort to demonstrate optimized exposure performance, a high frequency of these ALARA deficiencies may indicate a deficiency in the licensee's overall ALARA program in terms of the ability of different work groups (e.g., operations, radiation protection, maintenance, outage planning) to interface effectively with each other.

03.02 Radiological Work Planning.

- a. A work activity is one or more closely related tasks that the licensee has reasonably grouped together as a unit of work for the purpose of ALARA planning and work controls. In determining a reasonable grouping of radiological work, factors such as historical precedence, industry norms, and special circumstances should be considered.
- b. Focus on work activities that accrued dose significantly greater than projected and approached or exceeded the 5 rem collective dose thresholds by 50% (see NRC Inspection Manual Chapter 609, Appendix C, ALARA significance determination process).

A work activity may have benefited from proper ALARA radiological work planning, yet exceeded its intended dose outcome because of unplanned and/or unexpected conditions or emergent work. Although the pressures of outage scheduling may impact the determination of what additional controls and other measures are reasonably achievable, the licensee is still required to manage these activities such that the resulting doses are ALARA.

- c. ALARA work plans and dose reduction techniques should consider the overall benefit of the dose reduction method to collective dose.

A TEDE ALARA evaluation may be used to document the planning for dose reduction based on use (or non-use) of respiratory protection equipment.

- d. The regulation in 10 CFR 20.2206(c) requires that, on or before April 30 of each year, licensees submit to the NRC an annual report containing the results of individual monitoring (when required by §20.1502) carried out by the licensee for the previous year's collective exposure.

For licensees with work activity dose that significantly exceeds projections, consider evaluating the following:

- 1. the interfaces between operations, radiation protection, maintenance, maintenance planning, scheduling and engineering groups for interface problems or missing program elements,
  - 2. the shielding requests generated by the RP group with respect to dose rate reduction problem definition and assigning value (dose savings or dollars); engineering shielding responses for follow through, and
  - 3. whether work activity planning considers the benefits of dose rate reduction activities such as shielding provided by water-filled components/piping, job scheduling, and shielding and scaffolding installation and removal activities.
- e. No guidance provided.

03.03 Verification of Dose Estimates and Exposure Tracking Systems.

- a. The ability to determine if doses for a work activity are ALARA, or whether they need to be reduced further, will often depend on the source term reduction methods, and the accuracy of exposure estimates made in the planning process. If the work activity is a repetitive task (e.g., performed each outage), the inspector should determine if the licensee's planning process also considered long-term (e.g., over the life of the plant) cost-beneficial ALARA initiatives for exposure reduction.

For licensees in the high collective dose quartile with a work activity dose that significantly exceeds projections, the licensee's exposure tracking system and thresholds for re-evaluating dose estimates are reviewed in assessing the adequacy of ALARA planning. The level of exposure tracking detail, exposure report timeliness, and exposure report distribution are reviewed for assessment of keeping collective exposures ALARA.

- b. Exposure estimates should be based on good assumptions and correct calculations with some flexibility allowed for the expected variability caused by the limits of forecasting.

Accurate exposure estimates usually require a detailed task analysis of the work activity. However, in cases of routine activities, the licensee may rely on previous experience to establish the intended dose and reasonable work controls, in lieu of detailed analysis. Look for bottom-up (aggregation of individual task estimates) exposure estimates corroborated by top-down (historical work activity dose rate times work activity duration) estimating methods. Use of past outage experience combined with additional industry experience can provide a reasonable exposure estimate approach.

If exposure estimates appear questionable, use site-specific experience as the primary standard of comparison, and utilize industry data (as available) or actual work activity exposure data as a secondary standard of comparison to determine the reasonableness of licensee exposure estimates.

- c. During the conduct of exposure-significant maintenance work, the inspector should verify that licensee management was aware of the exposure status of the work and would intervene if exposure trends increased beyond exposure estimates.
- d. Verify that licensees are implementing reasonable ALARA programs based on the licensee's ALARA evaluations. Place particular focus on higher dose work activities.

When collective dose for work activities is not tracking true to projections, licensee actions should revolve around evaluation and implementation of in-field dose reduction strategies and not be limited to dose estimating activities.

Review the involvement and support from the Work Control Center; Outage Control Center, Station ALARA Committee and sub-committees, High Intensity Teams, etc.



#### 03.04 Implementation of ALARA and Radiological Work Controls

- a. Risk-significant work activities take place in high radiation, locked high radiation or very high radiation areas and should be inspected whenever possible. Also, work activities that involve hard-to-detect isotopes, alpha contamination and / or respirable radiation hazards should be evaluated. Focus on work activities that present radiological risk to workers in terms of high collective doses, high individual doses, diving activities in or around spent fuel or highly activated material, or that involves potentially changing (deteriorating) radiological conditions for detailed review.
- b. Radiological administrative, engineering and operational controls include, but are not limited to procedures, RWPs, ALARA Plans, TEDE ALARA Evaluations, work orders, etc. Engineering controls include temporary and permanent (lead, tungsten, water, etc.) shielding, system flushing, permanent and portable ventilation systems, glove bags, tents, etc. Operational controls include work sequencing, work scheduling, and other operational dose mitigation strategies such as consideration of the benefits of dose rate reduction activities provided by water filled components/piping, maintaining steam generators full when working on reactor coolant pumps, etc.
- c. In-progress reviews are important to ensure the effectiveness of ALARA planning and implementation.
- d. Emergent work activities create the need for prompt ALARA planning to achieve dose reductions, such as procedure review, work controls, shielding and worker pre-job ALARA briefings for dose intensive tasks.
- e. A comparison of dose accrual with dose estimates is an indicator of ALARA performance. The evaluation of any significant exposure variations which may exist among workers and collective exposures may indicate worker job skill differences or whether certain workers are receiving higher doses because of poor ALARA work practices.

#### 03.05 Radiation Worker Performance.

- a. Radiation workers should be utilizing the low dose waiting areas to maintain their doses ALARA (e.g., moving to the low dose waiting area when subjected to temporary work delays).
- b. Workers should be aware of ALARA controls, and should receive appropriate on-the-job supervision to ensure the ALARA requirements are met. First-line job supervisor should be ensuring the work activity is conducted in a dose efficient manner (e.g., work crew size minimized, workers properly trained, proper tools and equipment available at start of job, etc.).

03.06 Problem Identification and Resolution.

- a. See Inspection Procedure 71152, "Problem Identification and Resolution," for additional guidance.
- b. 10 CFR 20.1101 establishes the overall requirements for a Radiation Protection Program. 10 CFR 20.1101(b) requires that licensees use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are ALARA.

10 CFR 20.1101(c) requires an annual program review. See also Questions and Answers 118, 134, and 380 in NUREG/CR-6204, "Questions and Answers Based on Revised 10 CFR Part 20," dated May 1, 1994, (ML12166A179).

71124.02-04 RESOURCE ESTIMATE

For planning purposes, it is estimated to take, on average, 54 hours biennially to perform the requirements of this attachment. Normally, a minimum of 40 hours should be assessed for plants appearing in the top quartile (i.e., lowest dose) of the plant ranking based on TYRA collective dose. A maximum of 68 hours should be assessed for the plants appearing in the bottom quartile (highest dose). The plants in the second and third quartiles should receive an average of 54 inspection hours biennially. Adjustments to these inspection hours can be made (either an increase or decrease of hours within the range of 40 to 68 hours), based on the source term and overall effectiveness of a licensee's previous and ongoing ALARA and source term reduction efforts.

71124.02-05 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 five, 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.

END

Revision History for IP 71124.02

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution 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>	<p>YES 09/09/2009</p>	<p>ML092810389</p>
N/A	ML15344A278 03/02/16 CN 16-009	<p>Revisions to the IP 71124.02 procedure attachment were made in response to the 2013 ROP Enhancement Project.</p> <p>The revisions clarified the existing inspection requirements and enhanced the inspection guidance section. The revision also changes how inspection samples are counted.</p> <p>In addition, a feedback form was incorporated.</p>	<p>N/A</p>	<p>ML15344A308</p> <p>Closed FBF 71124.02-1762 ML15352A239</p>

Issue Date: 03/02/16  
Effective Date: 01/01/16