

ISSUE PAPER 6

REPORTING OF OCCUPATIONAL EXPOSURE

I. Introduction

In Staff Requirements Memorandum (SRM) SECY-12-0064, "Recommendations for Policy and Technical Direction To Revise Radiation Protection Regulations and Guidance," dated December 17, 2012,¹ the Commission directed the staff to improve the reporting of occupational exposure by the U.S. Nuclear Regulatory Commission (NRC) and Agreement State licensees, some of which do not currently submit reports.

II. Objective

Develop a regulatory basis for requirements that will ensure improvement of reporting of occupational exposure by the NRC and Agreement State licensees, including those that do not currently submit reports.

III. Existing Regulatory Framework

Improving the reporting of occupational exposure by NRC and Agreement State licensees requires an understanding of how nuclear materials are regulated in this country.

A. The NRC's Regulatory Program

The Atomic Energy Act of 1954, as amended (AEA), provided the NRC the statutory authority to regulate the beneficial civilian uses of radioactive materials while protecting public health and safety, promoting the common defense and security, and protecting the environment.

¹ SRM-SECY-12-0064 is available on the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/commission/srm/2012/>.

Under this authority, the NRC regulates commercial nuclear power plants, byproduct material, source material, and special nuclear materials (SNMs).

B. The Agreement State Program

Section 274 of the AEA provides the NRC with authority to relinquish portions of its regulatory authority to license and regulate radioactive materials (byproduct materials (radioisotopes), source materials (uranium and thorium), and noncritical mass quantities of SNMs) to a State that agrees to accept such authority under certain conditions (known as an Agreement State). The Agreement State assumes the regulatory authority from the NRC and asserts its authority under State laws and regulations to regulate the materials. An agreement signed by the Governor of the State and the Chairman of the Commission is the mechanism used to transfer the NRC's authority to a State in accordance with Section 274b of the AEA. Under Section 274 of the AEA, the Agreement State must maintain a regulatory program that is adequate to protect public health and safety and is compatible with the NRC's regulatory program. Currently, the 37 Agreement States are Alabama, Arkansas, Arizona, California, Colorado, Florida, Georgia, Iowa, Illinois, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Maine, Minnesota, Mississippi, North Carolina, North Dakota, Nebraska, New Hampshire, New Jersey, New Mexico, Nevada, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, and Wisconsin.

The NRC regulates radioactive materials in the 13 remaining States: Montana, Idaho, Wyoming, South Dakota, Missouri, West Virginia, Connecticut, Vermont, Delaware, Alaska, Hawaii, Indiana, and Michigan. There are approximately 22,400 licenses issued for medical, academic, industrial, and general uses of radioactive materials in the United States. Of these licenses, approximately 2,800 (12.5 percent) are regulated by the NRC, and 19,600

(87.5 percent) are regulated by the 37 Agreement States. The large percentage of radioactive material licenses regulated by the Agreement States will require extensive cooperation and collaboration between the NRC and the Agreement States to improve the reporting of occupational exposure by NRC and Agreement State licensees.

IV. NRC Occupational Reporting Requirements

A. The First NRC Requirements

On December 19, 1968, the NRC's predecessor agency, the U.S. Atomic Energy Commission (AEC), published an amendment to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection against Radiation," in Volume 33 of the *Federal Register*, page 18926 (33 FR 18926), that added a new section entitled, "Personnel Exposure and Monitoring Reports." This new section required the reporting of occupational radiation exposure information to a central repository at AEC headquarters. The amendment required four categories of licensees to report: (1) commercial nuclear power reactors, (2) industrial radiographers, (3) fuel processors and fabricators, and (4) manufacturers and distributors of byproduct material. The Commission considered these licensees to have the greatest potential for significant occupational doses. The AEC established this reporting requirement to assist in the following actions:

- Identify those individuals who are monitored by more than one licensee or AEC contractor.
- Analyze radiation exposure experience and indicate general exposure trends from year to year
- Analyze the exposure experience of AEC contractors and the four listed categories of licensees.
- Initiate appropriate remedial actions for which trends or experience in increased radiation exposures indicate the need for more effective controls.

- Consider and develop appropriate modifications to radiation protection standards and requirements.

The AEC established a procedure to extract the occupational exposure data from these reports and to enter it into the its Radiation Exposure Information and Reporting System (REIRS). The occupational data maintained in the system have been summarized and published in a report every year since 1969. Annual reports from 1969–1973 were published in six documents designated as WASH-1350-R1 through WASH-1350-R6.

B. The Agency’s Proposal To Expand Requirements to all NRC-Specific Licensees

On May 30, 1975, the NRC published a proposed rule in the *Federal Register* (40 FR 23478) that would require all categories of licensees with an NRC-specific license for the possession, use, receipt, transfer, or acquisition of radioactive material to submit personnel monitoring data to the agency. By a letter dated June 2, 1975 (43 FR 44827), a copy of the notice of the proposed rule was mailed to all NRC-specific licensees (e.g., well loggers, medical and academic institutions, and portable gauge manufactures). The NRC received 36 comments in response to the proposed rule. The majority of the comments supported the proposed rule, but offered suggestions for improvement. Medical licensees raised the majority of the opposition to the proposed rule. Their opposition was based on the following issues:

- Additional paperwork would increase the cost of health care.
- The personnel monitoring data might have theoretical value but no practical value.
- The NRC failed to demonstrate a sufficient cost versus benefit ratio for another administrative requirement.
- Occupational exposures (in medical diagnosis and therapy) are already as low as is reasonably achievable (ALARA).
- The requirements for reporting overexposures are adequate.

- Only licensees with repeated overexposures should be required to submit annual reports.
- Separating exposures received from NRC-licensed material from exposures received from non-NRC-licensed materials is not possible.
- Personnel monitoring data contain inherent inaccuracies.

In response to these comments, in a letter dated August 25, 1976, the NRC requested that all NRC specific licensees voluntarily submit personnel monitoring data for calendar year 1975, along with the total cost of preparing the data in man-hours and dollars-cents. The responses licensees indicated a total man-hours cost median of 2.75 minutes, and \$0.65 per monitored individual to collect the requested information (NUREG-0419, "Occupational Radiation Exposure at NRC-Licensed Facilities 1975, Office of Standards Development, U.S. Nuclear Regulatory Commission").

On September 29, 1978, the Commission published a final rule in the *Federal Register* (43 FR 44827) that required all NRC-specific licensees, including medical licensees, to provide personnel monitoring data for calendar years 1978 and 1979. In the Statements of Considerations for the September 29, 1978, rulemaking, the Commission indicated that the rule would remain in effect for 2 years, and then the Commission would revisit whether to extend the rule after that 2-year period. The Commission established the September 29, 1978, rulemaking based on the following reasons:

- The occupational monitoring data are essential for evaluating the risk of radiation exposure associated with activities in NRC-licensed facilities.
- The requested data will allow the NRC to evaluate exposure trends.
- The requested data will allow the NRC to assess the degree of radiation protection efficiency being maintained by its licensee, which is an indicator of the overall effectiveness of the Commission's regulatory program.
- Licensees need these data to evaluate their radiation control programs.

C. Amendments for Additional Licensee Categories

After a series of amendments in the 1980s, the occupational reporting requirements in 10 CFR Part 20 eliminated the provisions for all NRC-specific licensees to submit reports and expanded the license reporting categories from four to the current seven: (1) commercial nuclear power reactors, (2) industrial radiographers, (3) fuel processors and fabricators, (4) manufacturers and distributors of certain byproduct material, (5) geologic repositories for high-level waste (HLW), (6) independent spent fuel storage installations (ISFSIs), and (7) facilities for the land disposal of low-level waste (LLW) ((46 FR 13978; February 25, 1981), (46 FR 58282; December 1, 1981), and (47 FR 57480; December 27, 1982)).

D. Current NRC Occupational Dose Reporting Requirements

The current occupational reporting provisions, which were renumbered to 10 CFR 20.2206, "Reports of Individual Reporting," as a part of the 1991 amendments to 10 CFR Part 20, require the seven categories of licensees to provide an annual report of the monitoring of occupational dose by April 30 of each year to the NRC's REIRS database. Currently, five categories of NRC licensees report information to the database: (1) commercial nuclear power reactors, (2) industrial radiographers, (3) fuel processors (including uranium enrichment facilities), fabricators, and reprocessors, (4) ISFSIs, and (5) manufacturers and distributors of certain byproduct material. The NRC's REIRS database does not include occupational information for the two other reporting categories, LLW and HLW facilities, because the NRC has no licensees in those categories. As a result, the database provides a system for maintaining all relevant occupational doses received at nuclear power reactors, fuel processors and fabricators, and ISFSIs in the United States because all these facilities are licensed by the NRC regardless of whether they are located in an Agreement State.

However, a reporting gap exists because industrial radiographers and manufacturers and distributors of certain byproduct material who hold Agreement State licenses instead of NRC licenses are not subject to the reporting requirement in 10 CFR 20.2206. As described in Section VII.B of this paper, Agreement States are not required to adopt the requirements in 10 CFR 20.2206. Consequently, the NRC has experienced significant difficulty in developing reasonable assessments of the overall occupational doses received from industrial radiographers and manufacturers and distributors of certain byproduct material because the majority of these licensees, like all radioactive material licensees, hold Agreement State licenses. In addition to this reporting gap, several categories of NRC radioactive material licensees identified in Table 1 of Section V of this paper are not subject to the reporting

requirements in 10 CFR 20.2206. Therefore, the NRC lacks occupational exposure data for several categories of radioactive material licensees.

V. NRC Radioactive Material Licenses

The NRC issues various types of licenses for the possession and use of radioactive material (byproduct, source, and noncritical quantities of SNM). These licenses include various uses of radioactive material, such as industrial; academic; research and development; manufacturing; distribution; irradiators; well logging; industrial radiography; medical programs; various types of service providers (i.e., leak testing of sealed sources, calibration of instruments, servicing of devices, and collection and repackaging of radioactive waste for final disposal); and transportation of radioactive material. The NRC assigns a program code (Pcode) to each type of license based on the possession and use of radioactive material. In addition, each NRC Pcode is assigned an inspection priority code (1, 2, 3, or 5). Inspection Priority Codes 1, 2, 3, or 5 are the intervals in years between each routine inspection. If the NRC authorizes multiple uses of radioactive material to a license (i.e., multiple NRC Pcodes), it assigns a “primary Pcode” and a “secondary Pcode” to that license. The NRC assigns a primary Pcode to the licensed activity with the shortest routine inspection interval because, of all the licensed activities, it represents the greatest relative radiation risk. The NRC would inspect each licensed activity in accordance with its assigned inspection priority. For example, a license for a medical institution has a Pcode of 02121 and an Inspection Priority Code 5. If the NRC amends the license to authorize the use of a high dose rate (HDR) remote afterloader unit, the agency assigns a primary Pcode of 02230 and an Inspection Priority Code 2 to the license. The NRC would conduct a routine inspection every 2 years for activities related to the HDR unit and would conduct an inspection of the other portions of the licensee’s program during every other routine inspection.

The radioactive material licenses in Pcodes 02500, 03211, 03214, 03310, and 03320 must report to the NRC’s REIRS database. These Pcodes are assigned to the following types

of licenses: (1) nuclear pharmacies (02500), (2) manufacturing and distribution Type A Broad (03211), (3) manufacturing and distribution other (03214), (4) industrial radiography—fixed location (03310), and (5) industrial radiography—temporary job site (03320).

Many other categories of NRC radioactive material licensees do not report to the NRC's REIRS database. Table 1 provides a list of the various types of NRC radioactive material licenses. The NRC is asking stakeholders to examine the chart below and to provide information that could assist the agency in identifying potential categories of radioactive material licenses that could be added to the list of licensees subject to the occupational reporting requirements in 10 CFR 20.2206.

Table 1 List of the Various Types of NRC Radioactive Material Licenses

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
01100	<p>Academic Type A Broad This type of license is issued to educational institutions under 10 CFR 33.13 and is authorized to possess any byproduct material with an atomic number between 1 and 83 in any chemical or physical form. The maximum possession limit is specified for the individual radionuclide and for the total activity of all radionuclides. The Radiation Safety Officer (RSO) and the Radiation Safety Committee (RSC) make day-to-day decisions about the program. The RSC designates the authorized users of the material.</p>		

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01110	<p>Academic Type B Broad This type of license is issued to educational institutions under 10 CFR 33.14 and is authorized to possess a variety of radionuclides. The maximum limit is specified in Column I in Schedule A of 10 CFR 33.100. Licensees must have an RSO, approved users, and administrative controls.</p>		
01120	<p>Academic Type C Broad This type of license is issued to educational institutions under 10 CFR 33.15 and is authorized to possess a variety of radionuclides. The maximum limit is specified in Column II in Schedule A of 10 CFR 33.100. Academic Type C Broad licensees must have training and experience as specified in the regulations and must have adequate administrative controls.</p>		
02110	<p>Medical Institution Broad This type of license is issued to medical institutions that provide patient care and that conduct research programs that use radionuclides for in vitro, animal, and medical procedures. It is issued under 10 CFR Part 33 and 10 CFR Part 35 and must have RSC-approved users for the possession and use of a wide range of radionuclides in medical research, diagnosis, therapy, and research and development.</p>		

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02120	<p>Medical Institution—Limited Scope—Written Directive Required</p> <p>This type of license is issued under 10 CFR 35.32 and applies to (1) any teletherapy, (2) any gamma stereotactic radiosurgery, (3) any brachytherapy, (4) any administration of either sodium iodide (I-125) or (I-131) in quantities greater than 30 microcuries (μCi), or (5) any therapeutic administration of a radiopharmaceutical other than I-125 or I-131. It is used as a primary Pcode <i>only</i> for nuclear medicine and emerging technologies.</p>		
02121	<p>Medical Institution—Limited Scope—Written Directive Not Required</p> <p>This type of license is used as a primary Pcode <i>only</i> for diagnostic nuclear medicine and diagnostic types of use under 10 CFR 35.1000.</p>		

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02200	<p>Medical Private Practice—Written Directive Required This type of license is issued under 10 CFR 35.12 to a physician or physicians for possession and use of radionuclides outside a medical institution. It authorizes any (1) teletherapy, (2) gamma stereotactic radiosurgery, (3) brachytherapy, (4) administration of either I-125 or I-131 in quantities greater than 30 µCi, or (5) therapeutic administration of a radiopharmaceutical other than I-125 or I-131. It is used as a primary Pcode <i>only</i> for nuclear medicine and emerging technologies.</p>		
02201	<p>Medical Private Practice—Written Directive Not Required This type of license is used as a primary Pcode <i>only</i> for diagnostic nuclear medicine and diagnostic types of use under 10 CFR 35.1000.</p>		
02210	<p>Eye Applicators Strontium-90 (Sr-90) This type of license is issued under 10 CFR 35.11 and 10 CFR 35.12 to medical institutions or private practices.</p>		

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02220	<p>Mobile Medical Service—Written Directive Not Required This type of license is issued under 10 CFR 35.11 and 10 CFR 35.29. It is used as a primary Pcode if the license authorizes the mobile service <i>only</i>. It is used as a secondary code if the license authorizes medical use at a central facility (i.e., an institution or private practice facility) in addition to the mobile service.</p>		
02230	<p>HDR Remote Afterloader This type of license is issued under 10 CFR 35.400 and is used as a primary Pcode. HDR licenses authorize the use of large activity byproduct material sealed sources, typically 10 curies of iridium-192, for cancer brachytherapy. These sources are connected to a wire and are contained in a shielded device that feeds the source into the patient through a catheter.</p>		
02231	<p>Mobile Medical Service—Written Directive Required This type of license is issued under 10 CFR 35.400 and other sections of 10 CFR Part 35 and is used as a primary Pcode. It includes mobile HDR and non-HDR modalities under 10 CFR Part 35.</p>		
02240	<p>Medical Therapy—Other Emerging Technology This type of license is issued for medical therapy modalities used under 10 CFR 35.1000 (i.e., liquid sources, microspheres, and intravascular brachytherapy devices).</p>		

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02300	<p>Teletherapy This type of license is issued under 10 CFR 35.13 and is used as a primary Pcode. It authorizes the use of cobalt-60 (Co-60) or cesium-137 for external beam cancer therapy. Many of the teletherapy licensees also have a medical institution license and possess x-ray machines and linear accelerators that are outside the NRC's jurisdiction.</p>		
02310	<p>Gamma Stereotactic Radiosurgery This type of license is issued under 10 CFR 30.33 and 10 CFR Part 35 and is used as a primary Pcode. It includes a radiation therapy unit that contains Co-60 located in a hemispherical shield with collimator ports directed to a single three-dimensional focus inside the unit and is used for the treatment of intracranial anomalies. It is issued for the treatment of human subjects <i>only</i>.</p>		
02400	<p>Veterinary—Nonhuman Subjects This type of license is issued under 10 CFR Part 30 for the routine diagnosis or therapy on animals. It is not used for animal research.</p>		
02410	<p>In Vitro Testing Laboratories This type of license is issued under 10 CFR Part 30 to individuals or facilities that are not included in larger programs described by Pcode 02110 or Pcode 0212.</p>		
02511	<p>Medical Product Distribution (MPD) 32.72—Prepared</p>		

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	Radiopharmaceuticals This type of license is issued for the distribution of prepared radiopharmaceuticals to authorized medical licensees.		
02512	MPD 32.72—Prepared Radiopharmaceuticals, Nonprofit		
02513	MPD 32.74—Sources and Devices This type of license is issued for therapy sources, calibration, and reference sources.		
02600	Production of Pet Radioactive Drugs 30.32(J) This type of license is used as a secondary Pcode for identifying those entities that meet the criteria in 10 CFR 30.32(j).		
02700	Radium-226 (Ra-226) Luminous Products and Sources Up to 10 Times the Possession Limits in 10 CFR 31.12(a)(4) and 10 CFR 31.12(a)(5) This type of license is issued for luminous products that contain Ra-226 and is authorized under 10 CFR 31.12.		
02710	Ra-226 Luminous Products and Sources Greater Than 10 Times the Possession Limits in 10 CFR 31.12(a)(4) and 10 CFR 31.12(a)(5) This type of license is issued for luminous products that contain Ra-226 and is authorized under 10 CFR 31.12.		

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03110	<p>Well Logging Byproduct or SNM Tracer and Sealed Sources or Both This type of license is issued under 10 CFR 39.11 and 10 CFR 39.11 39.13 and is used for sealed or unsealed sources for the exploration of oil, gas, or minerals in wells.</p>		
03111	<p>Well Logging Byproduct or SNM Sealed Sources Only or Both This type of license is issued under 10 CFR 39.11 and 10 CFR 39.13 for the exploration of oil, gas, or minerals in wells and for the study of subsurface potable aquifers.</p>		
03112	<p>Well Logging Byproduct Only— Tracers Only This type of license is issued under 10 CFR 39.11 and 10 CFR 39.13 for the exploration of oil, gas, or minerals in wells.</p>		
03113	<p>Field Flooding Studies This type of license is issued under 10 CFR 39.11 and 10 CFR 39.13 for the injection of unsealed byproduct materials for tracing oil and gas reservoirs.</p>		
03120	<p>Measuring Systems Fixed Gauges This type of license is issued under 10 CFR 30.33 for nonportable gauges for the measurement or control of material density, flow, level, thickness, or weight.</p>		

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03121	<p>Measuring Systems Portable Gauges This type of license is issued under 10 CFR 30.33 for moisture/density gauges that contain gamma and neutron sources used for measurements in soils, compacted soils, and road surfacing materials.</p>		
03122	<p>Measuring Systems Analytical Instruments This type of license is issued under 10 CFR 30.33 for the possession and use of analytical systems (i.e., x-ray fluorescence analyzers that do not fit other measuring system categories).</p>		
03123	<p>Measuring Systems Gas Chromatographs This type of license is issued under 10 CFR 30.33 for quality control testing of samples from industrial process and environmental conditions.</p>		
03124	<p>Measuring Systems Other This type of license is issued under 10 CFR 30.33 for the possession and use of instrument calibrators, krypton leak detectors, and other measuring systems categories.</p>		
03130	<p>Inspection Systems This type of license is issued for fixed or mobile nonintrusive inspection systems.</p>		
03210	<p>Radionuclide Production Using an Accelerator This type of license covers activities that take place once radioactive materials are produced by the accelerator. It does not include the operation of the accelerator.</p>		

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03213	<p>Manufacturing and Distribution Type C Broad This type of license is issued under 10 CFR 33.15 for the possession and use of a limited number of radionuclides and in smaller quantities than those for Type B licenses.</p>		
03215	<p>Manufacturing, Assembly, Disassembly, and Repair Products That Contain Ra-226 This type of license is issued for manufacturing, assembly, disassembly, and repair products that contain Ra-226 or for certain items and self-luminous products that contain Ra-226 authorized under 10 CFR 31.12.</p>		
03218	<p>Nuclear Laundry This type of license is issued under 10 CFR 30.33 for the cleaning of protective clothing contaminated with radioactive materials.</p>		
03219	<p>Decontamination Services This type of license is issued under 10 CFR 30.33 for the cleaning of scrap materials for authorized release for unrestricted use.</p>		
03220	<p>Leak Test Service Only This type of license is issued under 10 CFR 30.33 to entities that provide commercial leak-test services.</p>		
03221	<p>Instrument Calibration Services Only—Source Less Than or Equal to 100 Curies This type of license is issued under 10 CFR 30.33 to entities that provide commercial calibration services.</p>		

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03222	<p>Instrument Calibration Services Only—Source Greater Than 100 Curies or Less Than or Equal to 100 Curies This type of license is issued under 10 CFR 30.33 to entities that provide commercial calibration services.</p>		
03225	<p>Other Services—Source Less Than or Equal to 100 Curies This type of license is issued under 10 CFR 30.33 to service organizations that offer their services to other licensees for the possession and use of radioactive material for commercial services, such as teletherapy or industrial gauge servicing, that are not covered in the descriptions for Pcodes 03220–03224.</p>		
03226	<p>Other Services—Source Less Than 100 Curies This type of license is issued under 10 CFR 30.33 for the commercial servicing of teletherapy, irradiators, and gamma stereotactic radiosurgery units that contain a total activity, during servicing, that is greater than 100 curies.</p>		
03232	<p>Waste Disposal Service Prepackaged Only This type of license is issued under 10 CFR 30.33. It authorizes the pickup, transfer, and storage of radioactive waste. The opening of packages is not authorized.</p>		

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03233	<p>Waste Disposal Service Incineration This type of license is issued under 10 CFR 30.33 and in accordance with 10 CFR 20.2004). It authorizes the commercial receipt of wastes from other persons and the disposal of the wastes by incineration.</p>		
03234	<p>Waste Disposal Service Processing or Repackaging or Both This type of license is issued under 10 CFR 30.33. It authorizes the receipt of packaged wastes from other persons, opening of the packages, compacting and repackaging of wastes, and transfer of the wastes to an authorized burial ground for disposal.</p>		
03235	<p>Incineration, Noncommercial This type of license is issued under 10 CFR 30.33 to organizations authorized under 10 CFR 20.2004 to incinerate their own radioactive wastes.</p>		
03236	<p>Waste Treatment Service (Other Than Compaction) This type of license is issued under 10 CFR 30.33 and 10 CFR 40.32. It authorizes both the receipt of wastes from other persons and treatment operations that are more complicated than the compacting and repackaging of wastes. It also authorizes the transfer of wastes to an authorized burial ground for disposal.</p>		

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03240	<p>General License Distribution—32.51 This type of license is issued under 10 CFR 32.51 for the transfer of byproduct material in sealed sources contained in devices to persons who may be general licensees under 10 CFR 31.5 and devices designed to detect, measure, gauge, or control density, thickness, radiation leakage, or chemical composition or to produce light or an ionized atmosphere.</p>		
03241	<p>General License Distribution—32.53 This type of license is issued under 10 CFR 32.53 for the distribution of luminous aircraft safety devices to general licensees under 10 CFR 31.7 for possession and use of tritium or promethium-147 (Pm-147) contained in luminous aircraft safety devices in which the device contains less than 10 curies (370 gigabecquerel (GBq)) of tritium or 300 millicuries (11.1 GBq) of Pm-147.</p>		
03242	<p>General License Distribution—32.57 This type of license is issued under 10 CFR 32.57 for the distribution of calibration or reference sources to general licensees under 10 CFR 31.8 for possession and use of americium-241 in calibration and reference sources.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03243	<p>General License Distribution—32.61 This type of license is issued under 10 CFR 32.61 for the distribution of ice detection devices to general licensees under 10 CFR 31.10 for possession and use of Sr-90 in ice detection devices.</p>		
03244	<p>General License Distribution—32.71 This type of license is issued under 10 CFR 32.71 for the distribution of byproduct material to physicians, hospitals, clinical laboratories, or veterinarians in the practice of veterinary medicine, who hold a general license under 10 CFR 31.11, for the use and possession of specified byproduct material in prepackaged units in certain in vitro clinical or laboratory tests.</p>		
03250	<p>Exempt Distribution—32.11: Exempt Concentrations and Items This type of license authorizes (1) the transfer of byproduct material or a product that contains byproduct material owned by, or in the possession of, the licensee and (2) the transfer of ownership or possession of the material or product that contains the byproduct material to persons exempt from the licensing requirements in 10 CFR 30.14.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03251	<p>Exempt Distribution—32.14: Certain Items This type of license authorizes the transfer of certain products that contain byproduct material specified in 10 CFR 30.15 or the initial transfer for sale or distribution of products specified in 10 CFR 30.15 to persons exempt from licensing requirements.</p>		
03252	<p>Exempt Distribution—32.17: Resins This type of license authorizes the initial transfer for sale or distribution of synthetic plastic resins that contain scandium-46 and are designed for sand consolidation in oil wells to persons exempt from the licensing requirements in 10 CFR 30.16.</p>		
03253	<p>Exempt Distribution—32.18: Small Quantities This type of license is issued for the commercial distribution of small quantities of byproduct material to persons exempt from the licensing requirements in 10 CFR 30.18.</p>		
03254	<p>Exempt Distribution—32.22: Self-Luminous Products This type of license is issued for the initial transfer of products that contain tritium, krypton-85, or Pm-147 to persons exempt from the licensing requirements in 10 CFR 30.19.</p>		
03255	<p>Exempt Distribution—32.26: Smoke Detectors This type of license is issued for the initial transfer of gas and aerosol detectors that contain byproduct material and are designed to protect life or property</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
	from fire and airborne hazards to persons exempt from the licensing requirements in 10 CFR 30.20.		
03256	Exempt Distribution—32.21, Carbon-14 (C-14) Urea Capsules This type of license is issued for the commercial distribution of a radioactive drug that contains 1 µCi of C-14 to persons exempt from the licensing requirements in 10 CFR 30.21.		
03510	Irradiators—Self-Shielded Less Than or Equal to 10,000 Curies This type of license is issued under 10 CFR 30.33 for the possession and use of sealed sources of byproduct material in devices in which the total radioactivity is less than 10,000 curies (370 terabecquerel (TBq)). The device is constructed so that there is no external beam during use; it is usually a small cabinet-type device that is not built in.		
03511	Irradiators—Other Less Than or Equal to 10,000 Curies This type of license is issued under 10 CFR 30.33 for the possession and use of sealed sources of byproduct material in devices in which the total radioactivity is less than 10,000 curies (370 TBq). The device does not provide shielding from the radiation beam; additional shielding and special radiation protection is needed.		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03520	<p>Irradiators—Self-Shielded Greater Than 10,000 Curies This type of license is issued under 10 CFR 30.33 for the possession and use of sealed sources of byproduct material in devices in which the total radioactivity is 10,000 curies (370 TBq) or more. The device is constructed so that there is no external beam during use; it is usually a small cabinet-type device that is not built in.</p>		
03521	<p>Irradiators—Other Greater than 10,000 Curies This type of license is issued under 10 CFR 30.33 for the possession and use of sealed sources of byproduct material in devices in which the total radioactivity is 10,000 curies (370 TBq) or more. The device does not provide shielding from the radiation beam. NRC regulations require additional shielding and special radiation protection precautions.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03610	<p>Research and Development Type A Broad This type of license is issued under 10 CFR 33.13 to private organizations, universities, and government agencies for the possession and use of radionuclides in research. It authorizes the possession of any byproduct material with an atomic number between 1 and 83 in any chemical or physical form. The maximum possession limit is specified for the individual radionuclide and for the total activity of all radionuclides. RSOs and RSCs make day-to-day decisions about the program. RSCs approve the users.</p>		
03611	<p>Research and Development Type B Broad This type of license is issued under 10 CFR 33.14; it authorizes the possession of a variety of radionuclides. The limit is specified in Column I in Schedule A of 10 CFR 33.100. Licensees must have an RSO who approves users and administrative controls.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03612	<p>Research and Development Type C Broad This type of license is issued under 10 CFR 33.15 for the possession of a variety of radionuclides. The limit is specified in Column II in Schedule A of 10 CFR 33.100. Type C Broad licensees must have training and experience as specified in 10 CFR 33.15. Authorized users specifically named in the license and the licensee must have adequate administrative controls.</p>		
03613	<p>Research and Development Broad Multisite Multiregional This type of license is issued to master materials licenses for the possession and use of material at fixed facilities in more than one region (e.g., the U.S. Department of the Air Force or the U.S. Department of the Navy)</p>		
03620	<p>Research and Development Other This type of license is issued under 10 CFR 30.33 for the possession and use of specifically designated radionuclides in academic institutions, industrial facilities, and medical institutions for nonhuman research.</p>		
03710	<p>Civil Defense This type of license is issued under 10 CFR 30.33 for the possession and use of sealed sources for training individuals in civil defense activities, such as calibrating and demonstrating the use of radiation survey and monitoring equipment.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
03800	<p>Byproduct Material Possession Only—Permanent Shutdown This type of license is issued under 10 CFR 30.33 for the possession and storage, or both, of residual contamination or other byproduct material in anticipation of the removal of all licensed material. Principle activities have ceased, and a license termination request is pending. Packaging and shipping operations are authorized. Decontamination and decommissioning (D&D) is not authorized.</p>		
03810	<p>Byproduct Material Standby—No Operations This type of license is issued under 10 CFR Part 30 for possession or storage, or both, of byproduct material. Principal activities have ceased, but the licensee is undecided about terminating the license. Packaging and shipping operations are authorized. D&D is not authorized.</p>		
11200	<p>Source Material—Other Less Than 150 Kilograms (kg) This type of license is issued under 10 CFR Part 40 for the possession and use of source material for the fabrication, research, or manufacturing of consumer product.</p>		
11210	<p>Source Material Shielding This type of license is issued under 10 CFR Part 40 for the possession and use of source material in shielding for protection against radiation.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
11220	<p>Source Material Military Munitions Indoor Testing This type of license is issued under 10 CFR Part 40 for the possession, use, and testing of depleted uranium (DU) products designed for the military. The testing is done within an enclosure and usually results in fragmentation of the munitions.</p>		
11221	<p>Source Material Military Munitions Outdoor Testing This type of license is issued under 10 CFR Part 40 for possession, use, and testing of DU products designed for the military.</p>		
11230	<p>Source Material General License Distribution—40.34 This type of license is issued under 10 CFR Part 40 either to authorize the initial transfer of industrial products and devices that contain DU or to initially transfer such products or devices to persons who have been issued a general license under 10 CFR 40.25 for the receipt, acquisition, possession, use, or transfer of DU in industrial products or devices to provide a concentrated mass in a small volume of the product or device.</p>		
11300	<p>Source Material—Other Greater Than 150 kg This type of license is issued under 10 CFR Part 40 for the possession and use of source material for the fabrication, research, or manufacturing of consumer products.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
11700	<p>Rare Earth Extraction and Processing Generates This type of license is issued under 10 CFR Part 40 for the possession and use of source material for processing activities not directly related to the nuclear fuel cycle. This category includes licenses for the extraction of metals, heavy metals, and rare earth materials.</p>		
11800	<p>Source Material Possession Only—Permanent Shutdown This type of license is issued under 10 CFR Part 40. Principal activities have ceased, and a license termination request is pending. Packaging and shipping operations are authorized. D&D is not authorized.</p>		
11810	<p>Source Material Standby—No Operations This type of license is issued under 10 CFR Part 40. Principal activities have ceased, but the licensee is undecided about terminating the license. Packaging and shipping operations are authorized. D&D is not authorized.</p>		
11900	<p>Decommissioning of Source Material Facilities This type of license is issued under 10 CFR Part 40. D&D may have been authorized according to an approved plan under 10 CFR 40.42. Less than 200 grams, total, is available for biological and chemical testing and instrument calibration.</p>		
21310	<p>Critical Mass Material—University This type of license is issued</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
	under 10 CFR Part 70 for greater than 350 grams of enriched uranium-235 (U-235), greater than 300 grams of uranium-233 (U-233), greater than 200 grams of plutonium, or any combination thereof.		
21320	Critical Mass Material—Other Than Universities This type of license is issued under 10 CFR Part 70 for greater than 350 grams of enriched U-235, greater than 300 grams of U-233, greater than 200 grams of plutonium, or any combination thereof.		
21325	Decommissioning of Critical Mass—Other Than Fuel Fabrication This type of license is issued under 10 CFR Part 70. D&D may have been authorized according to an approved plan under 10 CFR 70.38.		
22110	SNM Plutonium—Unsealed, Less than Critical Mass This type of license is issued under 10 CFR Part 70 for less than 200 grams, total, for biological and chemical testing and instrument calibration.		
22111	SNM, U-235, and/or U-233—Unsealed, Less than a Critical Mass This type of license is issued under 10 CFR Part 70 for less than 350 grams of U-235 or less than 300 grams of U-233, or both, for biological and chemical testing and instrument calibration.		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
22120	<p>SNM Plutonium—Sealed Neutron Sources, Less than 200 Grams</p> <p>This type of license is issued under 10 CFR Part 70 for the use of a plutonium-beryllium howitzer for instrument calibration, teaching and demonstration purposes, and industrial applications.</p>		
22130	<p>Power Sources with Byproduct or SNM, or Both</p> <p>This type of license is issued under 10 CFR Part 70 for heat or power generators for remote locations.</p>		
22140	<p>SNM Plutonium—Sealed Sources in Devices</p> <p>This type of license is issued under 10 CFR Part 70 for use in gauges.</p>		
22150	<p>SNM Plutonium—Sealed Sources Less Than a Critical Mass</p> <p>This type of license is issued under 10 CFR Part 70 for less than 200 grams total for biological and chemical testing and instrument calibration.</p>		
22151	<p>SNM, U-235, and/or U-233—Sealed Sources Less Than a Critical Mass</p> <p>This type of license is issued under 10 CFR Part 70 for less than 350 grams of U-235 or less than 300 grams of U-233, or both, for biological and chemical testing and instrument calibration.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
22160	<p>Byproduct- or SNM-Powered Pacemaker—Medical Institution This type of license is issued under 10 CFR Part 30 and 10 CFR Part 70 for surgical implantation, follow-up, recovery, and disposal of devices.</p>		
22161	<p>Byproduct- or SNM-Powered Pacemaker—Individual This type of license is issued under 10 CFR Part 30 and 10 CFR Part 70 to the recipient of a surgically implanted nuclear-powered cardiac pacemaker. These licenses authorize the person, usually from a foreign country, to possess the pacemaker while he or she is in the United States.</p>		
22162	<p>Byproduct- or SNM-Powered Pacemaker—Manufacturing and Distribution This type of license is issued under 10 CFR Part 30 and 10 CFR Part 70 for the manufacture of byproduct- or SNM-powered cardiac pacemakers and the distribution of these pacemakers to licensees authorized to receive them.</p>		
22170	<p>SNM General License Distribution—70.39 This type of license is issued under 10 CFR 70.39 for the initial distribution of calibration or reference sources that contain plutonium to general licensees, under 10 CFR 70.19, that are authorized to possess and use plutonium in calibration or reference sources.</p>		

PROGRAM CODE	LICENSE CATEGORY AND DESCRIPTION (FROM NUREG-1556, VOLUME 20)	WHAT IS THE AVERAGE ANNUAL OCCUPATIONAL DOSE FOR THIS CATEGORY?	SHOULD THIS LICENSE CATEGORY BE REQUIRED TO SUBMIT TO NRC's REIRS database? (YES OR NO AND WHY OR WHY NOT) (PLEASE ATTACH RESPONSE IF ADDITIONAL SPACE IS NEEDED.)
22200	<p>Decommissioning of Other SNM Facilities—Less Than Critical Mass</p> <p>This type of license is issued under 10 CFR Part 70. D&D may have been authorized according to an approved plan under 10 CFR 70.38.</p>		
23300	<p>SNM Possession Only (Nonfuel)—Permanent Shutdown</p> <p>This type of license is issued under 10 CFR Part 70. Principal activities have ceased, and a license termination request is pending. Packaging and shipping operations are authorized. D&D is not authorized.</p>		
23310	<p>SNM Standby (Nonfuel)—No Operations</p> <p>This type of license is issued under 10 CFR Part 70. Principal activities have ceased, but the licensee is undecided about terminating the license. Packaging and shipping operations are authorized. D&D is not authorized.</p>		

VI. Most Recent Occupational Radiation Exposure Data from NRC Licensees

NUREG-0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," Volume 33, "2011 Forty-Fourth Annual Report," issued April 2013 (NRC's Agencywide Documents Access and Management System (ADAMS) Accession No. ML13095A191), summarizes the occupational exposure data that are maintained in the NRC's REIRS database. The information in NUREG-0713 was compiled from the 2011

annual reports submitted by those NRC licensees subject to the reporting requirements in 10 CFR 20.2206. The annual reports submitted by these licensees include radiation exposure records for each monitored individual. These records are analyzed for trends and presented in NUREG-0713 in terms of collective dose and the distribution of dose among the monitored individuals.

The NRC received annual reports for 2011 from a total of 194 NRC licensees, including 104 commercial nuclear power reactors, 11 fuel cycle licensees (processors and fabricators), 2 ISFSIs, 62 industrial radiography licensees, and 15 manufacturing and distribution licenses (i.e., 12 nuclear pharmacies, 2 Type A Broad, and 1 Type B Broad Other). The summation of reports submitted by the 194 licensees indicates that 204,561 individuals were monitored, including 191,538 individuals from nuclear reactors, 9,535 individuals from fuel cycle licenses, 54 individuals from ISFSIs, 901 individuals from manufacturing and distribution licensees, and 2,533 individuals from industrial radiography licensees. Of the individuals monitored, 88,606 of them received a measurable dose. The number of persons monitored was adjusted to reflect the duplicate monitoring of reactor individuals who were monitored at more than one facility (transient individuals). Forty-four percent (66,408) of the 149,927 individuals monitored in the nuclear reactor category received a measurable dose. A further review of the data revealed that (1) 46 percent (4,361) of the 9,535 individuals monitored in the fuel cycle category received a measurable dose, (2) 46 percent (25) of the 54 individuals monitored in the ISFSIs category received a measurable dose, (3) 78 percent (700) of the 901 individuals monitored in the manufacturing and distribution category received a measurable dose, and (4) 87 percent (2,199) of the 2,533 individuals monitored in the industrial radiography category received a measurable dose.

The provisions of 10 CFR 20.2206 require licensees to report the total effective dose equivalent (TEDE). The phrase "collective dose" is used in the report to mean the collective

TEDE. The collective dose is determined by summing the TEDE of all monitored individuals. According to the 2011 data, the collective dose incurred by the individuals monitored was 11,097 person-rem. This represents a 5-percent increase from the 2010 value of 10,617 person-rem.

The increase in the collective dose reported in the 2011 data was primarily due to an increase in the collective dose for industrial radiography licensees and an increase in the collective dose for commercial nuclear power reactor licensees. Although the collective dose increased from 2010 to 2011, the average measurable dose for both years remained at 0.17 rem due to an equally proportional increase in the number of individuals who received a measurable dose and the correction made for transient individuals who are monitored at more than one facility.

The average measurable dose was obtained by dividing the collective TEDE by the number of individuals with a measurable dose. This average is the one that is most commonly used when examining trends and when comparing doses received by individuals in various segments of the nuclear industry. Before a correction was made for transient individuals, the average measurable TEDE per individual was 0.13 rem. After the correction was made for transient individuals, the average measurable TEDE per individual was 0.17 rem.

An increase in the collective dose for commercial nuclear power reactor licensees in 2011 contributed to the increase in the overall collective dose. The increase in collective dose for commercial nuclear power reactors was due to a 32-percent increase in total outage hours in 2011. The conduct of activities during the outage, such as refueling and the performance of maintenance, results in more occupational radiation exposure than the normal reactor operations. Although this category noted an increase in the collective dose, the average measurable TEDE per individual of 0.13 rem (0.17 rem after making the correction for transient individuals) was considerably less than those reported in the two categories involving

radioactive material licensees—industrial radiography and the manufacturing and distribution of certain byproduct materials. The ISFSIs and fuel cycle categories also had lower average measurable TEDEs per individual at 0.06 rem and 0.16 rem, respectively.

As noted earlier, the increase in the overall collective dose was primarily due to the increase in collective dose for industrial radiography licensees.² The industrial radiography category had an average measurable TEDE per individual of 0.73 rem. This TEDE was the highest of all the reporting categories. In addition, it had the highest percentage of individuals with a measurable dose (87 percent). The manufacturing and distribution of certain byproduct materials category³ had the second highest average measurable TEDE per individual at 0.16 rem. It also had the second highest percentage of individuals with a measurable dose at 78 percent. These data may be somewhat skewed because only 62 industrial radiography licensees reported results, and only 15 manufacturing and distribution licensees reported results. Based on information in the NRC License Tracking System database, more NRC licensees should have provided an annual 2011 occupational dose report to the NRC's REIRS database. Section VI.A further discusses this issue.

The majority of licensees in the industrial radiography and the manufacturing and distribution of certain byproduct materials categories are Agreement State licensees. Agreement State licensees are not required to submit a report under 10 CFR 20.2206 to the NRC, thus limiting the collection of this data. With this limitation on the data collection, the NRC's analysis of the reports that it receives under 10 CFR 20.2206 cannot fully evaluate (1) trends in nationwide occupational exposure in industrial radiography and manufacturing and

² NRC licensed industrial radiographers must file the annual monitoring report under 10 CFR 20.2206(a)(2).

³ NRC licensed byproduct manufacturers and distributors must file the annual monitoring report under 10 CFR 20.2206(a)(7).

distribution of certain byproduct materials or in LLW disposal or (2) the effectiveness of radioactive material licensees to maintain exposures ALARA.

Nevertheless, the average measurable TEDE per individual values in all five categories reported were considerably lower than the 0.31-rem average annual natural background radiation dose in the United States. The values were also lower than the current average worldwide annual natural background radiation dose of 0.24 rem.

A. NRC Radioactive Material Licensees Reporting of 2011 Occupational Exposure to the NRC's REIRS Database

An analysis of the reporting of the annual 2011 occupational information to the NRC's REIRS database by NRC radioactive material licensees was done using data in Table A1, "Annual TEDE for Nonreactor NRC Licensees," in Volume 33 of NUREG-0713. The July 30, 2013, list of active NRC radioactive material licenses in the NRC License Tracking System database with Pcodes 03310, 03320, 02500, 03211, and 03214 (which were required to provide an annual report of the 2011 monitoring of occupational dose by April 30, 2012, to the NRC) was compared to the list of licensees that actually reported.

In general, the analysis provided the following information in regard to compliance with the requirements in 10 CFR 20.2206 for the 2011 reporting period:

- The reporting category, industrial radiography, had the best compliance rate with 100 percent for fixed location and 71 percent for temporary jobsite; however, improvements are still needed for industrial radiography temporary jobsite licensees.
- The reporting category, manufacturing and distribution of certain byproduct material, needs to greatly improve its compliance with the reporting requirement in 10 CFR 20.2206, which is currently 40 percent for manufacturing and distribution Type A Broad, 25 percent for Nuclear Pharmacies, and a very low 3 percent for Manufacturing and Distribution Other (03214).

The NRC staff is aware that not all NRC radioactive material licensees report occupational exposure data to the REIRS database. Some licensees indicated that they did not report the information to the NRC because none of their workers exceeded 10 percent of the

annual occupational dose limit of 50 mSv (5 rem). Some licensees also indicated that they did not meet a threshold for reporting the dose information to the NRC's REIRS database.

However, there is no threshold for reporting dose information to the NRC's REIRS database. If the license is required to monitor an occupational worker under 10 CFR 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose," and to submit an annual report in accordance with 10 CFR 20.2206(a), it must report that occupational dose information to the NRC's REIRS database regardless of the actual dose received.

The staff recognizes that 10 CFR 19.13(b)(1) and 10 CFR 19.13(b)(2) require licensees to provide an annual report to each individual monitored under 10 CFR 20.1502 of the dose he or she received in that monitoring year if the individual's occupational dose exceeds a TEDE of 100 millirem (mrem) or 100 mrem to any individual organ or tissue or if the individual requests his or her annual dose report. However, the 100-mrem reporting threshold of 10 CFR 19.13(b)(1) does not exempt the licensees covered under 10 CFR 20.2206 from reporting occupational dose information to the NRC's REIRS database for those individuals receiving less than 100 mrem if these licensees were required to monitor that individual under 10 CFR 20.1502. A revision to 10 CFR 19.13, "Notifications and Reports to Individuals," may be necessary to clarify that the 100-mrem reporting threshold does not apply to occupational reporting under 10 CFR 20.2206.

Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Dose Data," Revision 2, issued November 2005 (ADAMS Accession No. ML052970092), provides guidance on this regulatory requirement. Regulatory Guide 8.7 notes that, according to 10 CFR 20.1502, monitoring is required if an adult is likely to receive a dose in a calendar year that is greater than the specified percentage of the limits defined in 10 CFR 20.1201, "Occupational Dose Limits for Adults"; 10 CFR 20.1207, "Occupational Dose Limits for Minors";

or 10 CFR 20.1208, “Dose Equivalent to an Embryo/Fetus,” or to enter a high⁴ or very high radiation area.⁵ The requirements in 10 CFR 20.1502 are a prospective determination that the individual will not exceed 10 percent of the annual occupational dose limits (if an adult) and will not enter a high or very high radiation area. Therefore, the licensee must evaluate the dose that such an individual is likely to receive before allowing the individual to receive any dose.

As discussed previously, if the licensee provides personal monitoring under 10 CFR 20.1502 and if it is required to submit an annual report in accordance with 10 CFR 20.2206(a), it must report the occupational dose information to the NRC REIS database. Section 1.2 of Regulatory Guide 8.7 states that 10 CFR 20.2106(a) and 10 CFR 20.2206(b), respectively, require the recording and reporting of monitoring results regardless of the actual dose received and even if the actual dose received is less than the dose limits for which monitoring is required. The only exception is when the licensee has performed and documented a prospectus evaluation before the individual receives any occupational exposure for the calendar year showing that an individual is not likely to receive a dose in a calendar year that exceeds the specified percentage of the limits in 10 CFR 20.1201, 10 CFR 20.1207, or 10 CFR 20.1208 or to enter a high or very high radiation area. Nevertheless, to accomplish the Commission’s direction to improve reporting of occupational exposure by NRC and Agreement State licensees, an amendment to 10 CFR 20.2206 and other 10 CFR Part 20 regulations may be appropriate to either clearly indicate that all occupational workers should be monitored and that all occupational doses should be reported or that the

⁴ “High radiation area” is an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 1 mSv (100 mrem) in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates. (See the definition of “high radiation area” in 10 CFR 20.1003, “Definitions.”)

⁵ “Very high radiation area” is an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 5 grays (500 radiation absorbed dose) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates. (See the definition of “very high radiation area” in 10 CFR 20.1003.)

number of license categories required to report to the NRC's REIRS database under 10 CFR 20.2206 should be expanded beyond the current seven. In addition, requiring Agreement States to adopt compatible regulations may be appropriate. Section VII further discusses this issue.

VII. Agreement State Program

A. Agreement State Regulatory Landscape

The NRC's Management Directive (MD) 5.9 Handbook, "Adequacy and Compatibility of Agreement State Programs" (ADAMS Accession No. ML041770094) (hereinafter referred to as the MD 5.9 Handbook), describes the implementation procedures for the NRC's Policy Statement on Adequacy and Compatibility of Agreement State Programs (ADAMS Accession No. ML040070213). The procedures identify the criteria that the NRC uses to determine those program elements that Agreement States must adopt to maintain an adequate and compatible program and those program elements that Agreement States may adopt. The MD 5.9 Handbook categorizes NRC program elements (including regulations) into five categories comprising four compatibility categories (Categories A–D) and a fifth category (the health and safety category). Category A program elements "are basic radiation protection standards and scientific terms and definitions that are necessary to understand radiation protection concepts. The program elements adopted by an Agreement State *should be essentially identical* to those of [the] NRC to provide uniformity in the regulation of agreement material on a nationwide basis."⁶ Category B program elements "apply to activities that have direct and significant transboundary implications. An Agreement State *should adopt program elements essentially*

⁶ See MD 5.9 Handbook, Part I, section B, paragraph (3), dated February 27, 1998 (emphasis added).

identical to those of [the] NRC.”⁷ Category C program elements are those “that do not meet the criteria of Category A or B, but the essential objectives of which an Agreement State should adopt to avoid conflict, duplication, gaps, or other conditions that would jeopardize an orderly pattern in the regulation of agreement material on a nationwide basis. An Agreement State *should adopt the essential objectives* of the NRC program elements.”⁸ Category D program elements “do not meet any of the criteria of Category A, B, or C, above, and, thus, *do not need to be adopted* by Agreement States for purposes of compatibility.”⁹ Finally, the health and safety program elements “are not required for compatibility (i.e., Category D), but that have been identified as having a particular health and safety role (i.e. adequacy) in the regulation of agreement material within the State. Although not required for compatibility, the State should adopt program elements in [the health and safety] category, based on those of [the] NRC, that embody the essential objectives of the NRC program elements because of particular health and safety considerations.”¹⁰

B. Agreement State Occupational Reporting

The regulations at 10 CFR 20.2206 require certain categories of NRC licensees to submit an annual report on the results of the monitoring required by 10 CFR 20.1502 to the NRC’s REIRS database. As the NRC has designated the reporting provisions of 10 CFR 20.2206 as Category D for Agreement State compatibility purposes, Agreement States are not required to adopt such regulations. Therefore, an Agreement State can choose not to have its licensees submit annual reports of occupational radiation dose information to either

⁷ See MD 5.9 Handbook Part I, section B, paragraph (3), dated February 27, 1998 (emphasis added).

⁸ See MD 5.9 Handbook Part I, section B, paragraph (3), dated February 27, 1998 (emphasis added).

⁹ See MD 5.9 Handbook Part I, section B, paragraph (3), dated February 27, 1998 (emphasis added).

¹⁰ See MD 5.9 Handbook at Part I, section B, paragraph (4), dated February 27, 1998 (alteration added).

itself or the NRC. Nevertheless, some Agreement State licensees voluntarily report occupational dose information to the NRC's REIRS database.

During the period 1997 through 2010, the NRC received occupational dose reports from 312 Agreement State licensees. The 312 licensees represented less than 2 percent of the total number of Agreement State licensees, at that time. The NRC staff review of the reports indicated that the 312 Agreement State licensees monitored exposures of 40,622 occupational workers, and 78 percent (31,704) of these occupational workers received a measurable dose. The complete staff review is available in NUREG-2118, Vol.1, "Occupational Radiation Exposure at Agreement State-Licensed Materials Facilities, 1997-2010" (ADAMS Accession No. ML12220A081).

As a result, the NRC is considering both the question of who needs to report and how to effectively integrate the reporting from licensees in the NRC and Agreement States programs. The NRC has determined that it should pursue a more detailed examination of the implications, benefits, and costs of requiring additional categories of licensees to report exposures to the NRC's REIRS database. This information could be useful in assessing the effectiveness of the NRC's regulatory programs. In addition, such information could constitute a source of data for ongoing use by the NRC and Agreement States in inspection, enforcement, and incident response activities.

If the use of the NRC's REIRS database increases, it could serve as a national occupational exposure database with information available to the NRC and Agreement States. Correlating the occupational exposures of an individual working at different licensee facilities would be one advantage of such a system, which is currently the case for power reactor licensees because they all report to the NRC's REIRS database. However, a mechanism that would allow the NRC or an Agreement State to independently determine, for the various types of radioactive material licenses, whether an individual is exceeding the occupational dose limits

as a result of concurrent exposures at multiple licensee facilities or sites, especially if the individual works concurrently in jurisdictions regulated by the NRC and one or more Agreement States, is not available. For example, a physician could practice concurrently in Washington, DC (an NRC jurisdiction); Alexandria, VA (an Agreement State jurisdiction); and Bethesda, MD (a different Agreement State jurisdiction). Because of the large percentage of radioactive material licenses regulated by the Agreement States (over 85 percent), extensive cooperation and collaboration between the NRC and the Agreement States would be needed to obtain occupational reports of concurrent employment of workers in multiple jurisdictions; as such, the NRC may consider developing regulatory requirements that will ensure improvement in the reporting of occupational exposure by NRC and Agreement State material licensees.

VIII. Proposals

In SRM-SECY-12-0064, the Commission directed the staff to improve reporting of occupational exposure by NRC and Agreement State licensees, some of which do not currently submit reports. The regulation at 10 CFR 20.2206(a) requires seven categories of licensees to provide reports each year of individual occupational exposure, although only five categories are currently active because the NRC has not licensed a geologic repository for HLW or any LLW facilities. (All LLW facilities that are currently operating are licensed by Agreement States.) The five active licensee categories include (1) operators of nuclear power reactors under 10 CFR 50.21(b) or 10 CFR 50.22, "Class 103 Licenses; for Commercial and Industrial Facilities," (2) industrial radiographers under 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," and 10 CFR Part 34, "Licenses for Industrial Radiography and Radiation Safety Requirements for Industrial Radiographic Operations," (3) fuel processors and fabricators under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," (4) operators of ISFSIs under 10 CFR Part 72, "Licensing Requirements for

the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste,” and (5) persons who process or manufacture for distribution specified quantities of certain byproduct material under 10 CFR Part 30, “Rules of General Applicability to Domestic Licensing of Byproduct Material”; 10 CFR Part 32, “Specific Domestic Licenses To Manufacture or Transfer Certain Items Containing Byproduct Material”; 10 CFR Part 33, “Specific Domestic Licenses of Broad Scope for Byproduct Material”; or 10 CFR Part 35, “Medical Use of Byproduct Material.”

The NRC regulates all commercial nuclear power reactors, fuel processors and fabricators, and ISFSIs. The NRC’s REIRS database information for these categories reflects all relevant occupational exposure activity for these three categories in the United States. However, the majority of licensees in the industrial radiography and the manufacturing and distribution of certain byproduct materials categories are licensed by Agreement States; as such, they are not required to submit annual reports under 10 CFR 20.2206 to the NRC. More than seven times as many radioactive material licensees are regulated by Agreement States than those regulated by the NRC. Currently, the NRC regulates approximately 2,800 (12.5 percent), and Agreement States regulate approximately 19,600 (87.5 percent) of the material licensees in the Nation. Agreement States are not required to adopt regulations compatible with 10 CFR 20.2206. However, if the NRC were to change the compatibility designation of 10 CFR 20.2206 and possibly the compatibility designation of 10 CFR 20.1502, those Agreement State licensees in the industrial radiography and the manufacturing and distribution of certain byproduct materials categories would be required to report occupational dose information to NRC’s REIRS database. The database would then reflect, on a nationwide basis, all relevant occupational exposure activities for all five of the active reporting categories for radioactive material under 10 CFR 20.2206 and the LLW facilities licensed by Agreement States.

For example, the 2011 occupational dose data in Volume 33 of NUREG-0713 indicate an increase in collective dose for NRC industrial radiography licensees. Knowing whether the collective dose increased for industrial radiography licensees in Agreement States or on a national basis could be helpful. Questions of this nature cannot be answered under the current occupational reporting framework.

The NRC staff is considering various options for developing a draft regulatory basis that would increase the reporting of occupational doses to the NRC's REIRS database. The NRC staff cannot explore the full breath of the various options on this issue until it has had an opportunity to fully evaluate the responses to various questions surrounding this issue.

Nevertheless, the potential options could include the following:

- Option 1: No Change. This option does not follow the Commission's direction.
- Option 2: Improvement in Compliance Reporting. How should the NRC improve the compliance reporting of the radioactive material licensees that currently must submit such reports under 10 CFR 20.2206? Should the NRC address this compliance reporting issue before additional categories of radioactive material licensees are required to report this information under 10 CFR 20.2206?
- Option 3: Expansion of the Licensee Reporting Categories in 10 CFR 20.2206. The NRC cannot fully evaluate this option until it obtains more information from stakeholders to better identify additional categories of licensees that should be subject to the annual reporting requirements under 10 CFR 20.2206.
- Option 4: Gradual Expansion of the Licensee Reporting Categories in 10 CFR 20.2206. Should the NRC gradually add categories of licensees required to comply with the requirements in 10 CFR 20.2206 (e.g., providing staggered compliance dates for different categories of licensees)? Similar to Option 3, the NRC cannot fully evaluate this option until it obtains additional information from stakeholders to better identify additional categories of licensees that should be subject to the reporting requirements in 10 CFR 20.2206.
- Option 5: Agreement State Compatibility. Should the NRC change the compatibility category of 10 CFR 20.2206 (i.e., currently Category D, which does not require an Agreement State adoption of the NRC regulation) to make it a matter of compatibility for adoption by Agreement States and to increase the compatibility level of 10 CFR 20.1502 to either Category A or Category B? Similar to the preceding options, the NRC cannot fully evaluate this option until it obtains input from stakeholders.

The NRC staff believes that additional input from the public, the regulated community, and other stakeholders is necessary to understand the implications of potential options on this issue.