ATTACHMENT 71124.04

INSPECTABLE AREA: Occupational Dose Assessment

CORNERSTONE: Occupational Radiation Safety

EFFECTIVE DATE: January 1, 2010

INSPECTION BASIS: In the radiation safety area, dose is the basic measure of risk from occupational radiation exposures. The ability to provide for adequate protection of the worker rests on effective risk assessment, which is dependent on the application of monitoring and dosimetry techniques appropriate for the exposure situation. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection against Radiation," Subpart F, "Surveys and Monitoring," contains provisions for individual monitoring of external and internal exposures, as well as requirements for the calibration and accuracy of dosimetry equipment. In addition, 10 CFR 20.1202, "Compliance with Requirements for Summation of External and Internal Doses," has requirements for summing external and internal exposures to determine the total effective dose equivalent. 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

71124.04-01 INSPECTION OBJECTIVES

To (1) determine the accuracy and operability of personal monitoring equipment, (2) determine the accuracy and effectiveness of the licensee's methods for determining total effective dose equivalent, and (3) ensure that occupational dose is appropriately monitored.

02.01 Inspection Planning.

a. Review the results of radiation protection program audits related to internal and external dosimetry (e.g., licensee's quality assurance (QA) audits, self-assessments, or other independent audits). The results of the reviews should be used to gain insights into overall licensee performance in the area of dose assessment and focus the inspector's activities consistent with the principle of "smart sampling."

b. Review the most recent National Voluntary Laboratory Accreditation Program (NVLAP) accreditation report on the licensee or, if dosimetry is provided by a vendor, review the vendor's most recent results to determine the status of the licensee's or contractor's accreditation.

c. Review licensee procedures associated with dosimetry operations, including issuance/use of external dosimetry (routine, multibadging, extremity, neutron, etc.), assessment of internal dose (operation of whole body counter, assignment of dose based on derived air concentration (DAC)-hours, urinalysis, etc.), and evaluation of and dose assessment for radiological incidents (distributed contamination, hot particles, loss of dosimetry, etc.).

d. Verify that the licensee has established procedural requirements for determining when external and internal dosimetry is required.

02.02 External Dosimetry.

a. NVLAP Accreditation

Verify that the licensee's personnel dosimeters that require processing are NVLAP accredited. If dosimeters are provided by a vendor, verify the vendor's NVLAP accreditation. Ensure that the approved irradiation test categories for each type of personnel dosimeter used (thermoluminescent dosimeter (TLD), optically stimulated luminescent (OSL), dietil glycol bisalil carbonate (CR-39), etc.) are consistent with the types and energies of the radiation present, and the way that the dosimeter is being used (e.g., to measure deep dose equivalent (DDE), shallow dose equivalent (SDE), or LDE).

b. Passive Dosimeters (TLD, OSL, Bubble Dosimeters)

1. Evaluate the onsite storage of dosimeters before their issuance, during use, and before processing/reading. If the licensee does not require issued dosimetry to be stored on site during the wear period, verify that guidance is provided to rad-workers with respect to care and storage of dosimeters.

2. For non-NVLAP accredited passive dosimeters (e.g., bubble dosimeters, direct ion storage), verify that licensee procedures or processes provide for periodic calibration, application of calibration factors, usage, reading (dose assessment), zeroing, etc.

c. Active Dosimeters (Electronic Dosimeters)

1. Determine if the licensee uses a "correction factor" to address the response of the electronic dosimeter (ED) as compared to TLD/OSL for situations when the ED must be used to assign dose. Verify that the correction factor is based on sound technical principles.

2. As part of the problem identification and resolution review in 02.05 below, select three to five (as available) dosimetry occurrence reports or corrective action program documents for adverse trends related to electronic dosimeters, such as interference from electromagnetic frequency, dropping or bumping, failure to hear alarms, etc. Determine if the licensee has identified any trends and implemented appropriate corrective actions.

02.03 Internal Dosimetry.

a. Routine Bioassay (in vivo)

1. To the extent not covered in 02.01 above, review procedures used to assess dose from internally deposited nuclides using whole body counting equipment. Verify that the procedures address methods for determining if an individual is internally or externally contaminated, the release of contaminated individuals, the determination of entry route (ingestion, inhalation), and assignment of dose.

2. If whole body counting is used to routinely verify, or quantify, the intakes of radionuclides (i.e., following the entry into a high airborne area, or following the use of respiratory protection equipment), verify that the frequency of such measurements is consistent with the biological half-life of the potential nuclides available for intake.

3. If the licensee uses a method other than whole body counting for screening intakes (e.g., passive monitoring using portal monitors), evaluate the minimum detectable activity (MDA) of the instrument. Determine if the MDA is adequate to determine the potential for internally deposited radionuclides sufficient to prompt additional investigation.

4. Select three to five whole body counts, and verify that the system used in each had sufficient counting time/low background to ensure appropriate sensitivity for the potential radionuclides of interest. Verify that the appropriate nuclide library was used. Verify that any anomalous count

peaks/nuclides indicated in each output spectra received appropriate disposition. Review the licensee's 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," analyses to ensure that the libraries include appropriate gamma-emitting nuclides. If the licensee relies solely on whole body counting for assessing internal dose, determine how hard-to-detect nuclides are accounted for in the dose assessment.

b. Special Bioassay (in vitro)

1. Select one to two, as available, internal dose assessments obtained using in vitro monitoring. Review and assess the adequacy of the licensee's program for in vitro monitoring (i.e., urinalysis and fecal analysis) of radionuclides (tritium, fission products, and activation products), including collection and storage of samples.

2. For the dose assessments selected in 02.03.b.1. above, review the counting lab's QA program or, if a vendor lab is used, the licensee's audits of the lab. Verify that the lab participates in an analysis cross-check program and that out-of-tolerance results are evaluated and resolved appropriately.

c. Review and assess the adequacy of the licensee's program for dose assessments based on airborne/DAC monitoring. Verify that flow rates and/or collection times for fixed head air samplers or lapel breathing zone air samplers are adequate to ensure that appropriate lower limits of detection (LLDs) are obtained. Review the adequacy of procedural guidance used to assess dose when, if using respiratory protection, the licensee applies protection factors. Review one to two dose assessments performed using airborne/DAC monitoring, if available. Verify that the licensee's DAC calculations are representative of the actual airborne radionuclide mixture, including hard-to-detect nuclides, as appropriate. Note that requirements in this section may overlap requirements in Inspection Procedure (IP) 71124.01 and IP 71124.03. Try to avoid duplication of effort to the extent possible.

d. Review and assess the adequacy of the licensee's internal dose assessments for any actual internal exposure greater than 10 millirem committed effective dose equivalent (limit these assessments to no more than two intake events with similar radionuclide mixes). Determine if the affected personnel were properly monitored with calibrated equipment and if the data were analyzed and internal exposures properly assessed in accordance with licensee procedures.

02.04 Special Dosimetric Situations.

a. Declared Pregnant Workers

1. Verify that the licensees inform workers, as appropriate, of the risks of radiation exposure to the embryo/fetus, the regulatory aspects of declaring a pregnancy, and the specific process to be used for (voluntarily) declaring a pregnancy.

2. Select one to two individuals (as available) who have declared their pregnancy during the current assessment period, and verify that the licensee's radiological monitoring program (internal and external) for declared pregnant workers is technically adequate to assess the dose to the embryo/fetus. Review the exposure results and monitoring controls employed by the licensee and with respect to the requirements of 10 CFR Part 20.

b. Dosimeter Placement and Assessment of Effective Dose Equivalent for External Exposures

1. Review the licensee's methodology for monitoring external dose in situations in which nonuniform fields are expected or large dose gradients will exist (e.g., diving activities and steam generator jumps). Verify that the licensee has established criteria for determining when alternate monitoring techniques (i.e., use of multibadging or determination of effective dose equivalent for external exposures (EDEX) using an approved method) are to be implemented.

2. Review one to two dose assessments performed using multibadging during the current assessment period. Verify that the assessment was performed consistently with licensee procedures and dosimetric standards.

c. Shallow Dose Equivalent

Review one to two SDE dose assessments for adequacy. Evaluate the licensee's method (e.g., VARSKIN or similar code) for calculating SDE from distributed skin contamination or discrete radioactive particles.

d. Neutron Dose Assessment

1. As appropriate, evaluate the licensee's neutron dosimetry program, including dosimeter type(s) and/or survey instrumentation.

2. As available, select one to two neutron exposure situations (e.g., independent spent fuel storage installation operations or at-power containment entries) and verify that (a) dosimetry and/or instrumentation is appropriate for the expected neutron spectra, (b) there is sufficient sensitivity for low dose and/or dose rate measurement, and (c) neutron dosimetry is properly calibrated. Verify that interference by gamma radiation has been accounted for in the calibration. Verify that time and motion evaluations are representative of actual neutron exposure events, as applicable.

e. For the special dosimetric situations reviewed in this section, determine how the licensee assigns dose of record for total effective dose equivalent, SDE, and LDE. This should include assessment of external and internal monitoring results,

supplementary information on individual exposures (e.g., radiation incident investigation reports and skin contamination reports), and radiation surveys and/or air monitoring results when dosimetry is based on these techniques.

02.05 Problem Identification and Resolution. Verify that problems associated with occupational dose assessment are being identified by the licensee at an appropriate threshold and are properly addressed for resolution in the licensee corrective action program. In addition, verify the appropriateness of the corrective actions for a selected sample of problems documented by the licensee involving occupational dose assessment.

71124.04-03 INSPECTION GUIDANCE

03.01 Inspection Planning. No guidance provided.

03.02 External Dosimetry.

a. Review NVLAP test results for outliers, bias in the measurements, or angular response issues. Determine if the licensee has entered these concerns into the corrective action program and whether the corrective actions are appropriate. If dosimetry is provided by a vendor, determine if licensee audits of the vendor lab assessed the NVLAP test results and performance and any necessary corrective actions. American National Standards Institute (ANSI) N13.11-2001, "Personnel Dosimetry Performance—Criteria for Testing," presents additional guidance.

b. See guidance in Information Notice 85-81, "Problems Resulting in Erroneously High Reading with Panasonic 800 Series Thermoluminescent Dosimeters," dated October 17, 1985.

c. See guidance in NUREG/CR-6581, "Considerations in the Application of the Electronic Dosimeter to Dose of Record," issued December 1997.

03.03 Internal Dosimetry.

a. See guidance in ANSI N13.30-1996, "Performance Criteria for Radiobioassay."

b. Verify that the licensee's sample collection procedures ensure the following:

1. collection and preservation of samples in a manner such that the loss of activity on the walls of the container is minimal and sample contamination is prevented,

2. a sample of adequate size for each type of analysis requested, including adequate amounts to allow verification or additional analysis if needed,

3. containers that are free of external and internal contamination,

4. precautions to ensure the integrity of the container and prevent leakage from the container and/or cross-contamination of samples during the shipment and storage of samples, and

5. accurate and unambiguous identification of samples. In addition, the licensee should specify the required LLDs and the reporting requirements, including standard error or confidence interval estimates, and alert the service laboratory of potentially "highly contaminated" samples, samples that may contain additives and/or preservatives, or samples that may contain extremely insoluble material.

c. No guidance provided.

d. No guidance provided.

03.04 Special Dosimetry Situations.

a. See the guidance in Regulatory Guide 8.36, "Radiation Dose to the Embryo/Fetus," and Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure."

b. See the guidance on several NRC-approved methods for assessing EDEX contained in Regulatory Issue Summary (RIS) 2003-04, "Use of the Effective Dose Equivalent in Place of the Deep Dose Equivalent in Dose Assessments," dated February 13, 2003; RIS 2004-01, "Method for Estimating Effective Dose Equivalent from External Radiation Sources Using Two Dosimeters," dated February 17, 2004; RIS 2009-09, "Use of Multiple Dosimetry and Compartment Factors in Determining Effective Dose Equivalent From External Radiation Exposures," dated July 13, 2009; and Draft Regulatory Guide DG-8039, "Methods for Estimating Effective Dose Equivalent from External Exposure."

c. SDE must be the dose averaged over the 10 square centimeters of skin receiving the highest exposure. This should combine contributions from distributed skin contamination, gamma contributions from clothing contamination (if significant), as well as Discrete Radioactive Particles (DRPs), into one dosimetric quantity. If licensees are keeping track of DRP dose separately from SDE, then they are not meeting the intent of the 2002 rule change to SDE evaluation. See the *Federal Register* notice dated April 5, 2002 (67FR16304), for a more detailed discussion.

Verify that the licensee has established procedures for wound monitoring, and dose assessment from imbedded sources. Verify that clear criteria have been established for releasing from the site personnel with imbedded radioactive particles.

d. See guidance on neutron dosimeters in ANSI N13.52-1999, "Personnel Neutron Dosimeters (Neutron Energies Less Than 20 MeV)."

e. See the guidance in ANSI N13.6-1999, “Practice for Occupational Radiation Exposure Records Systems.”

03.05 Problem Identification and Resolution.
See IP 71152, “Identification and Resolution of Problems,” for additional guidance.

71124.04-04 RESOURCE ESTIMATE

For planning purposes, it is estimated to take 20 hours, on average (with a range of 12 to 28 hours) to perform the requirements of this attachment.

71124.04-05 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 one, defined as the sum of all the inspection requirements. Therefore, all the inspection requirements of the procedure should be completed. If some of the requirements cannot be performed because of a lack of samples, the procedure should be closed with comment.

END

Revision History for
IP 71124.04

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
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 Reactor Oversight Process IP Realignment. It supersedes inspection requirements in IP 71121 and 71122.	YES	09/09/2009	ML092810401