Title 15: Mississippi State Department of Health

Part 21: Division of Radiological Health

Subpart 78: Radiological Health

Chapter 1 REGULATIONS FOR CONTROL OF RADIATION IN MISSISSIPPI

Subchapter 1 General Provisions

Rule 1.1.1 **Scope**. Except as otherwise specifically provided, these regulations apply to all persons who receive, possess, use, transfer, own, or acquire any source of radiation; provided, however, that nothing in these regulations shall apply to any person to the extent such person is subject to regulation by the U.S. Nuclear Regulatory Commission.[1]

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.2 **Definitions**. As used in these regulations, these terms have the definitions set forth below. Additional definitions used only in a certain section will be found in that section.

1. "A_1" means the maximum activity of special form radioactive material permitted in a Type A package. "A_2" means the maximum activity of radioactive material, other than special form, LSA and SCO material, permitted in a Type A package. These values are either listed in Appendix A, Table A-1 of Subchapter 13 of these regulations or may be derived in accordance with the procedure prescribed in Appendix A of Subchapter 13 of these regulations.

2. "Absorbed dose" means the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The units of absorbed dose are the rad and the gray (Gy).

3. "Accelerator" means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 MeV. For purposes of this definition, "particle accelerator" is an equivalent term.

4. "Accelerator-produced radioactive material" means any material made radioactive by a particle accelerator.

5. "Act" means the Mississippi Radiation Protection Law of 1976.

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[1] Attention is directed to the fact that regulation by the State of source material, byproduct material, and special nuclear material in quantities not sufficient to form a critical mass is subject to the provisions of the agreement between State and the U.S. Nuclear Regulatory Commission and to 10 CFR Part 150 of the Commission's regulations.

6. "Activity" means the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

7. "Adult" means an individual 18 or more years of age.

8. "Agency" means the Mississippi State Department of Health.

9. "Agreement State" means any State with which the U.S. Nuclear Regulatory Commission or the U.S. Atomic Energy Commission has entered into an effective agreement under Subchapter 274b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

10. "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

11. "Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

    a. in excess of the derived air concentrations (DACs) specified in Appendix B, Table I of Subchapter 4 of these regulations; or

    b. to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

12. "Alert" means events may occur, are in progress, or have occurred that could lead to a release of radioactive material but that the release is not expected to require a response by offsite response organizations to protect persons offsite.

13. "As low as is reasonably achievable" (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in these regulations as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest.

14. "Background radiation" means radiation from cosmic sources; naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under control of the licensee. "Background radiation" does not include sources of radiation from radioactive materials regulated by the Agency.

15. "Becquerel" (Bq) means the SI unit of activity. One becquerel is equal to 1 disintegration or transformation per second (dps or tps).

16. "Bioassay" means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these regulations, "radiobioassay" is an equivalent term.

17. "Brachytherapy" means a method of radiation therapy in which sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, or interstitial application.

18. "Byproduct material" means:

    a. Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

    b. The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition;

    c. Any discrete source of radium-226 that is produced, extracted, or converted after extraction, for use for a commercial, medical, or research activity;

    d. Any material that has been made radioactive by use of a particle accelerator; and is produced, extracted, or converted after extraction, for use for a commercial, medical, or research activity; and

    e. Any discrete source of naturally occurring radioactive material, other than source material, that the Nuclear Regulatory Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and is extracted or converted after extraction for use in a commercial, medical, or research activity.

19. "Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from

inclusion within a calendar quarter. No licensee or registrant shall change the method observed by him of determining calendar quarters for purposes of these regulations except at the beginning of a year.

20. "Calibration" means the determination of (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (2) the strength of a source of radiation relative to a standard.

21. "CFR" means Code of Federal Regulations”

22. "Chelating agent" means amine polycarboxylic acids, hydroxycarboxylic acids, gluconic acid, and polycarboxylic acids.

23. "Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

24. "Committed dose equivalent" (HT,50) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. "Committed effective dose equivalent" ($H_{E,\ 50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \Sigma\ w_T H_{T,50}$).

25. “Consortium” means an association of medical use licensees and a PET radionuclide production facility in the same geographical area that jointly own or share in the operation and maintenance cost of the PET radionuclide production facility that produces PET radionuclides for use in producing radioactive drugs within the consortium for noncommercial distributions among its associated members for medical use. The PET radionuclide production facility within the consortium must be located at an educational institution or a Federal facility or a medical facility.

26. "Controlled area" means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee or registrant for any reason.

27. “Critical Group” means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

28. "Curie" means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7E+10 transformations per second (tps). Commonly used submultiples of the curie are the millicurie and the microcurie. One millicurie (mCi) = 0.001 curie = 3.7E+7 tps. One microcurie (μCi) = 0.000001 curie = 3.7E+4 tps (See 1.1.16 for SI equivalent becquerel).

29. "Decommission" means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits:

    a. Release of the property for unrestricted use and termination of the license; or

    b. Release of the property under restricted conditions and termination of the license.

30. "Deep dose equivalent" (H_d), which applies to external whole body exposure, means the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2).

31. "Depleted uranium" means the source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.

32. “Discrete source” means a radionuclide that has been processed so that its concentration within a material has been purposely increased for use for commercial, medical, or research activities.

33. “Distinguishable from background” means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurements technology, survey, and statistical techniques.

34. "Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent. For purposes of these regulations, "radiation dose" is an equivalent term.

35. "Dose equivalent (H_T)" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and the sievert (Sv).

36. "Dose limits" means the permissible upper bounds of radiation doses established in accordance with these regulations. For purposes of these regulations, "limits" is an equivalent term.

37. "Effective dose equivalent (H_E)" means the sum of the products of the dose equivalent to each organ or tissue (H_T) and the weighting factor (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma\, w_T H_T$).

38. "Embryo/fetus" means the developing human organism from conception until the time of birth.

39. "Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to sources of

radiation. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

40. "Explosive material" means any chemical compound, mixture, or device which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

41. "Exposure" means being exposed to ionizing radiation or to radioactive material.

42. "Exposure" means the quotient of dQ by dm where "dQ" is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass "dm" are completely stopped in air. The SI unit of exposure is the coulomb per kilogram (C/kg). The special unit of exposure is the roentgen (R) (See 1.1.15 for SI equivalent coulomb per kilogram).[2]

43. "Exposure rate" means the exposure per unit of time, such as roentgen per minute and milliroentgen per hour.

44. "External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

45. "Extremity" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

46. "Former U.S. Atomic Energy Commission (AEC) or U.S. Nuclear Regulatory Commission (NRC) licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where AEC or NRC licenses have been terminated.

47. "Generally applicable environmental radiation standards" means standards issued by the U.S. Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

48. "Gray" (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

49. "Hazardous waste" means those wastes designated as hazardous by the U.S. Environmental Protection Agency regulations in 40 CFR Part 261.

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[2] "When not underlined as above or indicated as 'exposure' (x), the term 'exposure' has a more general meaning in these regulations."

50. "Healing arts" means the professional disciplines authorized by the laws of this state to use sources of radiation in the diagnosis or treatment of human or animal diseases.

51. "High radiation area" means 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 0.1 rem (1 millisievert) in 1 hour at 30 centimeters from any source of radiation or 30 centimeters from any surface that the radiation penetrates.

52. "Human use" means the internal or external administration of radiation or radioactive material to human beings.

53. "Individual" means any human being.

54. "Individual monitoring" means the assessment of:

    a. Dose equivalent: (a) by the use of individual monitoring devices, or (b) by the use of survey data; or

    b. Committed effective dose equivalent: (a) by bioassay, or (b) by determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours. (See the definition of DAC-hours in Subchapter 4).

55. "Individual monitoring devices" (individual monitoring equipment) means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescence dosimeters (TLDs), optically stimulated luminescence dosimeters (OSLs), pocket ionization chambers, and personal ("lapel") air sampling devices

56. "Inspection" means an official examination or observation including, but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements, and conditions of the Agency.

57. "Interlock" means a device arranged or connected such that the occurrence of an event or condition is required before a second event or condition can occur or continue to occur.

58. "Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body

59. "Lens dose equivalent" (LDE) applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

60. "License" means a license issued by the Agency in accordance with the regulations adopted by the Agency.

61. "Licensed material" means radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Agency.

62. "Licensee" means any person who is licensed by the Agency in accordance with these regulations and the Act.

63. "Licensing State" means any State with regulations equivalent to the Suggested State Regulations for Control of Radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the Conference of Radiation Control Program Directors, Inc.

64. "Limits" See "Dose limits".

65. "Lost or missing source of radiation" means a source of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system.

66. "Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material, or exceeding 4 times Type B quantities as sealed sources, but does not include nuclear medicine programs, universities, industrial radiographers, or small industrial programs. Type A and B quantities are defined in 1.13.2 of these regulations.

67. "Member of the public" means any individual except when that individual is receiving an occupational dose.

68. "Minor" means an individual less than 18 years of age.

69. "Monitoring" means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these regulations, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

70. "NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material.

71. “Nationally tracked source” means a sealed source containing a quantity equal to or greater than Category 1 or Category 2 levels of any radioactive material listed in Appendix G to Subchapter 4 of these regulations. In this context a sealed source is defined as radioactive material that is sealed in a capsule or closely bonded, in a solid form and which is not exempt from regulatory control. It does not mean material encapsulated solely for disposal, or nuclear material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet. Category 1 nationally tracked sources are those containing radioactive material at a quantity equal to or

greater than the Category 1 threshold. Category 2 nationally tracked sources are those containing radioactive material at a quantity equal to or greater than the Category 2 threshold but less than the Category 1 threshold.

72. "Natural radioactivity" means radioactivity of naturally occurring nuclides.

73. "Nuclear Regulatory Commission" (NRC) means the U.S. Nuclear Regulatory Commission or its duly authorized representatives.

74. "Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee, registrant, or other person. Occupational dose does not include doses from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with 1.7.33 of these regulations, from voluntary participation in medical research programs, or as a member of the public.

75. "Package" means the packaging together with its radioactive contents as presented for transport.

76. "Particle accelerator" See "Accelerator".

77. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the NRC and federal government agencies licensed or exempted by the NRC.

78. "Personnel monitoring equipment" See "Individual monitoring devices".

79. "Pharmacist" means an individual licensed by this State to compound and dispense drugs, prescriptions, and poisons.

80. "Physician" means an individual licensed by this State to dispense drugs in the practice of medicine.

81. "Principal activities" means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

82. "Public dose" means the dose received by a member of the public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of the licensee or registrant. Public dose does not include occupational dose or doses received from background radiation,

from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with 1.7.33 of these regulations, or from voluntary participation in medical research programs.

83. "Pyrophoric liquid" means any liquid that ignites spontaneously in dry or moist air at or below 130 ºF (54.4 ºC). A pyrophoric solid is any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

84. "Qualified expert" means an individual having the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs, for example, individuals certified in the appropriate field by the American Board of Radiology or the American Board of Health Physics, or those having equivalent qualifications. With reference to the calibration of radiation therapy equipment, an individual having, in addition to the above qualifications, training and experience in the clinical applications of radiation physics to radiation therapy, for example, individuals certified in Therapeutic Radiological Physics or X-Ray and Radium Physics by the American Board of Radiology, or those having equivalent qualifications.

85. "Quality factor" (Q) means the modifying factor, listed in Tables I and II of 1.1.15, that is used to derive dose equivalent from absorbed dose.

86. "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joule per kilogram (0.01 gray).

87. "Radiation" means gamma rays and x-rays, alpha and beta particles, high speed electrons, neutrons, high speed protons and other atomic particles and electromagnetic radiation consisting of associated and interacting electric and magnetic waves and ultrasonic waves.

88. "Radiation area" means any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 millisievert) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

89. "Radiation dose" See "Dose".

90. "Radiation machine" means any device capable of producing radiation except, those devices with radioactive material as the only source of radiation.

91. "Radiation safety officer" means an individual who has the knowledge to apply appropriate radiation protection regulations and has the responsibility for the overall radiation safety program at the facility.

92. "Radioactive material" means any solid, liquid, or gas which emits radiation spontaneously.

93. "Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.

94. "Radiobioassay" See "Bioassay".

95. "Registrant" means any person who is registered with the Agency and is legally obligated to register with the Agency pursuant to these regulations and the Act.

96. "Registration" means registration with the Agency in accordance with the regulations adopted by the Agency.

97. "Regulations of the U.S. Department of Transportation" means the regulations in 49 CFR Parts 100-189.

98. “Residual radioactivity” means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee(s control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of Subchapter 4 of these regulations.

99. "Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 sievert).

100. "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. Research and development does not include the internal or external administration of radiation or radioactive material to human beings.

101. "Restricted area" means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

102. "Roentgen" means the special unit of exposure. One roentgen (R) equals 2.58E-4 coulomb per kilogram of air (see "Exposure" and 1.1.15).

103. "Sealed source" means any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

104. "Shallow dose equivalent" (H_s), which applies to the external exposure of the skin of the whole body or the skin of an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2).

105. "SI" means the abbreviation for the International System of Units

106. "Sievert" (Sv) means the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 sievert = 100 rems).

107. "Site area emergency" means events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by offsite response organizations to protect persons offsite.

108. "Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

109. "Source material" means:

a. Uranium or thorium, or any combination thereof, in any physical or chemical form; or

b. Ores that contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium or any combination of uranium and thorium. Source material does not include special nuclear material.

110. "Source material milling" means any activity that results in the production of byproduct material as defined by definition (2) of byproduct material.

111. "Source of radiation" means any radioactive material or any device or equipment emitting, or capable of producing, radiation.

112. "Special form radioactive material" means radioactive material that satisfies the following conditions:

a. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

b. The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

c. It satisfies the test requirements specified by the U.S. Nuclear Regulatory Commission. A special form encapsulation designed in accordance with the U.S. Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used.

A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998, may continue to be used. A special form encapsulation either designed or constructed after April 1, 1998, must meet requirements of this definition applicable at the time of its design or construction.

113. "Special nuclear material" means:

a. Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the U.S. Nuclear Regulatory Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or

b. Any material artificially enriched by any of the foregoing but does not include source material.

114. "Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235; uranium-233 in quantities not exceeding 200 grams; plutonium in quantities not exceeding 200 grams; or any combination of them in accordance with the following formula: For each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all of the kinds of special nuclear material in combination shall not exceed 1. For example, the following quantities in combination would not exceed the limitation and are within the formula:

$$\frac{175(\text{grams contained U - 235})}{350} + \frac{50(\text{grams U - 233})}{200} + \frac{50(\text{grams Pu})}{200} = 1$$

115. "Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examinations, and measurements of levels of radiation or concentrations of radioactive material present.

116. "Test" means the process of verifying compliance with an applicable regulation.

117. "These regulations" mean all sections of the Mississippi State Board of Health Regulations for Control of Radiation, Subpart 78 -Radiation.

118. "Total effective dose equivalent" (TEDE) means the sum of the effective dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

119. "Total organ dose equivalent" (TODE) means the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in 1.4.47(1)(f) of these regulations.

120. "U.S. Department of Energy" means the Department of Energy established by Public Law 95-91, August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the Department exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104(b), (c) and (d) of the Energy Reorganization Act of 1974 (Public Law 93-438, October 11, 1974, 88 Stat. 1233 at 1237, 42 U.S.C. 5814, effective January 19, 1975) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Public Law 95-91, August 4, 1977, 91 Stat. 565 at 577-578, 42 U.S.C. 7151, effective October 1, 1977).

121. "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

122. "Unrestricted area" means any area access to which is neither limited nor controlled by the licensee or registrant for purposes of protection of individuals from exposure to radiation and radioactive material, and any area used for residential quarters. For purposes of these regulations, "uncontrolled area" is an equivalent term.

123. "Very high radiation area" means 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 500 rads (5 grays) in 1 hour at 1 meter from a source of radiation or from any surface that the radiation penetrates.[3]

124. "Waste" means those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in paragraphs (2), (3), (4) and (5) of the definition of byproduct material set forth in this section.

125. "Waste handling licensees" mean persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste.

126. "Week" means 7 consecutive days starting on Sunday.

[3] "Very high radiation area" means 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 500 rads (5 grays) in 1 hour at 1 meter from a source of radiation or from any surface that the radiation penetrates.

127. "Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow, or legs above the knee.

128. "Worker" means an individual engaged in work under a license or registration issued by the Agency and controlled by a licensee or registrant, but does not include the licensee or registrant.

129. "Working level" (WL) means any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of 1.3E+5 MeV of potential alpha particle energy. The short-lived radon daughters are -- for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212.

130. "Working level month" (WLM) means an exposure to 1 working level for 170 hours (2,000 working hours per year divided by 12 months per year is approximately equal to 170 hours per month).

131. "Year" means the period of time beginning in January used to determine compliance with the provisions of these regulations. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.3 **Exemptions**.

1. The Agency may, upon application or upon its own initiative, grant such exemptions or exceptions from the requirements of these regulations as it determines are authorized by law and will not result in undue hazard to public health and safety or property.

2. U.S. Department of Energy Contractors and U.S. Nuclear Regulatory Commission Contractors. Any U.S. Department of Energy contractor or subcontractor and any U.S. Nuclear Regulatory Commission contractor or subcontractor of the following categories operating within this State is exempt from these regulations to the extent that such contractor or subcontractor under his contract receives, possesses, uses, transfers, or acquires sources of radiation:

   a. prime contractors performing work for the U.S. Department of Energy at U.S. Government-owned or -controlled sites, including the transportation of sources of radiation to or from such sites and the performance of contract services during temporary interruptions of such transportation;

   b. prime contractors of the U.S. Department of Energy performing research in, or development, manufacture, storage, testing, or transportation of, atomic weapons or components thereof;

c. prime contractors of the U.S. Department of Energy using or operating nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel; and

d. any other prime contractor or subcontractor of the U.S. Department of Energy or of the U.S. Nuclear Regulatory Commission when the State and the U.S. Nuclear Regulatory Commission jointly determine:

i. that the exemption of the prime contractor or subcontractor is authorized by law; and

ii. that, under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.4 **Records**. Each licensee and registrant shall maintain records showing the receipt, transfer, and disposal of all sources of radiation. Additional record requirements are specified elsewhere in these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.5 **Inspections**.

1. Each licensee and registrant shall afford the Agency at all reasonable times opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored.

2. Each licensee and registrant shall make available to the Agency for inspection, upon reasonable notice, records maintained pursuant to these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.6 **Tests**. Each licensee and registrant shall perform upon instructions from the Agency, or shall permit the Agency to perform, such reasonable tests as the Agency deems appropriate or necessary including, but not limited to, tests of:

1. sources of radiation;

2. facilities wherein sources of radiation are used or stored;

3. radiation detection and monitoring instruments; and

4. other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.7 **Reports**. Notwithstanding any other requirements for notification:

1. **Immediate Report**. Each licensee shall notify the Agency as soon as possible but not later than 4 hours after the discovery of an event that prevents immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed regulatory limits or releases of licensed material that could exceed regulatory limits (events may include fires, explosions, toxic gas releases, etc.).

2. **Twenty-Four Hour Report**. Each licensee shall notify the Agency within 24 hours after the discovery of any of the following events involving licensed material:

   a. An unplanned contamination event that:

      i. requires access to the contaminated area, by workers or the public, to be restricted for more than 24 hours by imposing additional radiological controls or by prohibiting entry into the area;

      ii. involves a quantity of material greater than five times the lowest annual limit on intake specified in Appendix B of Subchapter 4 of these regulations for the material; and

      iii. has access to the area restricted for a reason other than to allow isotopes with a half-life of less than 24 hours to decay prior to decontamination.

   b. An event that requires unplanned medical treatment at a medical facility of an individual with spreadable radioactive contamination on the individual's clothing or body.

   c. An unplanned fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material when:

      i. the quantity of material involved is greater than five times the lowest annual limit on intake specified in Appendix B of Subchapter 4 of these regulations for the material; and

      ii. the damage affects the integrity of the licensed material or its container.

3. **Twenty-Four Hour Report**. Each licensee or registrant shall notify the Agency within 24 hours after the discovery of an event in which equipment is disabled or fails to function as designed when:

   a. The equipment is required by regulation or license condition to prevent releases exceeding regulatory limits, to prevent exposures to radiation and

radioactive materials exceeding regulatory limits, or to mitigate the consequences of an accident;

b. The equipment is required to be available and operable when it is disabled or fails to function; and

c. No redundant equipment is available and operable to perform the required safety function.

4. **Preparation and Submission of Reports**. Reports made by licensees or registrants in response to the requirements of this section must be made as follows:

a. Licensees or registrants shall make reports required by 1.1.7(1), (2), and (3) by telephone to the Agency. To the extent that the information is available at the time of notification, the information provided in these reports must include:

i. the caller's name and call back telephone number;

ii. a description of the event, including the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;

iii. the exact location of the event;

iv. the date and time of the event;

v. the isotopes, quantities, and chemical and physical form of the licensed material involved; and

vi. any personnel radiation exposure data available.

b. **Written report**. Each licensee or registrant who makes a report required by 1.1.7(1), (2), or (3) shall submit a written follow-up report within 30 days of the initial report. Written reports prepared pursuant to other regulations may be submitted to fulfill this requirement if the reports contain all of the necessary information and the appropriate distribution is made. The reports must include the following:

i. a description of the event, including the probable cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;

ii. the exact location of the event;

iii. the isotopes, quantities and chemical and physical form of the licensed material involved;

iv. date and time of the event;

v. corrective actions taken or planned and the results of any evaluations or assessments; and

vi. the extent of exposure of individuals to radiation or to radioactive materials without identification of individuals by name.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.8 **Additional Requirements**. The Agency may, by rule, regulation, or order, impose upon any licensee or registrant such requirements in addition to those established in these regulations as it deems appropriate or necessary to minimize danger to public health and safety or property.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.9 **Enforcement Requirements Violations**. An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or any regulation or order issued thereunder. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a misdemeanor and, upon conviction, may be punished by fine or imprisonment or both, as provided by Section 45-14-37 of the Act.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.10 **Enforcement Requirements Impounding**. Sources of radiation shall be subject to impounding pursuant to Section 45-14-23 of the Act.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.11 **Enforcement Requirements Prohibited Uses**.

1. A hand-held fluoroscopic screen shall not be used with x-ray equipment unless it has been listed in the Registry of Sealed Sources and Devices maintained by the Agency or accepted for certification by the U.S. Food and Drug Administration, Center for Devices and Radiological Health.

2. A shoe-fitting fluoroscopic device shall not be used.

3. Sources of radiation shall not be used to expose any individual solely for training or demonstration purposes.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.12 **Deliberate Misconduct**.

1. Any licensee, certificate holder, quality assurance program approval holder, or registrant; applicant for a license, certificate, quality assurance program approval,

or registration; employee of a licensee, certificate holder, quality assurance program approval holder, registrant or applicant; or any contractor (including a supplier or consultant), subcontractor, employee of a contractor or subcontractor of any licensee, certificate holder, quality assurance program approval holder, or registrant or applicant, who knowingly provides to any licensee, certificate holder, quality assurance program approval holder, registrant, applicant, contractor, or subcontractor, any components, equipment, materials, or other goods or services that relate to a licensee's, certificate holder's, quality assurance program approval holder's, registrant's or applicant's activities in these regulations, may not:

a. Engage in deliberate misconduct that causes or would have caused, if not detected, a licensee, certificate holder, quality assurance program approval holder, registrant, or applicant to be in violation of any rule, regulation, or order; or any term, condition, or limitation of any license, certificate, approval or registration issued by the Agency; or

b. Deliberately submit to the Agency, a licensee, certificate holder, quality assurance program approval holder, registrant, an applicant, or a licensee's, certificate holder's, quality assurance program approval holder's registrant's or applicant's, contractor or subcontractor, information that the person submitting the information knows to be incomplete or inaccurate in some respect material to the Agency.

2. A person who violates 1.1.12(1)(a) or (1)(b) of this section may be subject to enforcement action in accordance with the procedures in 1.1.17 and Chapter 45-14-37 of the Act.

3. For the purposes of 1.1.12(1)(a) of this section, deliberate misconduct by a person means an intentional act or omission that the person knows:

a. Would cause a licensee, certificate holder, quality assurance program approval holder, registrant or applicant to be in violation of any rule, regulation, or order; or any term, condition, or limitation, of any license or registration issued by the Agency; or

b. Constitutes a violation of a requirement, procedure, instruction, contract, purchase order, or policy of a licensee, certificate holder, quality assurance program approval holder, registrant, applicant, contractor, or subcontractor.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.13 **Interpretations**. Except as specifically authorized by the Agency in writing, no interpretation of these regulations by an officer or employee of the Agency other than a written interpretation by the legal counsel will be recognized to be binding upon the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.14 **Communications**. All communications and reports concerning these regulations, and applications filed thereunder, should be addressed to the Division of Radiological Health at its office located at 3150 Lawson Street, P.O. Box 1700, Jackson, Mississippi, 39215-1700.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.15 **Units of Exposure and Dose**.

1. As used in these regulations, the unit of Exposure is the coulomb per kilogram (C/kg) of air. One roentgen is equal to 2.58E-4 coulomb per kilogram of air.

2. As used in these regulations, the units of dose are:

   a. Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

   b. Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joule per kilogram (0.01 gray).

   c. Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 sievert).

   d. Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 sievert = 100 rems).

3. As used in these regulations, the quality factors for converting absorbed dose to dose equivalent are shown in Table I.

TABLE I

QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

TYPE OF RADIATION	Quality Factor (Q)	Absorbed Dose Equal to a Unit Dose Equivalent[a]
X, gamma, or beta radiation and high-speed electrons	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1

High-energy protons	10	0.1

[a]Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

4 If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rem per hour or sievert per hour, as provided in 1.1.15(3), 1 rem (0.01 sievert) of neutron radiation of unknown energies may, for purposes of these regulations, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee or registrant may use the fluence rate per unit dose equivalent or the appropriate Q value from Table II to convert a measured tissue dose in rad or gray to dose equivalent in rem or sievert.

TABLE II

MEAN QUALITY FACT0RS, Q, AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

	Neutron Energy (MeV)	Quality Factor[a] (Q)	Fluence per Unit Dose Equivalent[b] (neutrons cm^{-2} Sv^{-1})	Fluence per Unit Dose Equivalent[b] (neutrons cm^{-2} rem^{-1})
(thermal)	2.5E-8	2	980E+6	980E+8
	1E-7	2	980E+6	980E+8
	1E-6	2	810E+6	810E+8
	1E-5	2	810E+6	810E+8
	1E-4	2	840E+6	840E+8
	1E-3	2	980E+6	980E+8
	1E-2	2.5	1010E+6	1010E+8
	1E-1	7.5	170E+6	170E+8
	5E-1	11	39E+6	39E+8
	1	11	27E+6	27E+8
	2.5	9	29E+6	29E+8
	5	8	23E+6	23E+8
	7	7	24E+6	24E+8
	10	6.5	24E+6	24E+8
	14	7.5	17E+6	17E+8
	20	8	16E+6	16E+8
	40	7	14E+6	14E+8
	60	5.5	16E+6	16E+8
	1E+2	4	20E+6	20E+8
	2E+2	3.5	19E+6	19E+8

3E+2	3.5	16E+6	16E+8
4E+2	3.5	14E+6	14E+8

[a]Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-centimeter diameter cylinder tissue-equivalent phantom.

[b]Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.16 **Units of Activity**. For purposes of these regulations, activity is expressed in the special unit of curie (Ci), or in the SI unit of becquerel (Bq) or their multiples, or disintegrations or transformations per unit of time.

1. One becquerel (Bq) = 1 disintegration or transformation per second (dps or tps).

2. One curie (Ci) = 3.7E+10 disintegrations or transformations per second (dps or tps) = 3.7E+10 becquerel (Bq) = 2.22E+12 disintegrations or transformations per minute (dpm or tpm).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.17 **Hearings and Judicial Review**. In any proceedings under these regulations for granting, denying, suspending, revoking, or amending any license or registration, or for determining compliance with rules and regulations of the Agency, the Agency shall afford an opportunity for a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such a hearing. Any order or decision of the Agency regarding the granting, denying, suspending, revoking or amending any license or registration as provided by these regulations, shall be subject to review by writ of certiorari to the Circuit Court of Hinds County, Mississippi, at the instance of any party in interest. The filing of the appeal shall, in all cases, be with a bond, with security for all costs, as approved by the judge or clerk of the court, and shall operate as a stay of any such order or decision until the court directs otherwise. The court may review all the facts and, in disposing of the issue before it, may modify, affirm or reverse the order or decision of the Agency in whole or in part.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.1.18 **Fees:** The Agency is authorized to charge and collect fees in accordance with the categories established in Section 45-14-31 (Schedule of Fees) of the Mississippi Code of 1972, Annotated. For all categories not listed in the above, the Board of Health is authorized in accordance with Section 41-3-15 of the Mississippi Code of 1972, Annotated to charge and collect reasonable fees for radioactive material licenses, general licenses, x-ray registrations, x-ray services, reciprocity licenses

and registrations, accelerators, neutron generators, nuclear reactors, and naturally occurring radioactive materials (NORM). The fees shall not exceed the estimated cost to the Agency for performing licensing, registration, inspection, and other regulatory duties.

1. Scope and Purpose

   a. It is the purpose of these regulations to establish a fee for funding the monitoring, investigation, and other activities required to be conducted for the maintenance of a safe and healthful environment by the Mississippi State Department of Health in accordance with the Mississippi Radiation Protection Law of 1976 (Act). Fees are required for all licenses, registrations, and variances authorized by the Act.

2. Application Fees

   a. Each applicant or amendment thereto for which a fee is prescribed shall be accompanied by a remittance in the full amount of the fee. No application or amendment thereto shall be accepted or processed prior to payment of the full amount specified. No license, registration, or variance shall be issued, unless otherwise authorized by the administrative authority, until such check or draft has been accepted by the bank or drawee and the department's account has been credited with the amount of the fee in full.

   b. Payment of the prescribed annual fee does not automatically renew the license or registration, or approval for which the fee is paid. License renewal applications must be filed in accordance with Rule 1.2.6 and/or Rule 1.3.17.

3. Annual Fees

   a. All activities for which an annual fee is provided shall be subject to the payment of such fee by the due date indicated on the invoice upon written application to, and approval of, the administrative authority, may be paid in installments over a period not to exceed six months, according to a payment schedule established by the administrative authority.

4. Reciprocal Agreements—Licenses and Registrants

   a. Persons operating within Mississippi under the provision of Rule 1.2.10 and/or Rule 1.3.26 shall submit to the Mississippi State Department of Health Division of Radiological Health the annual fee of the applicable category before the first entry into the state. The fee will allow reciprocal recognition of the license or registration for one year from the date of receipt.

5. Determination of Fee

a. The fee for each applicable category is listed in Appendix A.

b. In the case of licenses that authorize more than one activity, the total fee will be for the activity assigned the higher fee.

c. Licenses that are amended and that result in a change in the Appendix A category to a more costly license shall be assessed the entire fee for that type of license effective with the amendment.

d. Electronic products that are in storage are subject to the same initial application fee and annual fee unless the X-ray unit is rendered permanently incapable of producing radiation and this fact is documented in writing to the Mississippi State Department of Health Division of Radiological Health.

e. Electronic products that are no longer possessed by the registrant (e.g., sold, donated, or transferred) shall not be subject to the annual fee, provided written documentation is received by the invoice due date, which includes the name address, and telephone number to whom possession was transferred.

6. Methods of Payment

a. All payments made by check, draft, or money order shall be payable to the Mississippi State Department of Health, and mailed to the Department at the address provided on the invoice.

b. Cash is not an acceptable form of payment.

7. Late Payment Fee

a. Payments not received within 90 days of the due date will be charged a late payment fee. Any late payment fee shall be calculated from the due date indicated on the invoice.

b. Payments not received by the department after 90 days from the due date will be assessed a 5 percent late fee on the original assessed fee as invoiced on the second billing.

c. Payments not received by the department after 180 days from the due date will be assessed an additional 5 percent late fee on the original assessed fee as invoiced on the third and final billing.

8. Failure to Pay

a. Failure to pay the prescribed application fee or annual fee as provided herein, within 180 days after the due date, will constitute a violation of these regulations and shall subject the person to applicable enforcement

action under the Act including, but not limited to, revocation or suspension of the applicable license, registration, or variance.

9. Effective Date

a. The schedule of fees prescribed herein shall be effective on August 15, 2016.

10. Multiple Locations

a. Those persons possessing licenses or registrations that name multiple locations where sources of radiation are stored, used, or otherwise possessed, shall be subject to an additional fee of 10 percent of the annual fee for each such location within the state of Mississippi, not to exceed an amount equal to the annual fee.

SOURCE: Miss. Code Ann. §45-14-31

Appendix A **Schedule of Fees**

License Category 1	**Application/Annual Fee**
Industrial Radiography	$3,500
Broad Scope Medical	$3,500
Nuclear Pharmacy	$3,500
NORM Decontamination	$3,500
General License Distribution	$3,500
Broad Scope Industrial	$3,500
Waste Compaction/transfer	$3,500
Waste Repackaging	$3,500
License Category 2	
Broad Scope Educational	$1,800
Environmental Tracer Studies	$1,800
Research & Development	$1,800
Educational Research & Development	$1,800
Medical Therapeutic	$1,800
Teletherapy	$1,800
Gamma-Knife/Stereotactic Radio Surgery	$1,800
Waste Receipt/Transfer	$1,800
Specific License Fees	
Civil Defense	$575

Other Specific	$690
Well logging	$2,875
Radioactive markers/collars	$400
Irradiator (self-shielded)	$1,035
Irradiator (Panoramic pool or source exposed)	$5,750
Fixed In-Plant Gauges	$1,100
Pipe wall thickness Gauges	$1,100
Portable densitometer gauge	$1,100
Portable Industrial Gauge (Troxler)	$690
Gauge Services (Repair, Installation, Removal, etc.)	$1,100
Medical Nuclear Medicine (Diagnostic only)	$1,265
Medical Eye Applicator/Bone Mineral Analyzer	$575
Medical Mobile Nuclear Services	$2,300
Medical Satellite Facility	$690
Gas Chromatograph	$350
NORM Removal (Pipe cleaning)	$1,150
Waste Disposal	$400,000

Specific License Fees (continued)

Waste Incineration	$6,900
Nuclear Laundry	$4,600
Licenses that authorize the possession, use and/or processing of source material for extraction of metals other than uranium or thorium. (greater than or equal to 150 kilograms)	$11,000.00
Licenses that authorize the possession, use and/or processing of source material for extraction of metals other than uranium or thorium. (less than 150 kilograms)	$5,000.00
Reciprocal License Fee	Same as Fees Above
Each Additional Storage and/or Use Area	10% of Licensing Fee

General Licenses

Gauges/certain measuring	$170.00
Gas Chromatographs	$115.00
Static Eliminators/ion generating	$115.00
Source material/Depleted Uranium	$115.00
In Vitro/clinical	$115.00
All other General Licenses	$115.00

Registrations	REGISTRATION FEE
X-Ray Fees	
Industrial/non-healing arts	$100/tube
Educational	$85/tube
Healing Arts/Veterinary	$100/tube
X-Ray Industrial Radiography	$690.00
X-Ray Services	$345.00
Accelerators	$860.00
Therapeutic X-Ray	$500.00
Neutron Generators	$600.00
Nuclear Reactor	
Possessing a Nuclear Regulatory Commission license or permit authorizing a nuclear reactor the State of Mississippi for commercial production of electrical energy utilizing special nuclear material sufficient to form a critical mass, shall pay an annual fee of **$126730.00** for each such reactor so licensed or permitted.	$126,730.00

SOURCE: Miss. Code Ann. §45-14-31

Subchapter 2 Registration of Radiation Machines Facilities And Services

Rule 1.2.1 **Purpose and Scope**.

1. This section provides for the registration of radiation machines and facilities and for the registration of persons providing radiation machine installation, servicing, and/or services.
2. In addition to the requirements of this section, all registrants are subject to the applicable provisions of other sections of these regulations.

Source: MS Code Ann. §45-14-3

Rule 1.2.2 **Definitions**.

1. "Facility" means the location at which one or more devices or sources are installed and are under the same administrative control.
2. "Storage" means a condition in which a device or source is not being used for an extended period of time, and has been made inoperable.

Source: MS Code Ann. §45-14-3

Rule 1.2.3 **Exemptions**.

1. Electronic equipment that produces radiation incidental to its operation for other purposes is exempt from the registration and notification requirements of this

section, providing dose equivalent rate averaged over an area of 10 square centimeters does not exceed 0.5 millirem (5 μ Sv) per hour at 5 centimeters from any accessible surface of such equipment. The production, testing, or factory servicing of such equipment shall be exempt.

2. Radiation machines while in transit or storage incident thereto are exempt from the requirements of this section.

3. Domestic television receivers are exempt from the requirements of this section.

Source: MS Code Ann. §45-14-3

Rule 1.2.4 **Shielding Plan Review**.

1. Prior to construction, the floor plans, shielding specifications and equipment arrangement of all new installations, or modifications of existing installations, utilizing ionizing radiation for diagnostic or therapeutic purposes shall be submitted to the Agency for review and approval. The required information is denoted in Appendices A and B of this Subchapter.

2. The Agency may require the applicant to uti1ize the services of a qualified expert to determine the shielding requirements prior to the plan review and approval.

3. The approval of such plans shall not preclude the requirement of additional modifications should a subsequent analysis of operating conditions indicate the possibility of an individual receiving a dose in excess of the limits prescribed in 1.4.1, of these regulations.

4. After installation of a radiation machine, the registrant shall maintain for inspection by the Agency:

   a. the maximum rated technique factors of each x-ray system control panel;

   b. scale drawing of the room in which a stationary radiation machine system is located with such drawing indicating the use of areas adjacent to the room and an estimation of the extent of occupancy by an individual in such areas. In addition, the drawing shall include:

      i. the results of a survey for radiation levels present at the operator's position and at pertinent points outside the room at specified test conditions, or

      ii. the type and thickness of materials, or lead equivalency, of each protective barrier.

Source: MS Code Ann. §45-14-3

Rule 1.2.2 **Registration of Radiation Machines and Facilities.** Each person having a radiation machine facility shall:

1. Apply for registration of such facility with the Agency prior to the operation of a radiation machine facility. Application for registration shall be completed on forms furnished by the Agency and shall contain all the information required by the form and accompanying instructions.

2. Designate on the application form an individual to be responsible for radiation protection.

3. Each registrant shall prohibit any person from furnishing radiation machine servicing or services as described in 1.2.6(4) to his radiation machine facility until such person provides evidence that he has been registered with the Agency as a provider of services in accordance with 1.2.6.

Source: MS Code Ann. §45-14-3

Rule 1.2.3 **Application for Registration of Servicing and Services**.

1. Each person who is engaged in the business of installing or offering to install radiation machines or is engaged in the business of furnishing or offering to furnish radiation machine servicing or services in this State shall apply for registration of such services with the Agency prior to furnishing or offering to furnish any such services.

2. Application for registration shall be completed on forms furnished by the Agency and shall contain all information required by the Agency as indicated on the forms and accompanying instructions.

3. Each person applying for registration under this section shall specify:

   a. that he has read and understands the requirements of these regulations;

   b. the services for which he is applying for registration;

   c. the training and experience that qualify him to discharge the services for which he is applying for registration;

   d. the type of measurement instruments to be used, frequency of calibration, and source of calibration; and

   e. the type of personnel dosimeters supplied, frequency of reading, and replacement or exchange schedule.

4. For the purpose of 1.2.6, services may include but shall not be limited to:

a. installation and/or servicing of radiation machines and associated radiation machine components,

b. calibration of radiation machines or radiation measurement instruments or devices,

c. radiation protection or health physics consultations or surveys, and

d. personnel dosimetry services.

5. No individual shall perform services which are not specifically stated for that individual on the notice of registration issued by the Agency.

Source: MS Code Ann. §45-14-3

Rule 1.2.4 **Issuance of Notice of Registration**.

1. Upon a determination that an applicant meets the requirements of the regulations, the Agency shall issue a notice of registration.

2. The Agency may incorporate in the notice of registration at the time of issuance or thereafter by appropriate rule, regulation, or order, such additional requirements and conditions with respect to the registrant's receipt, possession, use, and transfer of radiation machines as it deems appropriate or necessary.

Source: MS Code Ann. §45-14-3

Rule 1.2.5 **Expiration of Notice of Registration.** Except as provided by 1.2.9(2), each notice of registration shall expire at the end of the specified day in the month and year stated therein.

Source: MS Code Ann. §45-14-3

Rule 1.2.6 **Renewal of Notice of Registration**.

1. Application for renewal of registration shall be filed in accordance with 1.2.5 or 1.2.6.

2. In any case in which a registrant not less than 30 days prior to the expiration of his existing notice of registration has filed an application in proper form for renewal, such existing notice of registration shall not expire until the application status has been finally determined by the Agency.

Source: MS Code Ann. §45-14-3

Rule 1.2.7 **Report of Changes.** The registrant shall notify the Agency in writing before making any change which would render the information contained in the application for registration and/or the notice of registration no longer accurate.

Source: MS Code Ann. §45-14-3

Rule 1.2.8 **Approval Not Implied.** No person, in any advertisement, shall refer to the fact that he or his facility is registered with the Agency pursuant to the provisions of 1.2.5 or 1.2.6. and no person shall state or imply that any activity under such registration has been approved by the Agency.

Source: MS Code Ann. §45-14-3

Rule 1.2.9 **Assembler and/or Transfer Obligation**.

1. Any person who sells, leases, transfers, lends, disposes, assembles, or installs radiation machines in this State shall notify the Agency within 15 days of:[4]

   a. the name and address of persons who have received these machines;

   b. the manufacturer, model, and serial number of each radiation machine transferred; and

   c. the date of transfer of each radiation machine.

2. No person shall make, sell, lease, transfer, lend, assemble, or install radiation machines or the supplies used in connection with such machines unless such supplies and equipment when properly placed in operation and used shall meet the requirements of these regulations.

Source: MS Code Ann. §45-14-3

Rule 1.2.10 **Out-Of-State Radiation Machines**.

1. Whenever any radiation machine is to be brought into the State, for any temporary use, the person proposing to bring such machine into the State shall give written notice to the Agency at least 3 days before such machine is to be used in the State. The notice shall include:

   a. the type of radiation machine;

   b. the nature, duration, and scope of use;

   c. the exact location(s) where the radiation machine is to be used; and

   d. states in which this machine is registered.

[4] In the case of diagnostic x-ray systems which contain certified components, a copy of the assembler's report prepared in compliance with requirements of the Federal diagnostic x-ray standard (21 CFR 1020.30(d)) shall be submitted to the Agency within 15 days following completion of the assembly. Such report shall suffice in lieu of any other report by the assembler.

2. If, for a specific case, the 3 day period would impose an undue hardship on the person, upon application to the Agency, permission to proceed sooner may be granted.

3. The person referred to in 1.2.13(1) shall:

   a. comply with all applicable regulations of the Agency;

   b. supply the Agency with such other information as the Agency may reasonably request; and

   c. not operate within the State on a temporary basis in excess of 180 calendar days per year.

Source: MS Code Ann. §45-14-3

APPENDIX A

Information On Radiation Shielding Required For Plan Reviews

In order for the Agency to provide an evaluation, technical advice, and official approval on shielding requirements for a radiation installation, the following information must be submitted.

I. The plans should show, as a minimum, the following:

a. The normal location of the x-ray system's radiation port; the port's travel and traverse limits; general direction(s) of the useful beam; locations of any windows and doors; the location of the operator's booth; and the location of the x-ray control panel.

b. The structural composition and thickness or lead equivalent of all walls, doors, partitions, floor, and ceiling of the room(s) concerned.

c. The dimensions of the room(s) concerned.

d. The type of occupancy of all adjacent areas inclusive of space above and below the room(s) concerned. If there is an exterior wall, show distance to the closest area(s) where it is likely that individuals may be present.

e. The make and model of the x-ray equipment and the maximum technique factors, and the energy waveform (single phase, three phase, etc.).

f. The type of examination(s) or treatment(s) which will be performed with the equipment.

II. Information on the anticipated workload of the x-ray system(s) in mA-minutes per week.

III. A report showing all basic assumptions used in the development of the shielding specifications.

APPENDIX B

Design Requirements For An Operator's Booth

I. **Space Requirements**:

a. The operator shall be allotted not less than 7.5 square feet (0.70m²) of unobstructed floor space in the booth.

b. The operator's booth may be any geometric configuration with no dimension of less than 2 feet (0.61 m).

c. The space shall be allotted excluding any encumbrance by the x-ray control panel, such as overhang, cables, or other similar encroachments.

d. The booth shall be located or constructed such that unattenuated direct scatter radiation originating from the examination table or at the wall cassette holder will not reach the operator's position in the booth.

II. **Structural Requirements**:

a. The booth walls shall be permanently fixed barriers of at least 7 feet (2.1 m) high.

b. When a door or movable panel is used as an integral part of the booth structure, it must have an interlock which will prevent an exposure when the door or panel is not closed.

c. Shielding shall be provided to meet the requirements of Subchapter 4 of these regulations.

III. **X-Ray Exposure Control Placement**:

a. The x-ray exposure control for the system shall be fixed within the booth and:

b. Shall be at least 40 inches (1.0 m) from any open edge of the booth wall which is nearest to the examining table.

c. Shall allow the operator to use the majority of the available viewing windows.

IV. **Viewing System Requirements**:

a. Each booth shall have at least one viewing device which will:

i. Be so placed that the operator can view the patient during any exposure, and

ii. Be so placed that the operator can have full view of any occupant of the room and should be so placed that the operator can view any entry into the room. If any door which allows access to the room cannot be seen from

the booth, then outside that door there shall be an "x-ray on" warning sign that will be lighted anytime the rotor of the x-ray tube is activated. Alternatively, an interlock must be present such that exposures are prevented unless the door is closed.

b. When the viewing system is a window, the following requirements also apply:

i. It shall have a viewing area of at least 1 square foot (0.093 m^2).

ii. Regardless of size or shape, at least 1 square foot of the window area must be centered no less than 2 feet (0.61 m) from the open edge of the booth and no less than 5 feet (1.52 m) from the floor.

iii. The window shall have at least the same lead equivalence as that required in the booth's wall in which it is mounted.

c. When the viewing system is by mirrors, the mirror(s) shall be so located as to accomplish the general requirements of Appendix B.IV(A).

d. When the viewing system is by electronic means:

i. The camera shall be so located as to accomplish the general requirements of Appendix B.IV(A), and

ii. There shall be an alternate viewing system as a backup for the primary system

Subchapter 3 Licensing of Radioactive Material

Rule 1.3.1 **Purpose and Scope.**

1. This section of these regulations provides for the licensing of radioactive material. No person shall manufacture, produce, receive, possess, use, transfer, own or acquire radioactive material except as authorized in a specific or general license issued pursuant to this section or as otherwise provided in this section.

2. In addition to the requirements of this section, all licensees are subject to the requirements of Subchapters 1, 4, 10, and 13 of these regulations. Furthermore, licensees engaged in industrial radiographic operations are subject to the requirements of Subchapter 5 of these regulations, licensees using radionuclides in the healing arts are subject to the requirements of Subchapter 7 of these regulations, licensees engaged in the extraction, mining, beneficiating, processing, use, transfer, transport, storage, and/or disposal of naturally occurring radioactive materials (NORM) are subject to the requirements of Subchapter 11 of these regulations, licensees authorizing the use of sealed sources containing radioactive materials in irradiators are subject to the requirements of Subchapter 12 of these regulations, and licensees engaged in wireline and subsurface tracer studies are subject to the requirements of Subchapter 14 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.2 **Exemptions from the Regulatory Requirements Source Material.**

1. Any person is exempt from this section to the extent that such person receives, possesses, uses, owns, or transfers source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than 1/20 of 1 percent (0.05 percent) of the mixture, compound, solution, or alloy.

2. Any person is exempt from this section to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided that, except as authorized in a specific license, such person shall not refine or process such ore.

3. Any person is exempt from this section to the extent that such person receives, possesses, uses, or transfers:

   a. any quantities of thorium contained in

      i. incandescent gas mantles,

      ii. vacuum tubes,

      iii. welding rods,

iv. electric lamps for illuminating purposes provided that each lamp does not contain more than 50 milligrams of thorium,

v. germicidal lamps, sunlamps, and lamps for outdoor or industrial lighting provided that each lamp does not contain more than 2 grams of thorium,

vi. rare earth metals and compounds, mixtures, and products containing not more than 0.25 percent by weight thorium, uranium, or any combination of these, or

vii. personnel neutron dosimeters, provided that each dosimeter does not contain more than 50 milligrams of thorium;

b. source material contained in the following products:

i. glazed ceramic tableware, provided that the glaze contains not more than 20 percent by weight source material,

ii. glassware containing not more than 10 percent by weight source material; but not including commercially manufactured glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction,

iii. glass enamel or glass enamel frit containing not more than 10 percent by weight source material imported or ordered for importation into the United States, or initially distributed by manufacturers in the United States, before July 25, 1983, or

iv. piezoelectric ceramic containing not more than 2 percent by weight source material;

c. photographic film, negatives, and prints containing uranium or thorium;

d. any finished product or part fabricated of, or containing, tungsten-thorium or magnesium-thorium alloys, provided that the thorium content of the alloy does not exceed 4 percent by weight and that this exemption shall not be deemed to authorize the chemical, physical, or metallurgical treatment or processing of any such product or part;

e. uranium contained in counterweights installed in aircraft, rockets, projectiles, and missiles, or stored or handled in connection with installation or removal of such counterweights, provided that:

i. the counterweights are manufactured in accordance with a specific license issued by the U.S. Nuclear Regulatory Commission, authorizing distribution by the licensee pursuant to 10 CFR Part 40,

ii. each counterweight has been impressed with the following legend clearly legible through any plating or other covering: "DEPLETED URANIUM",[1]

iii. each counterweight is durably and legibly labeled or marked with the identification of the manufacturer and the statement: "UNAUTHORIZED ALTERATIONS PROHIBITED",[5] and

iv. this exemption shall not be deemed to authorize the chemical, physical, or metallurgical treatment or processing of any such counterweights other than repair or restoration of any plating or other covering;

f. natural or depleted uranium metal used as shielding constituting part of any shipping container, provided that:

i. the shipping container is conspicuously and legibly impressed with the legend "CAUTION - RADIOACTIVE SHIELDING-URANIUM", and

ii. the uranium metal is encased in mild steel or equally fire resistant metal of minimum wall thickness of 1/8 inch (3.2mm);

g. thorium contained in finished optical lenses, provided that each lens does not contain more than 30 percent by weight of thorium, and that this exemption shall not be deemed to authorize either:

i. the shaping, grinding, or polishing of such lens or manufacturing processes other than the assembly of such lens into optical systems and devices without any alteration of the lens, or

ii. the receipt, possession, use, or transfer of thorium contained in contact lenses, or in spectacles, or in eyepieces in binoculars or other optical instruments;

h. uranium contained in detector heads for use in fire detection units, provided that each detector head contains not more than 0.005 microcurie of uranium; or

i. thorium contained in any finished aircraft engine part containing nickel-thoria alloy, provided that:

[5] The requirements specified in 1.3.2(e)(ii) and (iii) need not be met by counterweights manufactured prior to December 31, 1969; provided, that such counterweights are impressed with the legend. "CAUTION - RADIOACTIVE MATERIAL - URANIUM", as previously required by the regulations.

i. the thorium is dispersed in the nickel-thoria alloy in the form of finely divided thoria (thorium dioxide), and

ii. the thorium content in the nickel-thoria alloy does not exceed 4 percent by weight.

4. The exemptions in 1.3.2(3) do not authorize the manufacture of any of the products described.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.3 **Radioactive Material Other Than Source Material**

1. **Exempt Concentrations.**

a. Except as provided in 1.3.3(1)(c) and (d), any person is exempt from this section to the extent that such person receives, possesses, uses, transfers, owns or acquires products containing radioactive material introduced in concentrations not in excess of those listed in Appendix A of this section.

b. This section shall not be deemed to authorize the import of radioactive material or products containing radioactive material.

c. No person may introduce radioactive material into a product or material knowing or having reason to believe that it will be transferred to persons exempt under 1.3.3(1)(a) or equivalent regulations of the Nuclear Regulatory Commission, an Agreement State or Licensing State, except in accordance with a specific license issued pursuant to 10 CFR 32.11.

d. A manufacturer, processor, or producer of a product or material is exempt from the requirements for a license set forth in the Act and from these regulations to the extent that the person transfers radioactive material contained in a product or material in concentrations not in excess of those specified in Appendix A of Subchapter 3 and introduced into the product or material by a licensee holding a specific license issued by the Nuclear Regulatory Commission expressly authorizing such introduction. This exemption does not apply to the transfer of radioactive material contained in any food, beverage, cosmetic, drug, or other commodity or product designed for ingestion or inhalation by, or application to, a human being.

2. **Exempt Quantities.**

a. Except as provided in 1.3.3(2)(c) through (e), any person is exempt from the requirements for a license set forth in the Act and these regulations to the extent that such person receives, possesses, uses, transfers, owns, or acquires radioactive material in individual quantities each of which does not exceed the applicable quantity set forth in Appendix B of this section.

b. Any person who possesses radioactive material received or acquired under the general license formerly provided in 1.3.6(2) is exempt from the requirements for a license set forth in this section to the extent that such person possesses, uses, transfers or owns such radioactive material. Such exemption does not apply for radium-226.

c. 1.3.3(2) does not authorize the production, packaging, repackaging or transfer of radioactive material for purposes of commercial distribution, or the incorporation of radioactive material into products intended for commercial distribution.

d. No person may, for purposes of commercial distribution, transfer radioactive material in the individual quantities set forth in Appendix B of this section, knowing or having reason to believe that such quantities of radioactive material will be transferred to persons exempt under 1.3.3(2) or equivalent regulations of the Nuclear Regulatory Commission, any Agreement State or Licensing State, except in accordance with a specific license issued by the Nuclear Regulatory Commission pursuant to 10 CFR 32.18 or by the Agency pursuant to 1.3.12(2) which license states that the radioactive material may be transferred by the persons exempt under 1.3.3(2) or the equivalent regulations of the Nuclear Regulatory Commission, an Agreement State, or Licensing State.

e. No person may, for purposes of producing an increased radiation level, combine quantities of byproduct material covered by this exemption so that the aggregate quantity exceeds the limits set forth in Appendix B of this section, except for radioactive material combined within a device placed in use before May 3, 1999, or as otherwise permitted by the regulations in this section

3. **Exempt Items.**

a. **Certain Items Containing Radioactive Material.** Except for persons who apply radioactive material to, or persons who incorporate radioactive material into the following products, or persons who desire to initially transfer for sale or distribute such products containing radioactive material, any person is exempt from these regulations to the extent that he receives, possesses, uses, transfers, owns, or acquires the following products:[6]

[6] Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing byproduct material whose subsequent possession, use, transfer, and disposal by all other persons are exempted from regulatory requirements may be obtained only from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

i. Timepieces or hands or dials containing not more than the following specified quantities of radioactive material and not exceeding the following specified radiation dose rate:

i. 925 MBq (25 millicuries) of tritium per timepiece.

ii. 185 MBq (5 millicuries) of tritium per hand.

iii. 555 MBq (15 millicuries) of tritium per dial (bezels when used shall be considered as part of the dial).

iv. 3.7 MBq (100 microcuries) of promethium-147 per watch or 7.4 MBq (200 microcuries) of promethium-147 per any other timepiece.

v. 0.74 MBq (20 microcuries) of promethium-147 per watch hand or 1.48 MBq (40 microcuries) of promethium-147 per other timepiece hand.

vi. 2.22 MBq (60 microcuries) of promethium-147 per watch dial or 4.44 MBq (120 microcuries) of promethium-147 per other timepiece dial (bezels when used shall be considered as part of the dial).

vii. The radiation dose rate from hands and dials containing promethium-147 will not exceed, when measured through 50 milligrams per square centimeter of absorber:

i. For wrist watches, 1 μGy (0.1 millirad) per hour at 10 centimeters from any surface.

ii. For pocket watches, 1 μGy (0.1 millirad) per hour at 1 centimeter from any surface.

iii. For any other timepiece, 2 μGy (0.2 millirad) per hour at 10 centimeters from any surface.

viii. 0.037 megabecquerel (1 microcurie) of radium-226 per timepiece in timepieces acquired prior to May 9, 1986.

ii. Precision balances containing not more than 37 MBq (1 millicurie) of tritium per balance or not more than 18.5 MBq (0.5 millicurie) of tritium per balance part manufactured before December 17, 2007.

iii. Marine compasses containing not more than 27.8 GBq (750 millicuries) of tritium gas and other marine navigational

instruments containing not more than 9.25 GBq (250 millicuries) of tritium gas manufactured before December 17, 2007.

iv. Electron tubes provided, that each tube does not contain more than one of the following specified quantities of radioactive material:

i. 5.55 GBq (150 millicuries) of tritium per microwave receiver protector tube or 370 MBq (10 millicuries) of tritium per any other electron tube.

ii. 37 kBq (1 microcurie) of cobalt-60.

iii. 185 kBq (5 microcuries) of nickel-63.

iv. 1.11 MBq (30 microcuries) of krypton-85.

v. 185 kBq (5 microcuries) of cesium-137.

vi. 1.11 MBq (30 microcuries) of promethium-147.

And provided further, that the radiation dose rate from each electron tube containing radioactive material will not exceed 10 μGy (1 millirad) per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber. [7]

v. Ionizing radiation measuring instruments containing, for purposes of internal calibration or standardization, one or more sources of radioactive material, provided that:

i. Each source contains no more than one exempt quantity set forth in Appendix B of this section, and

ii. Each instrument contains no more than 10 exempt quantities. For purposes of this requirement, an instrument's source(s) may contain either one or different types of radionuclides and an individual exempt quantity may be composed of fractional parts of one or more of the exempt quantities in Appendix B of this section, provided that the sum of such fractions shall not exceed unity.

iii. For americium-241, 1.85 kBq (0.05 microcurie) is considered an exempt quantity under 1.3.3(3)(a)(viii).

[7] For purposes of 1.3.3(3)(a)(vii), "electron tubes" include spark gap tubes, power tubes, gas tubes, including glow lamps, receiving tubes, microwave tubes, indicator tubes, pick-up tubes, radiation detection tubes, and any other completely sealed tube that is designed to conduct or control electrical currents.

vi. Ionization chamber smoke detectors containing not more than 1 microcurie (μCi) of americium-241 per detector in the form of a foil and designed to protect life and property from fires.

b. **Self-Luminous Products Containing Radioactive Material.**

i. **Tritium, Krypton-85, or Promethium-147.** Except for persons who manufacture, process, produce, or initially transfer for sale or distribution self-luminous products containing tritium, krypton-85, or promethium-147, any person is exempt from these regulations to the extent that such person receives, possesses, uses, transfers, owns, or acquires tritium, krypton-85 or promethium-147 in self-luminous products manufactured, processed, produced, or initially transferred in accordance with a specific license issued by the Nuclear Regulatory Commission pursuant to 10 CFR 32.22, which license authorizes the transfer of the product to persons who are exempt from regulatory requirements. The exemption in 1.3.3(3)(b) does not apply to tritium, krypton-85, or promethium-147 used in products primarily for frivolous purposes or in toys or adornments.

ii. **Radium-226.** Any person is exempt from these regulations to the extent that such person receives, possesses, uses, transfers, or owns articles containing less than 3.7 kBq (0.1 microcurie) of radium-226 which were acquired prior to May 9, 1986.

iii. Any person who desires to manufacture, process, or produce self-luminous products containing tritium, krypton-85, or promethium-147, or to transfer such products for use pursuant to 1.3.3(3)(b)(i), should apply for a license pursuant to 10 CFR 32.22, which license states that the product may be transferred by the licensee to persons exempt from 1.3.3(3)(b)(i), or equivalent regulations of an Agreement State.

c. **Gas and Aerosol Detectors Containing Radioactive Material.**

i. Except for persons who manufacture, process, produce, or initially transfer for sale or distribution gas and aerosol detectors containing radioactive material, any person is exempt from these regulations to the extent that such person receives, possesses, uses, transfers, owns, or acquires radioactive material in gas and aerosol detectors designed to protect life or property from fires and airborne hazards provided that detectors containing radioactive material shall have been manufactured, processed, produced, or initially transferred in accordance with a specific license issued by the Nuclear

Regulatory Commission[8] pursuant to 10 CFR 32.26; or an Agreement State or a Licensing State pursuant to 1.3.12(3) which authorizes the initial transfer of the detectors to persons who are exempt from regulatory requirements. This exemption also covers gas and aerosol detectors manufactured or distributed before November 30, 2007 in accordance with a specific license issued by an Agreement State under comparable provisions to 1.3.12(3) authorizing distribution to persons exempt from regulatory requirements.

ii. Gas and aerosol detectors previously manufactured and distributed to general licensees in accordance with a specific license issued by an Agreement State or a Licensing State shall be considered exempt under 1.3.3(3)(c)(i), provided that the device is labeled in accordance with the specific license authorizing distribution of the generally licensed device, and provided further that they meet the requirements of 1.3.12(3).

iii. Any person who desires to manufacture, process, or produce gas and aerosol detectors containing byproduct material, or to initially transfer such products for use in accordance with 1.3.3(3)(c)(i), should apply for a license in accordance with 10 CFR 32.26, which license states that the product may be initially transferred by the licensee to persons exempt from 1.3.3(3)(c)(i), or equivalent regulations of an Agreement State.

4. **Radioactive Drug: Capsules Containing Carbon-14 Urea for "in vivo" Diagnostic Use for Humans.**

a. Except as provided in 1.3.3(4)(b) and (c) of this section, any person is exempt from the requirements for a license set forth in these regulations provided that such person receives, possesses, uses, transfers, owns, or acquires capsules containing 37 kBq (1μCi) carbon-14 urea each (allowing for nominal variation that may occur during the manufacturing process), for "in vivo" diagnostic use for humans.

b. Any person who desires to use the capsules for research involving human subjects shall apply for and receive a specific license as specified in these regulations.

c. Any person who desires to manufacture, prepare, process, produce, package, repackage, or transfer for commercial distribution such capsules

[8] Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing byproduct material whose subsequent possession, use, transfer, and disposal by all other persons are exempted from regulatory requirements may be obtained only from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

shall apply for and receive a specific license as specified in 10 CFR Part 32, Sec.32.21.

d. Nothing in this section relieves persons from complying with applicable FDA, other Federal, and State requirements governing receipt, administration, and use of drugs.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.4 **Types of Licenses**. Licenses for radioactive materials are of two types: general and specific.

1. General licenses provided in this section are effective without the filing of applications with the Agency or the issuance of licensing documents to the particular persons, although the filing of a certificate with the Agency may be required by the particular general license.[9] The general licensee is subject to all other applicable portions of these regulations and any limitations of the general license.

2. Specific licenses require the submission of an application to the Agency and the issuance of a licensing document by the Agency. The licensee is subject to all applicable portions of these regulations as well as any limitations specified in the licensing document.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.5 **General Licenses - Source Material.**

1. A general license is hereby issued authorizing commercial and industrial firms, research, educational and medical institutions, and State and local government agencies to use and transfer not more than 6.82 kg (15 lbs) of source material at any one time for research, development, educational, commercial, or operational purposes. A person authorized to use or transfer source material, pursuant to this general license, may not receive more than a total of 68.2 kg (150 lbs) of source material in any one calendar year.

2. Persons who receive, possess, use, or transfer source material pursuant to the general license issued in 1.3.5(1) are exempt from the provisions of Subchapters 4 and 10 of these regulations to the extent that such receipt, possession, use, or transfer is within the terms of such general license; provided, however, that this exemption shall not be deemed to apply to any such person who is also in possession of source material under a specific license issued pursuant to this section.

[9] Certificate of registration for General Licenses shall be accompanied by the fee as provided in Section 45-14-31 of the Act. Fees are not required for registrations issued to local, city, county, or state government for general licensed devices associated with Homeland Security.

3. Persons who receive, possess, use, or transfer source material pursuant to the general license in 1.3.5(1) are prohibited from administering source material, or the radiation therefrom, either externally or internally, to human beings except as may be authorized by the Agency in a specific license.

4. A general license is hereby issued authorizing the receipt of title to source material without regard to quantity. This general license does not authorize any person to receive, possess, use, or transfer source material.

5. **Depleted Uranium in Industrial Products and Devices.**

   a. A general license is hereby issued to receive, acquire, possess, use, or transfer, in accordance with the provisions of 1.3.5(5)(b), (c), (d), and (e), depleted uranium contained in industrial products or devices for the purpose of providing a concentrated mass in a small volume of the product or device.

   b. The general license in 1.3.5(5)(a) applies only to industrial products or devices which have been manufactured either in accordance with a specific license issued to the manufacturer of the products or devices pursuant to 1.3.12(13) or in accordance with a specific license issued to the manufacturer by the Nuclear Regulatory Commission or an Agreement State which authorizes manufacture of the products or devices for distribution to persons generally licensed by the. Nuclear Regulatory Commission or an Agreement State.

   c. Persons who receive, acquire, possess, or use depleted uranium pursuant to the general license established by 1.3.5(5)(a) shall file Agency Form "Registration Certificate - Use of Depleted Uranium Under General License," with the Agency. The form shall be submitted within 30 days after the first receipt or acquisition of such depleted uranium. The general licensee shall furnish on the Agency Form the following information and such other information as may be required by that form:

      i. name and address of the general licensee;

      ii. a statement that the general licensee has developed and will maintain procedures designed to establish physical control over the depleted uranium described in 1.3.5(5)(a) and designed to prevent transfer of such depleted uranium in any form, including metal scrap, to persons not authorized to receive the depleted uranium; and

      iii. name, title, address, and telephone number of the individual duly authorized to act for and on behalf of the general licensee in supervising the procedures identified in 1.3.5(5)(c)(ii).

iv. The general licensee possessing or using depleted uranium under the general license established by 1.3.5(5)(a) shall report in writing to the Agency any changes in information furnished by him in Agency Form "Registration Certificate - Use of Depleted Uranium Under General License." The report shall be submitted within 30 days after the effective date of such change.

d. A person who receives, acquires, possesses, or uses depleted uranium pursuant to the general license established by 1.3.5(5)(a):

i. shall not introduce such depleted uranium, in any form, into a chemical, physical, or metallurgical treatment or process, except a treatment or process for repair or restoration of any plating or other covering of the depleted uranium;

ii. shall not abandon such depleted uranium;

iii. shall transfer or dispose of such depleted uranium only by transfer in accordance with the provisions of 1.3.24. In the case where the transferee receives the depleted uranium pursuant to the general license established by 1.3.5(5)(a), the transferor shall furnish the transferee a copy of this regulation and a copy of Agency Form, "Registration Certificate - Use of Depleted Uranium Under General License,". In the case where the transferee receives the depleted uranium pursuant to a general license contained in the Nuclear Regulatory Commission's or Agreement State's regulation equivalent to 1.3.5(5)(a), the transferor shall furnish the transferee a copy of this regulation and a copy of Agency Form "Registration Certificate - Use of Depleted Uranium Under General License," accompanied by a note explaining that use of the product or device is regulated by the Agency, the Nuclear Regulatory Commission or an Agreement State under requirements substantially the same as those in this regulation;

iv. within 30 days of any transfer, shall report in writing to the Agency the name and address of the person receiving the depleted uranium pursuant to such transfer; and

v. shall not export such depleted uranium except in accordance with a license issued by the U.S. Nuclear Regulatory Commission pursuant to 10 CFR Part 110.

e. Any person receiving, acquiring, possessing, using, or transferring depleted uranium pursuant to the general license established by 1.3.5(5)(a) is exempt from the requirements of Subchapters 4 and 10 of these regulations with respect to the depleted uranium covered by that general license.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.6 **General Licenses-Radioactive Material Other Than Source Material.**

1. **Certain Devices and Equipment.** A general license is hereby issued to transfer, receive, acquire, own, possess, and use radioactive material incorporated in the following devices or equipment which have been manufactured, tested and labeled by the manufacturer in accordance with a specific license issued to the manufacturer by the Nuclear Regulatory Commission or an Agreement State for use pursuant to 10 CFR Part 31.3. This general license is subject to the provisions of 1.1.4 through 1.1.10, 1.3.3(1)(b), 1.3.15, 1.3.24, 1.3.20, 1.3.25, and Subchapters 4,[10]10 and 13 of these regulations, as applicable.

   a. **Static Elimination Device.** Devices designed for use as static eliminators which contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5MBq (500 microcuries) of polonium-210 per device.

   b. **Ion Generating Tube.** Devices designed for ionization of air which contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5 MBq (500 microcuries) of polonium-210 per device or a total of not more than 1.85 GBq (50 millicuries) of hydrogen-3 (tritium) per device.

2. **Reserved.**

3. **Reserved.**

4. **Certain Measuring, Gauging or Controlling Devices.**

   a. A general license is hereby issued to commercial and industrial firms and to research, educational and medical institutions, individuals in the conduct of their business, and State or local government agencies to own, receive, acquire, possess, use or transfer in accordance with the provisions of 1.3.6(4)(b), (c), (d) and (e), radioactive material, excluding special nuclear material, contained in devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere.

   b. The general license in 1.3.6(4)(a) applies only to radioactive material contained in devices which have been manufactured or initially transferred and labeled in accordance with the specifications contained in a specific license issued by the Agency pursuant to 1.3.12(4) or an equivalent

[10] Attention is directed particularly to the provisions of Subchapter 4 of these regulations which relate to the labeling of containers.

specific license issued by the Nuclear Regulatory Commission, an Agreement State or a Licensing State with provisions comparable to 1.3.12(4).[11]

i. The devices shall have been received from one of the specific licensees described in 1.3.6(4)(b); or

ii. Through a transfer made under 1.3.6(4)(c)(ix).

c. Any person who owns, receives, acquires, possesses, uses, or transfers radioactive material in a device pursuant to the general license in 1.3.6(4)(a):

i. Shall assure that all labels affixed to the device at the time of receipt, and bearing a statement that removal of the label is prohibited, are maintained thereon and shall comply with all instructions and precautions provided by such labels;

ii. Shall assure that the device is tested for leakage of radioactive material and proper operation of the "on-off" mechanism and indicator, if any, at no longer than 6-month intervals or at such other intervals as are specified in the label, however,

i. Devices containing only krypton need not be tested for leakage of radioactive material, and

ii. Devices containing only tritium or not more than 3.7 MBq (100 microcuries) of other beta- and/or gamma-emitting material or 0.37 MBq (10 microcuries) of alpha-emitting material and devices held in storage in the original shipping container prior to initial installation need not be tested for any purpose;

iii. Shall assure that other testing, installation, servicing, and removal from installation involving the radioactive material, its shielding or containment, are performed:

i. In accordance with the instructions provided by the labels, or

ii. By a person holding an applicable specific license from the Agency, the Nuclear Regulatory Commission, an Agreement State or a Licensing State to perform such activities;

[11] Regulations under the Federal Food, Drug, and Cosmetic Act authorizing the use of radioactive control devices in food production require certain additional labeling thereon which is found in 21 CFR 179.21.

iv. Shall maintain records showing compliance with the requirements of 1.3.6(4)(c)(ii) and (iii). The records shall show the results of tests. The records also shall show the dates of performance and the names of persons performing, testing, installation, servicing, and removal from installation concerning the radioactive material, its shielding or containment. Records of tests for leakage of radioactive material required by 1.3.6(4)(c)(ii) shall be retained for 3 years after the next required leak test is performed or until the sealed source is transferred or disposed of. Records of tests of the "on-off" mechanism and indicator required by 1.3.6(4)(c)(ii) shall be retained for 3 years after the next required test of the "on-off" mechanism and indicator is performed or until the sealed source is transferred or disposed of. Records which are required by 1.3.6(4)(c)(iii) shall be retained for a period of 3 years from the date of the recorded event or until the device is transferred or disposed of;

v. Upon the occurrence of a failure of or damage to, or any indication of a possible failure of or damage to the shielding of the radioactive material or the "on-off" mechanism or indicator, or upon the detection of 1.85 Bq (0.005 microcurie) or more removable radioactive material, shall immediately suspend operation of the device until it has been repaired by the manufacturer or other person holding an applicable specific license from the Agency, the Nuclear Regulatory Commission, an Agreement State or a Licensing State to repair such devices, or disposed of by transfer to a person authorized by an applicable specific license to receive the radioactive material contained in the device or as otherwise approved by the Agency. A report containing a brief description of the event and the remedial action taken; and, in the case of detection of 185 Bq (0.005 μCi) or more removable radioactive material or failure of or damage to a source likely to result in contamination of the premises or the environs, a plan for ensuring that the premises and environs are acceptable for unrestricted use, shall be furnish to the Agency within 30 days.

vi. Shall not abandon the device containing radioactive material;

vii. Shall not export the device containing radioactive material except in accordance with 10 CFR Part 110.

viii. Shall transfer or dispose of the device containing radioactive material:

i. Only by export as provided by 1.3.6(4)(c)(vii), by transfer to another general licensee as authorized in 1.3.6(4)(c)(ix), or to a person authorized to receive the device by a specific

license under Subchapter 3 or a specific license that authorizes waste collection under Subchapter 3, or equivalent regulations of the Nuclear Regulatory Commission or an Agreement State, or as otherwise approved under 1.3.6(4)(c)(viii)(iii).

ii. Shall furnish a report to the Agency within 30 days after the transfer of a device to a specific licensee or export. The report shall contain:

i. The identification of the device by manufacturer's (or initial transferor's) name, model and serial number;

ii. The name, address and license number of the person receiving the device (license number not applicable if exported); and

iii. The date of the transfer.

iii. Shall obtain written Agency approval before transferring the device to any other specific licensee not specifically identified in 1.3.6(4)(c)(viii)(i); however, a holder of a specific license may transfer a device for possession and use under its own specific license without prior approval, if, the holder:

i. Verifies that the specific license authorizes the possession and use, or applies for and obtains an amendment to the license authorizing the possession and use;

ii. Removes, alters, covers, or clearly and unambiguously augments the existing label otherwise required by 1.3.6(4)(c)(i) of this section so that the device is labeled in compliance with 1.4.32 of these regulations; however the manufacturer, model number, and serial number must be retained;

iii. Obtains the manufacturer's or initial transferor's information concerning maintenance that would be applicable under the specific license (such as leak testing procedures); and

iv. Reports the transfer under 1.3.6(4)(c)(xiii)(ii) of this section.

ix. Shall transfer the device to another general licensee only:

i. Where the device remains in use at a particular location. In such case the transferor shall give the transferee a copy of 1.1.4 through 1.1.10, 1.3.6., 1.4.54, 1.4.55 of these regulations and any safety documents identified in the label on the device. Within 30 days of the transfer, report to the Agency;

i. The manufacturer's or initial transferor's name

ii. The model number and serial number of device transferred,

iii. The transferee's name and mailing address for the location of use; and

iv. The name, title, and telephone number of the responsible individual identified by the transferee in accordance with 1.3.6(4)(c)(xii) to have knowledge of and authority to take actions to ensure compliance with the appropriate regulations and requirements; or

ii. Where the device is held in storage by an intermediate person in the original shipping container at its intended location of use prior to initial use by a general licensee.

x. Shall comply with the provisions of 1.4.54 and 1.4.55 of these regulations for reporting radiation incidents, theft, or loss of licensed material, but shall be exempt from the other reporting requirements of Subchapters 4 and 10 of these regulations.

xi. Shall respond to written requests from the Agency to provide information relating to the general license within 30 calendar days of the date of the request, or other time specified in the request. If the general licensee cannot provide the requested information within the allotted time, it shall, within the same time period, request a longer period to supply information by submitting a letter to the Agency and provide written justification as to why it cannot comply.

xii. Shall appoint an individual responsible for having knowledge of the appropriate regulations and requirements and the authority for taking required actions to comply with appropriate regulations and requirements. The general licensee, through this individual, shall ensure the day-to-day compliance with appropriate regulations and

requirements. This appointment does not relieve the general licensee of any of its responsibility in this regard.

xiii. Shall register general license devices:

i. In accordance with 1.3.6(4)(c)(xiii)(ii) and (iii). Each address for a location of use, as described in 1.3.6(4)(c)(xiii)(iii)(iv), represents a separate general licensee and requires a separate registration and fee.

ii. Registration shall be done by verifying, correcting, and/or adding to the information provided in a request for registration received from the Agency. The registration information shall be submitted to the Agency within 30 days of the date of the request for registration or as otherwise indicated in the request. In addition, a general licensee is subject to the bankruptcy notification requirement in 1.3.15(5).

iii. In registering devices, the general licensee shall furnish the following information and any other information specifically requested by the Agency:

i. Name and mailing address of the general licensee;

ii. Information about each device: the manufacturer or initial transferor, model number, serial number, the radionuclide and activity, as indicated on the label;

iii. Name, title, and telephone number of the responsible person designated as a representative of the general licensee in 1.3.6(4)(c)(xii);

iv. Address or location at which the device(s) are used and/or stored. For portable devices, the address of the primary place of storage;

v. Certification by the responsible representative of the general licensee that the information concerning the device(s) has been verified through a physical inventory and checking of label information; and

vi. Certification by the responsible representative of the general licensee that they are aware of the requirements of the general license.

xiv. Report changes to the mailing address for the location of use, including change in name of general licensee, to the Agency within 30 days of the effective date of the change. For a portable device, a report of address change is only required for a change in the device's primary place of storage.

xv. Not hold devices that are not in use for longer than 2 years. If devices with shutters are not being used, the shutter shall be locked in the closed position. The testing required by 1.3.6(4)(c)(ii) need not be performed during the period of storage only. However, when devices are put back into service or transferred to another person, and have not been tested within the required test interval, they shall be tested for leakage before use or transfer and the shutter tested before use. Devices kept in standby for future use are excluded from the two-year time limit if the general licensee performs quarterly physical inventories of these devices while they are in standby.

d. The general license in 1.3.6(4)(a) does not authorize the manufacture or import of devices containing radioactive material.

e. The general license provided in 1.3.6(4)(a) is subject to the provisions of 1.1.4 through 1.1.10, 1.3.15, 1.3.24 1.3.25, and Subchapter 13 of these regulations.

5. **Luminous Safety Devices for Aircraft.**

a. A general license is hereby issued to own, receive, acquire, possess, and use tritium or promethium-147 contained in luminous safety devices for use in aircraft, provided:

i. each device contains not more than 370 GBq (10 curies) of tritium or 11.1 GBq (300 millicuries) of promethium-147; and

ii. each device has been manufactured, assembled or initially transferred in accordance with a specific license issued by the U.S. Nuclear Regulatory Commission, or each device has been manufactured or assembled in accordance with the specifications contained in a specific license issued by the Agency or any Agreement State to the manufacturer or assembler of such device pursuant to licensing requirements equivalent to those in 10 CFR Part 32.53.

b. Persons who own, receive, acquire, possess, or use luminous safety devices pursuant to the general license in 1.3.6(5)(a) are exempt from the requirements of Subchapters 4 and 10 of these regulations except that they shall comply with the provisions of 1.4.54 and 1.4.55.

c. This general license does not authorize the manufacture, assembly, repair, or import of luminous safety devices containing tritium or promethium-147.

d. This general license does not authorize the ownership, receipt, acquisition, possession or use of promethium-147 contained in instrument dials.

e. This general license is subject to the provisions of 1.1.4 through 1.1.10, 1.3.15, 1.3.24, 1.3.25, and Subchapter 13 of these regulations.

f. This general license does not authorize the export of luminous safety devices containing tritium or promethium-147.

6. **Ownership of Radioactive Material.** A general license is hereby issued to own radioactive material without regard to quantity. Notwithstanding any other provisions of these regulations, this general license does not authorize the manufacture, production, transfer, receipt, possession, use, import, or export of radioactive material except as authorized in a specific license.

7. **Calibration and Reference Sources.**

a. A general license is hereby issued to those persons listed below to own, receive, acquire, possess, use, and transfer, in accordance with the provisions of 1.3.6(7)(d) and (e), americium-241 in the form of calibration or reference sources:

i. any person who holds a specific license issued by the Agency which authorizes the licensee to receive, possess, use, and transfer radioactive material; and

ii. any person who holds a specific license issued by the Nuclear Regulatory Commission which authorizes the licensee to receive, possess, use, and transfer special nuclear material.

b. A general license is hereby issued to own, receive, possess, use, and transfer plutonium in the form of calibration or reference sources in accordance with the provisions of 1.3.6(7)(d) and (e) to any person who holds a specific license issued by the Agency which authorizes him to receive, possess, use, and transfer radioactive material.

c. A general license is hereby issued to own, receive, possess, use, and transfer radium-226 in the form of calibration or reference sources in accordance with the provisions of 1.3.6(7)(d) and (e) to any person who holds a specific license issued by the Agency which authorizes him to receive, possess, use, and transfer radioactive material.

d. The general licenses in 1.3.6(7)(a), (b) and (c) apply only to calibration or reference sources which have been manufactured or initially transferred in accordance with the specifications contained in a specific license issued to the manufacturer or importer of the sources by the Nuclear Regulatory Commission pursuant to 10 CFR 32.57 or 10 CFR 70.39 or which have been manufactured in accordance with the specifications contained in a specific license issued to the manufacturer by the Agency, any Agreement State or Licensing State pursuant to licensing requirements equivalent to those contained in 1.3.12(6), 10 CFR 32.57 or of 10 CFR 70.39.

e. The general licenses provided in 1.3.6(7)(a), (b), and (c) are subject to the provisions of 1.1.4 through 1.1.10, 1.3.15, 1.3.24, 1.3.25, and Subchapters 4, 10, and 13 of these regulations. In addition, persons who own, receive, acquire, possess, use, or transfer one or more calibration or reference sources pursuant to these general licenses:

i. shall not possess at any one time, at any one location of storage or use, more than 185 kBq (5 microcuries) of americium-241, 185 kBq (5 microcuries) of plutonium, or 185 kBq (5 microcuries) of radium-226 in such sources;

ii. shall not receive, possess, use, or transfer such source unless the source, or the storage container, bears a label which includes one of the following statements, as appropriate, or a substantially similar statement which contains the information called for in one of the following statements, as appropriate:

i. The receipt, possession, use and transfer of this source, Model _____, Serial No._____, are subject to a general license and the regulations of the U.S. Nuclear Regulatory Commission or of a State with which the Commission has entered into an agreement for the exercise of regulatory authority. Do not remove this label.

CAUTION - RADIOACTIVE MATERIAL - THIS SOURCE CONTAINS (AMERICIUM-241). (PLUTONIUM)[12] DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE. _____ Name of manufacturer or initial transferor

ii. The receipt, possession, use and transfer of this source, Model _____, Serial No._____, are subject to a general license and the regulations of a Licensing State. Do not remove this label.

[12] Showing only the name of the appropriate material.

CAUTION - RADIOACTIVE MATERIAL - THIS SOURCE CONTAINS RADIUM-226. DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE.

_____

Name of manufacturer or initial transferor

iii. shall not transfer, abandon, or dispose of such source except by transfer to a person authorized by a license from the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State or a Licensing State to receive the source;

iv. shall store such source, except when the source is being used, in a closed container adequately designed and constructed to contain americium-241, plutonium, or radium-226 which might otherwise escape during storage; and

v. shall not use such source for any purpose other than the calibration of radiation detectors or the standardization of other sources.

f. These general licenses do not authorize the manufacture, import or export of calibration or reference sources containing americium-241, plutonium, or radium-226.

8. **Reserved.**

9. **General License for Use of Radioactive Material for Certain *In Vitro* Clinical or Laboratory Testing.** [13]

a. A general license is hereby issued to any physician, veterinarian, clinical laboratory or hospital to receive, acquire, possess, transfer or use, for any of the following stated tests, in accordance with the provisions of 1.3.6(9)(b), (c), (d), (e), and (f), the following radioactive materials in prepackaged units for use in *in vitro* clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation therefrom, to human beings or animals:

i. Carbon-14, in units not exceeding 370 kBq (10 microcuries) each.

ii. Cobalt-57, in units not exceeding 370 kBq (10 microcuries) each.

[13] The New Drug provisions of the Federal Food, Drug, and Cosmetic Act also govern the availability and use of any specific diagnostic drugs in interstate commerce.

iii. Hydrogen-3 (tritium), in units not exceeding 1.85 MBq (50 microcuries) each.

iv. Iodine-125, in units not exceeding 370 kBq (10 microcuries) each.

v. Mock Iodine-125 reference or calibration sources, in units not exceeding 1.85 Bq (0.05 microcurie) of iodine-129 and 1.85 Bq (0.05 microcurie) of americium-241 each.

vi. Iodine-131, in units not exceeding 370 kBq (10 microcuries) each.

vii. Iron-59, in units not exceeding 740 kBq (20 microcuries) each.

viii. Selenium-75, in units not exceeding 370 kBq (10 microcuries) each.

b. No person shall receive, acquire, possess, use or transfer radioactive material pursuant to the general license established by 1.3.6(9)(a) until that person has filed Agency Form, "Registration Certificate - *In Vitro* Testing with Radioactive Material Under General License", with the Agency and received from the Agency a validated copy of the Agency Form with certification number assigned. The physician, veterinarian, clinical laboratory or hospital shall furnish on the Agency Form the following information and such other information as may be required by that form:

i. Name and address of the physician, veterinarian, clinical laboratory or hospital;

ii. the location of use; and

iii. a statement that the physician, veterinarian, clinical laboratory or hospital has appropriate radiation measuring instruments to carry out *in vitro* clinical or laboratory tests with radioactive material as authorized under the general license in 1.3.6(9)(a) and that such tests will be performed only by personnel competent in the use of such instruments and in the handling of the radioactive material.

c. A person who receives, acquires, possesses or uses radioactive material pursuant to the general license established by 1.3.6(9)(a) shall comply with the following:

i. The general licensee shall not possess at any one time, pursuant to the general license in 1.3.6(9)(a), at any one location of storage or use, a total amount of iodine-125, iodine-131, selenium-75, iron-59, and/or cobalt-57 in excess of 7.4 MBq (200 microcuries).

ii. The general licensee shall store the radioactive material, until used, in the original shipping container or in a container providing equivalent radiation protection.

iii. The general licensee shall use the radioactive material only for the uses authorized by 1.3.6(9)(a).

iv. The general licensee shall not transfer the radioactive material to a person who is not authorized to receive it pursuant to a license issued by the Agency, the U.S. Nuclear Regulatory Commission, any Agreement State or Licensing State, nor transfer the radioactive material in any manner other than in the unopened, labeled shipping container as received from the supplier.

v. The general licensee shall dispose of the Mock Iodine-125 reference or calibration sources described in 1.3.6(9)(a)(v) as required by 1.4.35(1) of these regulations.

d. The general licensee shall not receive, acquire, possess, or use radioactive material pursuant to 1.3.6(9)(a):

i. Except as prepackaged units which are labeled in accordance with the provisions of an applicable specific license issued pursuant to 1.3.12(8) or in accordance with the provisions of a specific license issued by the Nuclear Regulatory Commission, any Agreement State or Licensing State which authorizes the manufacture and distribution of iodine-125, iodine-131, carbon-14, hydrogen-3 (tritium), iron-59, selenium-75, cobalt-57, or Mock Iodine-125 to persons generally licensed under 1.3.6(9) or its equivalent, and

ii. unless one of the following statements, as appropriate, or a substantially similar statement which contains the information called for in one of the following statements, appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package:

i. This radioactive material shall be received, acquired, possessed, and used only by physicians, veterinarians, clinical laboratories or hospitals and only for, *in vitro* clinical or laboratory tests not involving internal or external administration of the material, or the radiation therefrom, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the Nuclear Regulatory Commission or of a State with which the Commission has entered into an agreement for the exercise of regulatory authority.

_____
Name of manufacturer

ii. This radioactive material shall be received, acquired, possessed, and used only by physicians, veterinarians, clinical laboratories or hospitals and only for *in vitro* clinical or laboratory tests not involving internal or external administration of the material, or the radiation therefrom, to human beings or animals. Its receipt, acquisition, possession, use and transfer are subject to the regulations and a general license of a Licensing State.

_____
Name of manufacturer

e. The physician, veterinarian, clinical laboratory or hospital possessing or using radioactive material under the general license of 1.3.6(9)(a) shall report in writing to the Agency, any changes in the information furnished by him in the "Registration Certificate - *In Vitro* Testing with Radioactive Material Under General License". The report shall be furnished within 30 days after the effective date of such change.

f. Any person using radioactive material pursuant to the general license of 1.3.6(9)(a) is exempt from the requirements of Subchapters 4 and 10 of these regulations with respect to radioactive material covered by that general license, except that such persons using the Mock Iodine-125 described in 1.3.3(9)(a)(v) shall comply with the provisions of 1.4.35(1), 1.4.54, and 1.4.55 of these regulations.

10. **Ice Detection Devices.**

a. A general license is hereby issued to own, receive, acquire, possess, use, and transfer strontium-90 contained in ice detection devices, provided each device contains not more than 1.85 MBq (50 microcuries) of strontium-90 and each device has been manufactured or initially transferred in accordance with a specific license issued by the Nuclear Regulatory Commission or each device has been manufactured in accordance with the specifications contained in a specific license issued by the Agency or an Agreement State to the manufacturer of such device pursuant to licensing requirements of 1.3.12(9) or equivalent to those in 10 CFR 32.61.

b. Persons who own, receive, acquire, possess, use, or transfer strontium-90 contained in ice detection devices pursuant to the general license in 1.3.6(10)(a):

i. shall, upon occurrence of visually observable damage, such as a bend or crack or discoloration from overheating to the device, discontinue use of the device until it has been inspected, tested for leakage and repaired by a person holding a specific license from the U.S. Nuclear Regulatory Commission or an Agreement State to manufacture or service such devices; or shall dispose of the device pursuant to the provisions of 1.4.35(1) of these regulations;

ii. shall assure that all labels affixed to the device at the time of receipt, and which bear a statement which prohibits removal of the labels, are maintained thereon; and

iii. are exempt from the requirements of Subchapters 4 and 10 of these regulations except that such persons shall comply with the provisions of 1.4.35(1), 1.4.54, and 1.4.55.

c. This general license does not authorize the manufacture, assembly, disassembly, repair, or import of strontium-90 in ice detection devices.

d. This general license is subject to the provisions of 1.1.4 through 1.1.10, 1.3.15, 1.3.24, 1.3.25, and Subchapter 13 of these regulations.

11. **Self-Luminous Products Containing Radium-226.**

a. A general license is hereby issued to any person to acquire, receive, possess, use, or transfer, in accordance with the provisions of 1.3.6(11)(b) through (d), radium-226 contained in the following products manufactured prior to November 30, 2007.

i. Antiquities originally intended for use by the general public. For the purposes of this paragraph, antiquities mean products originally intended for use by the general public and distributed in the late 19th and early 20th centuries, such as radium emanator jars, revigators, radium water jars, radon generators, refrigerator cards, radium bath salts, and healing pads.

ii. Intact timepieces containing greater than 0.037 MBq (1 μCi), nonintact timepieces, and timepiece hands and dials no longer installed in timepieces.

iii. Luminous items installed in air, marine, or land vehicles.

iv. All other luminous products, provided that no more than 100 items are used or stored at the same location at any one time.

v. Small radium sources containing no more than 0.037 MBq (1 μCi) of radium-226. For the purposes of this paragraph, “small radium sources" means discrete survey instrument check sources, sources contained in radiation measuring instruments, sources used in Nuclear Regulatory Commission educational demonstrations (such as cloud chambers and spinthariscopes), electron tubes, lightning rods, ionization sources, static eliminators, or as designated by the Nuclear Regulatory Commission.

b. Persons who acquire, receive, possess, use, or transfer radioactive material under the general license issued in 1.3.6(11)(a) are exempt from the provisions of Subchapters 4 and 10, and 1.1.7 and 1.3.20 of these regulations, to the extent that the receipt, possession, use, or transfer of radioactive material is within the terms of the general license; provided, however, that this exemption shall not be deemed to apply to any such person specifically licensed under Subchapter 3 of these regulations.

c. Any person who acquires, receives, possesses, uses, or transfers radioactive material in accordance with the general license in 1.3.6(11)(a) shall:

i. Notify the Agency should there be any indication of possible damage to the product so that it appears it could result in a loss of the radioactive material. A report containing a brief description of the event, and the remedial action taken, must be furnished to the Agency within 30 days.

ii. Not abandon products containing radium-226. The product, and any radioactive material from the product, may only be disposed of according to 1.4.42 of these regulations or by transfer to a person authorized by a specific license to receive the radium-226 in the product or as otherwise approved by the Agency.

iii. Not export products containing radium-226 except in accordance with 10 CFR Part 110.

iv. Dispose of products containing radium-226 at a disposal facility authorized to dispose of radioactive material in accordance with any Federal or State solid or hazardous waste law, including the Solid Waste Disposal Act, as authorized under the Energy Policy Act of 2005, by transfer to a person authorized to receive radium-226 by a specific license issued under this section, or equivalent regulations of the Nuclear Regulatory Commission or an

Agreement State, or as otherwise approved by the Nuclear Regulatory Commission or an Agreement State.

v. Respond to written requests from the Agency to provide information relating to the general license within 30 calendar days of the date of the request, or other time specified in the request. If the general licensee cannot provide the requested information within the allotted time, it shall, within that same time period, request a longer period to supply the information by providing the Agency, a written justification for the request.

d. The general license in 1.3.6(11)(a) does not authorize the manufacture, assembly, disassembly, repair, or import of products containing radium-226, except that timepieces may be disassembled and repaired.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.7 **Reserved.**

Rule 1.3.8 **Filing Application for Specific Licenses.**

1. Applications for specific licenses shall be filed on a form prescribed by the Agency and shall be accompanied by the fee as provided in Section 45-14-31 of the Act.

2. The Agency may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Agency to determine whether the application should be granted or denied or whether a license should be modified or revoked.

3. Each application shall be signed by the applicant or licensee or a person duly authorized to act for and on their behalf.

4. An application for a license may include a request for a license authorizing one or more activities.

5. In the application, the applicant may incorporate by reference information contained in previous applications, statements, or reports filed with the Agency provided such references are clear and specific.

6. Applications and documents submitted to the Agency may be made available for public inspection except that the Agency may withhold any document or part thereof from public inspection if disclosure of its content is not required in the public interest and would adversely affect the interest of the person concerned.

7. An application for a specific license to use radioactive material in the form of a sealed source or in a device that contains the sealed source shall either:

a. identify the source or device by manufacturer and model number as registered with the Nuclear Regulatory Commission under 10 CFR 32.210 or with an Agreement State or for a source or a device containing radium-226 or accelerator-produced radioactive material with an Agreement State under provisions comparable to 10 CFR 32.210; or

b. Contain the information identified in 10 CFR 32.210(c); or

c. For sources or devices containing naturally occurring or accelerator produced radioactive material manufactured prior to November 30, 2007 that are not registered with the NRC under 10 CFR 32.210 or with an Agreement State, and for which the applicant is unable to provide all categories of information specified in 10 CFR 32.210(c), the applicant must provide:

i. All available information identified in 10 CFR 32.210(c) concerning the source, and, if applicable, the device; and

ii. Sufficient additional information to demonstrate that there is reasonable assurance that the radiation safety properties of the source or device are adequate to protect health and minimize danger to life and property. Such information must include a description of the source or device, a description of radiation safety features, the intended use and associated operating experience, and the results of a recent leak test.

8. Certain applications for specific licenses submitted under this section and Subchapters 5, 7, 11, 12, and 14 must contain a proposed decommissioning funding plan or a certification of financial assurance for decommissioning, as provided by 1.3.9(7),

a. Each application submitted after April 7, 1993, to possess radioactive materials in unsealed form, on foils or plated sources, or sealed in glass in excess of the quantities in Appendix C, "Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release," of this section must contain either:

i. An evaluation showing that the maximum dose to a person offsite due to a release of radioactive materials would not exceed 1 rem effective dose equivalent or 5 rems to the thyroid; or

ii. An emergency plan for responding to a release of radioactive material.

b. One or more of the following factors may be used to support an evaluation submitted under 1.3.8(8)(a)(i) of this section:

i. The radioactive material is physically separated so that only a portion could be involved in an accident;

ii. All or part of the radioactive material is not subject to release during an accident because of the way it is stored or packaged;

iii. The release fraction in the respirable size range would be lower than the release fraction shown in Appendix C of this section due to the chemical or physical form of the material;

iv. The solubility of the radioactive material would reduce the dose received;

v. Facility design or engineered safety features in the facility would cause the release fraction to be lower than shown in Appendix C of this section;

vi. Operating restrictions or procedures would prevent a release fraction as large as that shown in Appendix C of this section; or

vii. Other factors appropriate for the specific facility.

c. An emergency plan for responding to a release of radioactive material submitted under 1.3.8(8)(a)(ii) must include the following information:

i. **Facility description.** A brief description of the licensee's facility and area near the site.

ii. **Types of accidents.** An identification of each type of radioactive materials accident for which protective actions may be needed.

iii. **Classification of accidents**. A classification system for classifying accidents as alerts or site area emergencies.

iv. **Detection of accidents**. Identification of the means of detecting each type of accident in a timely manner.

v. **Mitigation of consequences**. A brief description of the means and equipment for mitigating the consequences of each type of accident, including those provided to protect workers on-site, and a description of the program for maintaining the equipment.

vi. **Assessment of releases**. A brief description of the methods and equipment to assess releases of radioactive materials.

vii. **Responsibilities**. A brief description of the responsibilities of licensee personnel should an accident occur, including identification of personnel responsible for promptly notifying

offsite response organizations and the Agency, also responsibilities for developing, maintaining, and updating the plan.

viii. **Notification and coordination**. A commitment to and a brief description of the means to promptly notify offsite response organizations and request offsite assistance, including medical assistance for the treatment of contaminated injured on-site workers when appropriate. A control point must be established. The notification and coordination must be planned so that unavailability of some personnel, parts of the facility, and some equipment will not prevent the notification and coordination. The licensee shall also commit to notify the Agency immediately after notification of the appropriate offsite response organizations and not later than one hour after the licensee declares an emergency.

ix. **Information to be communicated.** A brief description of the types of information on facility status, radioactive releases, and recommended protective actions, if necessary, to be given to offsite response organizations and to the Agency.

x. **Training**. A brief description of the frequency, performance objectives and plans for the training that the licensee will provide workers on how to respond to an emergency including any special instructions and orientation tours the licensee would offer to fire, police, medical and other emergency personnel. The training shall familiarize personnel with site-specific emergency procedures. Also, the training shall thoroughly prepare site personnel for their responsibilities in the event of accident scenarios postulated as most probable for the specific site, including the use of team training for such scenarios.

xi. **Safe shutdown**. A brief description of the means of restoring the facility to a safe condition after an accident.

xii. **Exercises**. Provisions for conducting quarterly communications checks with offsite response organizations and biennial on-site exercises to test response to simulated emergencies. Quarterly communications checks with offsite response organizations must include the check and update of all necessary telephone numbers. The licensee shall invite offsite response organizations to participate in the biennial exercises. Participation of offsite response organizations in biennial exercises although recommended is not required. Exercises must use accident scenarios postulated as most probable for the specific site and the scenarios shall not be known to most exercise participants. The licensee shall critique each exercise using individuals not having direct implementation responsibility for the plan. Critiques of

exercises must evaluate the appropriateness of the plan, emergency procedures, facilities, equipment, training of personnel, and overall effectiveness of the response. Deficiencies found by the critiques must be corrected.

xiii. **Hazardous chemicals.** A certification that the applicant has met its responsibilities under the Emergency Planning and Community Right-to-Know Act of 1986, Title III, Public Law 99-499, if applicable to the applicant's activities at the proposed place of use of the radioactive material.

d. The licensee shall allow the offsite response organizations expected to respond in case of an accident 60 days to comment on the licensee's emergency plan before submitting it to the Agency. The licensee shall provide any comments received within the 60 days to the Agency with the emergency plan.

9. An application from a medical facility, or educational institution, to produce Positron Emission Tomography (PET) radioactive drugs for noncommercial transfer to licensees in its consortium authorized for medical use under Subchapter 7 of these regulations or equivalent Nuclear Regulatory Commission or Agreement State requirements shall include:

a. A request for authorization for the production of PET radionuclides or evidence of an existing license issued under Subchapter 3 of these regulations or Nuclear Regulatory Commission or Agreement State requirements for a PET radionuclide production facility within its consortium from which it receives PET radionuclides.

b. Evidence that the applicant is qualified to produce radioactive drugs for medical use by meeting one of the criteria in 1.3.12(10)(a)(ii) of this section.

c. Identification of individual(s) authorized to prepare the PET radioactive drugs if the applicant is a pharmacy, and documentation that each individual meets the requirements of an authorized nuclear pharmacist as specified in 1.3.12(10)(b)(ii) of this section.

d. Information identified in 1.3.12(10)(a)(iii) of this section on the PET drugs to be noncommercially transferred to members of its consortium.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.9 **General Requirements for the Issuance of Specific Licenses**. A license application will be approved if the Agency determines that:

1. the applicant is qualified by reason of training and experience to use the material in question for the purpose requested in accordance with these regulations in such a manner as to minimize danger to public health and safety or property;

2. the applicant's proposed equipment, facilities, and procedures are adequate to minimize danger to public health and safety or property;

3. the issuance of the license will not be inimical to the health and safety of the public; and

4. the applicant satisfies any applicable special requirements in 1.3.11, 1.3.12, or Subchapter 5, Subchapter 7, Subchapter 11, Subchapter 12, or Subchapter 14 of these regulations.

5. **Environmental Report, Commencement of Construction**. In the case of an application for a license to receive and possess radioactive material for commercial waste disposal by land burial, or for the conduct of any other activity which the Agency determines will significantly affect the quality of the environment, the Agency, before commencement of construction of the plant or facility in which the activity will be conducted, has concluded, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values. Commencement of construction prior to such conclusion shall be grounds for denial of a license to receive and possess radioactive material in such plant or facility. As used in this paragraph the term "commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a site. The term does not mean site exploration, necessary roads for site exploration, borings to determine foundation conditions, or other preconstruction monitoring or testing to establish background information related to the suitability of the site or the protection of environmental values.

6. **Reserved**.

7. **Financial Assurance and Recordkeeping for Decommissioning.**

   a. Financial Assurance and Recordkeeping for Decommissioning

      i. Each applicant for a specific license authorizing the possession and use of unsealed radioactive material of half-life greater than 120 days and in quantities exceeding 10^5 times the applicable quantities set forth in Appendix F to Subchapter 4 of these regulations shall submit a decommissioning funding plan as described in 1.3.9(7)(e). The decommissioning funding plan must also be submitted when a combination of isotopes is involved if R divided by 10^5 is greater than 1 (unity rule), where R is defined

here as the sum of the ratios of the quantity of each isotope to the applicable value in Appendix F to Subchapter 4 of these regulations.

ii. Each holder of, or applicant for, any specific license authorizing the possession and use of sealed sources or plated foils of half-life greater than 120 days and in quantities exceeding 10^{12} times the applicable quantities set forth in Appendix F to Subchapter 4 (or when a combination of isotopes is involved if R, as defined in 1.3.9(7)(a)(i), divided by 10^{12} is greater than 1), shall submit a decommissioning funding plan as described in 1.3.9(7)(e) of this section. The decommissioning funding plan must be submitted to the Agency by July 1, 2009.

b. Each applicant for a specific license authorizing possession and use of radioactive material of half-life greater than 120 days and in quantities specified in 1.3.9(7)(d) shall either:

i. Submit a decommissioning funding plan as described in 1.3.9(7)(e); or

ii. Submit a certification that financial assurance for decommissioning has been provided in the amount prescribed by 1.3.9(7)(d) using one of the methods described in 1.3.9(7)(f). For an applicant, this certification may state that the appropriate assurance will be obtained after the application has been approved and the license issued but prior to the receipt of licensed material. If the applicant defers execution of the financial instrument until after the license has been issued, a signed original of the financial instrument obtained to satisfy the requirements of 1.3.7(7)(f) must be submitted to the Agency before receipt of licensed material. If the applicant does not defer execution of the financial instrument, the applicant shall submit to the Agency, as part of the certification, a signed original of the financial instrument obtained to satisfy the requirements of 1.3.9(7)(f).

c. Each holder of a specific license issued on or after November 15, 1992, which is of a type described in 1.3.9(7)(a) or (b), shall provide financial assurance for decommissioning in accordance with the criteria set forth in this section.

i. Each holder of a specific license issued before November 15, 1992, and of a type described in 1.3.9(7)(a) shall submit on or before January 1, 1993, a decommissioning funding plan as described in 1.3.9(7)(e) or a certification of financial assurance for decommissioning in an amount at least equal to $1,125,000 in accordance with the criteria set forth in this section. If the licensee

submits the certification of financial assurance rather than a decommissioning funding plan at this time, the licensee shall include a decommissioning funding plan in any application for license renewal.

ii. Each holder of a specific license issued before November 15, 1992, and of a type described in 1.3.9(7)(b) shall submit, on or before January 1, 1993, a decommissioning funding plan as described in 1.3.9(7)(e) or a certification of financial assurance for decommissioning in accordance with the criteria set forth in this section.

iii. Any licensee who has submitted an application before November 15, 1992, for renewal of license in accordance with 1.3.17 shall provide financial assurance for decommissioning in accordance with 1.3.9(7)(a) and (b) of this section. This assurance must be submitted within 180 days of the effective date of these regulations.

iv. Waste collectors and waste processors, as defined in Subchapter 4, Appendix D, must provide financial assurance in an amount based on a decommissioning funding plan as described in 1.3.9(7)(e) of this section. The decommissioning funding plan must include the cost of disposal of the maximum amount (curies) of radioactive material permitted by license, and the cost of disposal of the maximum quantity, by volume, of radioactive material which could be present at the licensee's facility at any time, in addition to the cost to remediate the licensee's site to meet the license termination criteria of Subchapter 4. The decommissioning funding plan must be submitted by July 1, 2009.

d. Table of required amounts of financial assurance for decommissioning by quantity of material. Licensees required to submit the $1,125,000 amount must do so by July 1, 2009. Licensees required to submit the $113,000 or $225,000 amount must do so by September 1, 2009. Licensees having possession limits exceeding the upper bounds of this table must base financial assurance on a decommissioning funding plan.

greater than 10^4 but less than or equal to 10^5 times the applicable quantities of Appendix F to Subchapter 4 of these regulations in unsealed form. (For a combination of radionuclides, if R, as defined in 1.3.9(7)(a), divided by 10^4 is greater than 1 but R divided by 10^5 is less than or equal to 1).....$1,125,000

greater than 10^3 but less than or equal to 10^4 times the applicable quantities of Appendix F to Subchapter 4 of these regulations in unsealed form. (For a combination of radionuclides, if R, as defined in 1.3.9(7)(a),

divided by 10^3 is greater than 1 but R divided by 10^4 is less than or equal to 1).....$225,000

greater than 10^{10} but less than or equal to 10^{12} times the applicable quantities of Appendix F to Subchapter 4 of these regulations in sealed sources or plated foils. (For a combination of radionuclides, if R, as defined in 1.3.9(7)(a), divided by 10^{10} is greater than 1 but R divided by 10^{12} is less than or equal to 1).....$113,000

e. Each decommissioning funding plan must contain a cost estimate for decommissioning and a description of the method of assuring funds for decommissioning from 1.3.9(7)(f), including means of adjusting cost estimates and associated funding levels periodically over the life of the facility. Cost estimates must be adjusted at intervals not to exceed 3 years. The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning and a signed original of the financial instrument obtained to satisfy the requirements of 1.3.9(7)(f).

f. Financial assurance for decommissioning must be provided by one or more of the following methods:

i. **Prepayment**. Prepayment is the deposit prior to the start of operation into an account segregated from licensee assets and outside the licensee's administrative control of cash or liquid assets such that the amount of funds would be sufficient to pay decommissioning costs. Prepayment may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.

ii. **A surety method, insurance, or other guarantee method**. These methods guarantee that decommissioning costs will be paid should the licensee default. A surety method may be in the form of a surety bond, letter of credit, or line of credit. A parent company guarantee of funds for decommissioning costs based on a financial test may be used if the guarantee and test are as contained in Appendix D of this section. A parent company guarantee may not be used in combination with other financial methods to satisfy the requirements of this section. For commercial corporations that issue bonds, a guarantee of funds by the applicant or licensee for decommissioning costs based on a financial test may be used if the guarantee and test are as contained in Appendix E of this section. For commercial companies that do not issue bonds, a guarantee of funds by the applicant or licensee for decommissioning costs may be used if the guarantee and test are as contained in Appendix F to this section. A guarantee by the applicant or licensee may not be

used in combination with any other financial methods to satisfy the requirements of this section or in any situation where the applicant or licensee has a parent company holding majority control of the voting stock of the company. Any surety method or insurance used to provide financial assurance for decommissioning must contain the following conditions:

i. The surety method or insurance must be open-ended or, if written for a specified term, such as five years, must be renewed automatically unless 90 days or more prior to the renewal date, the issuer notifies the Agency, the beneficiary, and the licensee of its intention not to renew. The surety method or insurance must also provide that the full face amount be paid to the beneficiary automatically prior to the expiration without proof of forfeiture if the licensee fails to provide a replacement acceptable to the Agency within 30 days after receipt of notification of cancellation.

ii. The surety method or insurance must be payable to a trust established for decommissioning costs. The trustee and trust must be acceptable to the Agency. An acceptable trustee includes an appropriate State or Federal government agency or an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency.

iii. The surety method or insurance must remain in effect until the Agency has terminated the license.

iii. An external sinking fund in which deposits are made at least annually, coupled with a surety method or insurance, the value of which may decrease by the amount being accumulated in the sinking fund. An external sinking fund is a fund established and maintained by setting aside funds periodically in an account segregated from licensee assets and outside the licensee's administrative control in which the total amount of funds would be sufficient to pay decommissioning costs at the time termination of operation is expected. An external sinking fund may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities. The surety or insurance provisions must be as stated in 1.3.9(7)(f)(ii).

iv. In the case of Federal, State or local government licensees, a statement of intent containing a cost estimate for decommissioning or an amount based on the Table in 1.3.9(7)(d) and indicating that funds for decommissioning will be obtained when necessary.

g. Each person licensed under this section and Subchapters 5, 7, 11, 12, and 14 of these regulations shall keep records of information important to the safe and effective decommissioning of the facility in an identified location until the site is released for unrestricted use. Before licensed activities are transferred or assigned in accordance with 1.3.15(2), licensees shall transfer all records described in this paragraph to the new licensee. In this case, the new licensee will be responsible for maintaining these records until the license is terminated. If records of relevant information are kept for other purposes, reference to these records and their locations may be used. Information the Agency considers important to decommissioning consists of:

i. Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. These records may be limited to instances when contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records must include any known information on identification of involved nuclides, quantities, forms and concentrations.

ii. As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used and/or stored, and of locations of possible inaccessible contamination such as buried pipes which may be subject to contamination. If required drawings are referenced, each relevant document need not be indexed individually. If drawings are not available, the licensee shall substitute appropriate records of available information concerning these areas and locations.

iii. Except for areas containing only sealed sources (provided the sources have not leaked or no contamination remains after any leak) or radioactive materials having only half-lives of less than 65 days, a list contained in a single document and updated every 2 years, of the following:

i. All areas designated and formerly designated restricted areas as defined in 1.1.2 of these regulations.

ii. All areas outside of restricted areas that require documentation under 1.3.9(g)(i).

iii. All areas outside of restricted areas where current and previous wastes have been buried as documented under 1.4.51 of these regulations.

iv. All areas outside of restricted areas which contain material such that, if the license expired, the licensee would be required to either decontaminate the area to unrestricted release levels or apply for approval for disposal under 1.4.36 of these regulations.

iv. Records of the cost estimate performed for the decommissioning funding plan or of the amount certified for decommissioning, and records of the funding method used for assuring funds if either a funding plan or certification is used.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.10 **Reserved**

Rule 1.3.11 **Special Requirements for Specific Licenses of Broad Scope**. This section prescribes requirements for the issuance of specific licenses of broad scope for radioactive material and certain regulations governing holders of such licenses.[14]

1. **Reserved.**

2. An application for a specific license of broad scope will be approved if:

a. the applicant satisfies the general requirements specified in 1.3.9;

b. the applicant has engaged in a reasonable number of activities involving the use of radioactive material; and

c. the applicant has established administrative controls and provisions relating to organization and management, procedures, record keeping, material control and accounting, and management review that are necessary to assure safe operations, including:

i. the establishment of a radiation safety committee composed of such persons as a radiation safety officer, a representative of management, and persons trained and experienced in the safe use of radioactive material;

ii. the appointment of a radiation safety officer who is qualified by training and experience in radiation protection, and who is available for advice and assistance on radiation safety matters; and

[14] Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing byproduct material whose subsequent possession, use, transfer, and disposal by all other persons are exempted from regulatory requirements may be obtained only from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

iii. the establishment of appropriate administrative procedures to assure:

i. control of procurement and use of radioactive material;

ii. completion of safety evaluations of proposed uses of radioactive material which take into consideration such matters as the adequacy of facilities and equipment, training and experience of the user, and the operating or handling procedures; and

iii. review, approval, and recording by the radiation safety committee of safety evaluations of proposed uses prepared in accordance with 1.3.11(2)(c)(iii)(ii) prior to use of the radioactive material.

3. **Reserved**.

4. **Reserved**.

5. Specific licenses of broad scope are subject to the following conditions:

a. Unless specifically authorized, persons licensed pursuant to 1.3.11 shall not:

i. conduct tracer studies in the environment involving direct release of radioactive material;

ii. receive, acquire, own, possess, use, or transfer devices containing 100,000 curies (3.7 PBq) or more of radioactive material in sealed sources used for irradiation of materials;

iii. conduct activities for which a specific license issued by the Agency under 1.3.12, Subchapters 5, 7, 11, 12 or 14 is required; or

iv. add or cause the addition of radioactive material to any food, beverage, cosmetic, drug, or other product designed for ingestion or inhalation by, or application to, a human being.

b. Each specific license of broad scope issued under this section shall be subject to the condition that radioactive material possessed under the license may only be used by, or under the direct supervision of, individuals approved by the licensee's radiation safety committee.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.12 **Special Requirements for a Specific License to Manufacture, Assemble, Repair, or Distribute Commodities, Products or Devices which Contain Radioactive Material.**

1. **Licensing Introduction of Radioactive Material into Products in Exempt Concentrations.**

a. In addition to the requirements set forth in 1.3.9, a specific license authorizing the introduction of radioactive material into a product or material owned by or in the possession of the licensee or another to be transferred to persons exempt under 1.3.3(1)(a) will be issued if:

i. the applicant submits a description of the product or material into which the radioactive material will be introduced, intended use of the radioactive material and the product or material into which it is introduced, method of introduction, initial concentration of the radioactive material in the product or material, control methods to assure that no more than the specified concentration is introduced into the product or material, estimated time interval between introduction and transfer of the product or material, and estimated concentration of the radioactive material in the product or material at the time of transfer; and

ii. the applicant provides reasonable assurance that the concentrations of radioactive material at the time of transfer will not exceed the concentrations in Appendix A of Subchapter 3, that reconcentration of the radioactive material in concentrations exceeding those in Appendix A is not likely, that use of lower concentrations is not feasible, and that the product or material is not likely to be incorporated in any food, beverage, cosmetic, drug or other commodity or product designed for ingestion or inhalation by, or application to, a human being.

b. Each person licensed under 1.3.12(1) shall file an annual report with the Agency which shall identify:

i. The type and quantity of each product or material into which radioactive material has been introduced during the reporting period;

ii. Name and address of the person who owned or possessed the product or material, into which radioactive material has been introduced, at the time of introduction;

iii. The type and quantity of radionuclide introduced into each such product or material; and

iv. The initial concentrations of the radionuclide in the product or material at time of transfer of the radioactive material by the licensee.

c. If no transfers of radioactive material have been made pursuant to 1.3.12(1) during the reporting period, the report shall so indicate. The report shall cover the year ending December 31, and shall be filed within 30 days thereafter.

2. **Licensing the Distribution of Radioactive Material in Exempt Quantities**.[15]

a. An application for a specific license to distribute NARM to persons exempted from these regulations pursuant to 1.3.3(2) will be approved if:

i. the radioactive material is not contained in any food, beverage, cosmetic, drug, or other commodity designed for ingestion or inhalation by, or application to, a human being;

ii. the radioactive material is in the form of processed chemical elements, compounds, or mixtures, tissue samples, bioassay samples, counting standards, plated or encapsulated sources, or similar substances identified as radioactive and to be used for its radioactive properties, but is not incorporated into any manufactured or assembled commodity, product, or device intended for commercial distribution; and

iii. the applicant submits copies of prototype labels and brochures and the Agency approves such labels and brochures.

b. The license issued under 1.3.12(2)(a) is subject to the following conditions:

i. No more than 10 exempt quantities shall be sold or transferred in any single transaction. However, an exempt quantity may be composed of fractional parts of one or more of the exempt quantity provided the sum of the fractions shall not exceed unity.

ii. Each exempt quantity shall be separately and individually packaged. No more than 10 such packaged exempt quantities shall

[15] Authority to transfer possession or control by the manufacturer, processor, or producer any equipment, device, commodity, or other product containing byproduct material whose subsequent possession, use, transfer, and disposal by all other persons are exempted from regulatory requirements may be obtained only from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

be contained in any outer package for transfer to persons exempt pursuant to 1.3.3(2). The outer package shall be such that the dose rate at the external surface of the package does not exceed 0.5 millirem (5 μSv) per hour.

iii. The immediate container of each quantity or separately packaged fractional quantity of radioactive material shall bear a durable, legible label which:

i. identifies the radionuclide and the quantity of radioactivity, and

ii. bears the words "Radioactive Material".

iv. In addition to the labeling information required by 1.3.12(2)(b)(iii), the label affixed to the immediate container, or an accompanying brochure, shall:

i. state that the contents are exempt from Licensing State requirements,

ii. bear the words "Radioactive Material--Not for Human Use-Introduction into Foods, Beverages, Cosmetics, Drugs, or Medicinals, or into Products Manufactured for Commercial Distribution is Prohibited--Exempt Quantities Should Not Be Combined", and

iii. set forth appropriate additional radiation safety precautions and instructions relating to the handling, use, storage, and disposal of the radioactive material.

c. Each person licensed under 1.3.12(2) shall maintain records identifying, by name and address, each person to whom radioactive material is transferred for use under 1.3.3(2) or the equivalent regulations of a Licensing State, and stating the kinds and quantities of radioactive material transferred. An annual summary report stating the total quantity of each radionuclide transferred under the specific license shall be filed with the Agency. Each report shall cover the year ending December 31, and shall be filed within 30 days thereafter. If no transfers of radioactive material have been made pursuant to 1.3.12(2) during the reporting period, the report shall so indicate.

3. **Licensing the Incorporation of Naturally Occurring and Accelerator Produced Radioactive Material into Gas and Aerosol Detectors.** An application for a specific license authorizing the incorporation of NARM into gas and aerosol detectors to be distributed to persons exempt under 1.3.3(3)(c) will be approved if the application satisfies requirements equivalent to those contained in

10 CFR 32.26. The maximum quantity of radium-226 in each device shall not exceed 3.7 kBq (0.1 microcurie).

4. **Licensing the Manufacture or Initial Transfer of Devices to Persons Generally Licensed Under 1.3.6(4).**

a. An application for a specific license to manufacture or initially transfer devices containing radioactive material, excluding special nuclear material, to persons generally licensed under 1.3.6(4) or equivalent regulations of the Nuclear Regulatory Commission, an Agreement State, or a Licensing State will be approved if:

i. The applicant satisfies the general requirements of 1.3.9;

ii. The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control, labels, proposed uses, installation, servicing, leak testing, operating and safety instructions, and potential hazards of the device to provide reasonable assurance that:

i. the device can be safely operated by persons not having training in radiological protection,

ii. under ordinary conditions of handling, storage, and use of the device, the radioactive material contained in the device will not be released or inadvertently removed from the device, and it is unlikely that any person will receive, in 1 year, a dose in excess of 10 percent of the annual limits specified in the table in 1.4.6(1) of these regulations, and

iii. under accident conditions such as fire and explosion associated with handling, storage, and use of the device, it is unlikely that any person would receive an external radiation dose or dose commitment in excess of the following organ doses:

Whole body; head and trunk; active blood-forming organs; gonads; or lens of eye.....150 mSv (15 rems)

Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter.....2 Sv (200 rems)

Other organs .....500 mSv (50 rems); and

iii. Each device bears a durable, legible, clearly visible label or labels approved by the Agency, which contain in a clearly identified and separate statement:

i. instructions and precautions necessary to assure safe installation, operation, and servicing of the device; documents such as operating and service manuals may be identified in the label and used to provide this information,

ii. the requirement, or lack of requirement, for leak testing, or for testing any "on-off" mechanism and indicator, including the maximum time interval for such testing, and the identification of radioactive material by isotope, quantity of radioactivity, and date of determination of the quantity, and

iii. the information called for in one of the following statements, as appropriate, in the same or substantially similar form:

> The receipt, possession, use, and transfer of this device, Model _____, Serial No._____[16], are subject to a general license or the equivalent and the regulations of the Nuclear Regulatory Commission or a State with which the Nuclear Regulatory Commission has entered into an agreement for the exercise of regulatory authority. This label shall be maintained on the device in a legible condition. Removal of this label is prohibited.
>
> CAUTION - RADIOACTIVE MATERIAL
>
> _____
>
> Name of manufacturer or initial transferor

[16] The model, serial number, and name of the manufacturer or initial transferor may be omitted from this label provided the information is elsewhere specified in labeling affixed to the device.

The receipt, possession, use, and transfer of this device, Model _____, Serial No. _____[17], are subject to a general license or the equivalent, and the regulations of a Licensing State. This label shall be maintained on the device in a legible condition. Removal of this label is prohibited.

CAUTION - RADIOACTIVE MATERIAL

_____

Name of manufacturer or initial transferor

iv. Each device having a separable source housing that provides the primary shielding for the source also bears, on the source housing, a durable label containing the device model number and serial number, the radionuclide and quantity, the words, "Caution-Radioactive Material," the radiation symbol described in 1.4.29 of these regulations, and the name of the manufacturer or initial distributor.

v. Each device meeting the criteria of 1.3.6(4)(c)(xiii)(i), bears a permanent, embossed, etched, stamped or engraved label affixed to the source housing if separable, or the device if the source housing is not separable, that includes the words, "Caution-Radioactive Material," and, if practicable, the radiation symbol described in 1.4.29 of these regulations.

b. In the event the applicant desires that the device be required to be tested at intervals longer than 6 months, either for proper operation of the "on-off" mechanism and indicator, if any, or for leakage of radioactive material or for both, the applicant shall include in the application sufficient information to demonstrate that such longer interval is justified by performance characteristics of the device or similar devices and by design features which have a significant bearing on the probability or consequences of leakage of radioactive material from the device or failure of the "on-off" mechanism and indicator. In determining the acceptable interval for the test for leakage of radioactive material, the Agency will consider information which includes, but is not limited to:

i. primary containment or source capsule;

[17] The model, serial number, and name of the manufacturer or initial transferor may be omitted from this label provided the information is elsewhere specified in labeling affixed to the device.

ii. protection of primary containment;

iii. method of sealing containment;

iv. containment construction materials;

v. form of contained radioactive material;

vi. maximum temperature withstood during prototype tests;

vii. maximum pressure withstood during prototype test;

viii. maximum quantity of contained radioactive material;

ix. radiotoxicity of contained radioactive material; and

x. operating experience with identical devices or similarly designed and constructed devices.

c. In the event the applicant desires that the general licensee under 1.3.6(4), or under equivalent regulations of the Nuclear Regulatory Commission, and Agreement State, or a Licensing State be authorized to install the device, collect the sample to be analyzed by a specific licensee for leakage of radioactive material, service the device, test the "on-off" mechanism and indicator, or remove the device from installation, the applicant shall include in the application written instructions to be followed by the general licensee, estimated calendar quarter doses associated with such activity or activities, and bases for such estimates. The submitted information shall demonstrate the performance of such activity or activities by an individual untrained in radiological protection, in addition to other handling, storage, and use of devices under the general license, is unlikely to cause that individual to receive a dose in excess of 10 percent of the annual limits specified in the table in 1.4.6(1) of these regulations.

d. **Conditions of Transferring a Device for Use Under a General License in 1.3.6(4).**

i. If a device containing radioactive material is to be transferred for use under the general license in 1.3.6(4), each person that is licensed under 1.3.12(4). shall provide the information specified in this paragraph to each person to whom a device is to be transferred. This information shall be provided before the device may be transferred. In the case of a transfer through an intermediate person, the information shall also be provided to the intended user prior to initial transfer to the intermediate person. The required information includes:

i. A copy of the general license contained in 1.3.6(4); if sections 1.3.6(4)(c)(ii) through (iv) or 1.3.6(4)(c)(xiii) do not apply to the particular device, those sections may be omitted.

ii. A copy of 1.1.4, 1.4.54 and 1.4.55 of these regulations;

iii. A list of the services that can only be performed by a specific licensee; and

iv. Information on acceptable disposal options including estimated costs of disposal.

ii. If radioactive material is to be transferred in a device for use under an equivalent general license of the Nuclear Regulatory Commission or an Agreement State, each person that is licensed under 1.3.12(4) shall provide the information specified in this section to each person to whom a device is to be transferred. This information shall be provided before the device may be transferred. In the case of a transfer through an intermediate person, the information shall also be provided to the intended user prior to initial transfer to the intermediate person. The required information includes:

i. A copy of 1.3.6(1), 1.3.6(4), 1.3.20, 1.4.54, and 1.4.55 of these regulations, or a copy of equivalent Nuclear Regulatory Commission or Agreement State's regulations. If a copy of the Nuclear Regulatory Commission's regulations is provided to a prospective general licensee in lieu of the Agreement State's regulations, it shall be accompanied by a note explaining that use of the device is regulated by the Agreement State; if certain parts of the regulations do not apply to the particular device, those parts may be omitted.

ii. A list of the services that can only be performed by a specific licensee;

iii. Information on acceptable disposal options including estimated costs of disposal; and

iv. The name or title, address, and telephone number of the contact at the Agency, Nuclear Regulatory Commission or Agreement State from which additional information may be obtained.

iii. An alternative approach to informing customers may be proposed by the licensee for approval by the Agency.

iv. Each device that is transferred shall meet the labeling requirements in 1.3.12(4)(a)(iii) through 1.3.12(4)(a)(v).

v. If a notification of bankruptcy has been made under 1.3.15(5) or the license is to be terminated, each person licensed under 1.3.12(4) shall provide, upon request, to the Agency, the Nuclear Regulatory Commission, and to any appropriate Agreement State, records of final disposition required under 1.3.12(4)(e)(iii).

e. **Material Transfer Reports and Records**. Each person licensed under 1.3.12(4) to initially transfer devices to generally licensed persons shall comply with the following requirements:

i. The person shall report to the Agency all transfers of devices to persons for use under the general license in 1.3.6(4) and all receipts of devices from persons licensed under 1.3.6(4). The report shall be submitted on a quarterly basis on the NRC Form 653 "Transfers of Industrial Devices Report" or in a clear and legible report containing all of the data required by the form.

i. The required information for transfers to general licensees includes:

i. The identity of each general licensee by name and mailing address for the location of use; if there is no mailing address for the location of use, an alternate address for the general licensee shall be submitted along with information on the actual location of use.

ii. The name, title, and telephone number of the person identified by the general licensee as having knowledge of and authority to take required actions to ensure compliance with the appropriate regulations and requirements;

iii. The date of transfer;

iv. The type, model number, and serial number of the device transferred; and

v. The quantity and type of radioactive material contained in the device.

ii. If one or more intermediate persons will temporarily possess the device at the intended place of use before its possession by the user, the report shall include the same information for both the intended user and each intermediate person, and clearly designate the intermediate person(s).

iii. For devices received from a general licensee, the report shall include the identity of the general licensee by name and address, the type, model number, and serial number of the device received, the date of receipt, and, in the case of devices not initially transferred by the reporting licensee, the name of the manufacturer or initial transferor.

iv. If the licensee makes changes to a device possessed by a general licensee, such that the label shall be changed to update required information, the report shall identify the general licensee, the device, and the changes to information on the device label.

v. The report shall cover each calendar quarter, shall be filed within 30 days of the end of the calendar quarter, and shall clearly indicate the period covered by the report.

vi. The report shall clearly identify the specific licensee submitting the report and include the license number of the specific licensee.

vii. If no transfers have been made to or from persons generally licensed under 1.3.6(4) during the reporting period, the report shall so indicate.

ii. The person shall report all transfers of devices to persons for use under a general license in an Nuclear Regulatory Commission’s or Agreement State's regulations that are equivalent to 1.3.6(4) and all receipts of devices from general licensees in the Nuclear Regulatory Commission’s or Agreement State's jurisdiction to the Nuclear Regulatory Commission or responsible Agreement State agency. The report shall be submitted on NRC Form 653--``Transfers of Industrial Devices Report" 10 CFR 32.52(a) or in a clear and legible report containing all of the data required by the form.

i. The required information for transfers to general licensees includes:

i. The identity of each general licensee by name and mailing address for the location of use; if there is no mailing address for the location of use, an alternate address for the general licensee shall be submitted along with information on the actual location of use.

ii. The name, title, and telephone number of the person identified by the general licensee as having knowledge of and authority to take required actions to ensure compliance with the appropriate regulations and requirements;

iii. The date of transfer;

iv. The type, model number, and serial number of the device transferred; and

v. The quantity and type of radioactive material contained in the device.

ii. If one or more intermediate persons will temporarily possess the device at the intended place of use before its possession by the user, the report shall include the same information for both the intended user and each intermediate person, and clearly designate the intermediate person(s).

iii. For devices received from a general licensee, the report shall include the identity of the general licensee by name and address, the type, model number, and serial number of the device received, the date of receipt, and, in the case of devices not initially transferred by the reporting licensee, the name of the manufacturer or initial transferor.

iv. If the licensee makes changes to a device possessed by a general licensee, such that the label shall be changed to update required information, the report shall identify the general licensee, the device, and the changes to information on the device label.

v. The report shall cover each calendar quarter, shall be filed within 30 days of the end of the calendar quarter, and shall clearly indicate the period covered by the report.

vi. The report shall clearly identify the specific licensee submitting the report and shall include the license number of the specific licensee.

vii. If no transfers have been made to or from the Nuclear Regulatory Commission or a particular Agreement State during the reporting period, this information shall be reported to the Nuclear Regulatory Commission or responsible Agreement State agency upon request of the agency.

iii. The person shall maintain all information concerning transfers and receipts of devices that supports the reports required by this section. Records required by 1.3.6(4)(e) shall be maintained for a period of 3 years following the date of the recorded event.

5. **Special Requirements for the Manufacture, Assembly, or Repair of Luminous Safety Devices for Use in Aircraft**. An application for a specific license to manufacture, assemble, or repair luminous safety devices containing tritium or promethium-147 for use in aircraft, for distribution to persons generally licensed under 1.3.6(5) will be approved if:

a. the applicant satisfies the general requirements specified in 1.3.9; and

b. the applicant satisfies the requirements of Sections 32.53, 32.54, 32.55, 32.56, and 32.101 of 10 CFR Part 32, or their equivalent.

6. **Special Requirements for License to Manufacture or Initially Transfer Calibration Sources Containing Americium-241, Plutonium or Radium-226 for Distribution to Persons Generally Licensed Under 1.3.6(7)**. An application for a specific license to manufacture or initially transfer calibration and reference sources containing americium-241, plutonium or radium-226 to persons generally licensed under 1.3.6(7) will be approved if:

a. the applicant satisfies the general requirement of 1.3.9; and

b. the applicant satisfies the requirements of Sections 32.57, 32.58, 32.59, and 32.102 of 10 CFR Part 32 and Section 70.39 of 10 CFR Part 70 or their equivalent.

7. **Reserved**.

8. **Manufacture and Distribution of Radioactive Material for Certain *In Vitro* Clinical or Laboratory Testing Under General License**. An application for a specific license to manufacture or distribute radioactive material for use under the general license of 1.3.6(9) will be approved if:

a. the applicant satisfies the general requirements specified in 1.3.9.

b. the radioactive material is to be prepared for distribution in prepackaged units of:

i. carbon-14 in units not exceeding 370 kBq (10 microcuries) each.

ii. cobalt-57 in units not exceeding 370 kBq (10 microcuries) each.

iii. hydrogen-3 (tritium) in units not exceeding 1.85 MBq (50 microcuries) each.

iv. iodine-125 in units not exceeding 370 kBq (10 microcuries) each.

v. Mock Iodine-125 in units not exceeding 1.85 kBq (0.05 microcurie) of iodine-129 and 1.85 kBq (0.05 microcurie) of americium-241 each.

vi. iodine-131 in units not exceeding 370 kBq (10 microcuries) each.

vii. iron-59 in units not exceeding 740 kBq (20 microcuries) each.

viii. selenium-75 in units not exceeding 370 kBq (10 microcuries) each.

c. each prepackaged unit bears a durable, clearly visible label:

i. identifying the radioactive contents as to chemical form and radionuclide, and indicating that the amount of radioactivity does not exceed 370 kBq (10 microcuries) of iodine-125, iodine-131, carbon-14, cobalt-57, or selenium-75; 1.85 MBq (50 microcuries) of hydrogen-3 (tritium); 740 kBq (20 microcuries) of iron-59; or Mock Iodine-125 in units not exceeding 1.85 kBq (0.05 microcurie) of iodine-129 and .185 kBq (0.005 microcurie) of americium-241 each; and

ii. displaying the radiation caution symbol described in 1.4.29(1) and the words, "CAUTION, RADIOACTIVE MATERIAL" and "Not for Internal or External Use in Humans or Animals".

d. one of the following statements, as appropriate, or a substantially similar statement which contains the information called for in one of the following statements, appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package:

This radioactive material may be received, acquired, possessed, and used only by physicians, veterinarians, clinical laboratories or hospitals and only for *in vitro* clinical or laboratory tests not involving internal or external administration of the material, or the radiation therefrom, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the Nuclear Regulatory Commission or of a State with which the Commission has entered into an agreement for the exercise of regulatory authority.

_____

Name of manufacturer

or

This radioactive material may be received, acquired, possessed, and used only by physicians, veterinarians, clinical laboratories or hospitals and only for *in vitro* clinical or laboratory tests not involving internal or external administration of the material, or the radiation there from, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of a Licensing State.

_____

Name of manufacturer

e. the label affixed to the unit, or the leaflet or brochure which accompanies the package, contains adequate information as to the precautions to be observed in handling and storing such radioactive material. In the case of the Mock Iodine-125 reference or calibration source, the information accompanying the source must also contain directions to the licensee regarding the waste disposal requirements set out in 1.4.35 of these regulations.

9. **Licensing the Manufacture and Distribution of Ice Detection Devices Containing Strontium-90.** An application for a specific license to manufacture and initially transfer ice detection devises to persons generally licenses under 1.3.6(10) will be approved if:

a. the applicant satisfies the general requirements of 1.3.9; and

b. the criteria of Sections 32.61, 32.62, and 32.103 of 10 CFR Part 32 are met.

10. **Manufacture, Preparation, or Transfer for Commercial Distribution of Radioactive Drugs Containing Radioactive Material for Medical Use Pursuant to Subchapter 7 of These Regulations.**

a. An application for a specific license to manufacture, prepare, or transfer for commercial distribution radioactive drugs containing radioactive material for use by persons authorized pursuant to Subchapter 7 of these regulations will be approved if:

i. the applicant satisfies the general requirements specified in 1.3.9 of this section;

ii. the applicant submits evidence that the applicant is at least one of the following:

i. Registered with the U. S. Food and Drug Administration (FDA) as the owner or operator of a drug establishment that engages in the manufacture, preparation, propagation, compounding, or processing of a drug under 21 CFR 207.20(a);

ii. Registered or licensed with a state agency as a drug manufacturer; or

iii. Licensed as a pharmacy by a State Board of Pharmacy; or

iv. Operating as a nuclear pharmacy within a Federal medical institution; or

v. A Positron Emission Tomography (PET) drug production facility registered with a State agency.

iii. the applicant submits information on the radionuclide, chemical and physical form; the maximum activity per vial, syringe, generator, or other container of the radioactive drug; and the shielding provided by the packaging to show it is appropriate for safe handling and storage of the radioactive drugs by medical use licensees; and

iv. the applicant satisfies the following labeling requirements:

i. a label is affixed to each transport radiation shield, whether it is constructed of lead, glass, plastic, or other material, of a radioactive drug to be transferred for commercial distribution. The label must include the radiation symbol and the words ***"CAUTION, RADIOACTIVE MATERIAL"*** or ***"DANGER, RADIOACTIVE MATERIAL"***; the name of the radioactive drug or its abbreviation; and the quantity of radioactivity at a specified date and time. For radioactive drugs with a half life greater than 100 days, the time may be omitted.

ii. a label is affixed to each syringe, vial, or other container used to hold a radioactive drug to be transferred for commercial distribution. The label must include the radiation symbol and the words ***"CAUTION, RADIOACTIVE MATERIAL"*** or ***"DANGER, RADIOACTIVE MATERIAL"*** and an identifier that ensures that the syringe, vial, or other container can be correlated with the information on the transport radiation shield label.

b. A licensee described by 1.3.12(10)(a)(ii)(iii) or (iv) of this section:

i. may prepare radioactive drugs for medical use, as defined in 1.7.2 of these regulations provided that the radioactive drug is prepared by either an authorized nuclear pharmacist, as specified in 1.3.12(10)(b)(ii) or 1.3.12(10)(b)(iv) of this section, or an individual under the supervision of an authorized nuclear pharmacist as specified in 1.7.15 of these regulations.

ii. may allow a pharmacist to work as an authorized nuclear pharmacist if:

i. this individual qualifies as an authorized nuclear pharmacist as defined in 1.7.2 ; or

ii. this individual meets the requirements specified in 1.7.21(2) and 1.7.23 of these regulations and the licensee has received an approved license amendment identifying this individual as an authorized nuclear pharmacist; or

iii. this individual is designated as an authorized nuclear pharmacist in accordance with 1.3.12(10)(b)(iv).

iii. The actions authorized in 1.3.12(10)(b)(i) and 1.3.12(10)(b)(ii) are permitted in spite of more restrictive language in license conditions.

iv. May designate a pharmacist (as defined in 1.7.2) as an authorized nuclear pharmacist if:

i. the individual was a nuclear pharmacist preparing only radioactive drugs containing accelerator-produced radioactive material, and

ii. the individual practiced at a pharmacy at a Government agency or Federally recognized Indian Tribe before November 30, 2007 or at all other pharmacies before

August 8, 2009, or an earlier date as noticed by the Nuclear Regulatory Commission.

v. Shall provide to the Agency:

i. a copy of each individual's certification by a specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State as specified in 1.7.21(1) of these regulations with the written attestation signed by a preceptor as required by 1.7.21(2)(b); or

ii. the Agency, Nuclear Regulatory Commission or Agreement State license; or

iii. Nuclear Regulatory Commission master materials licensee permit; or

iv. the permit issued by a licensee or Nuclear Regulatory Commission master materials permittee of broad scope; or the authorization from a commercial nuclear pharmacy authorized to list its own authorized nuclear pharmacist; or

v. documentation that only accelerator-produced radioactive materials were used in the practice of nuclear pharmacy at a Government agency or Federally recognized Indian Tribe before November 30, 2007 or at all other locations of use before August 8, 2009, or an earlier date as noticed by the Nuclear Regulatory Commission Nuclear Regulatory Commission; and

vi. a copy of the State pharmacy licensure or registration, no later than 30 days after the date that the licensee allows, under 1.3.12(10)(b)(ii)(i) and (b)(ii)(iii) of this section, the individual to work as an authorized nuclear pharmacist.

c. A licensee shall possess and use instrumentation to measure the radioactivity of radioactive drugs. The licensee shall have procedures for use of the instrumentation. The licensee shall measure, by direct measurement or by combination of measurements and calculations, the amount of radioactivity in dosages of alpha-, beta-, or photon-emitting radioactive drugs prior to transfer for commercial distribution. In addition, the licensee shall:

i. Perform tests before initial use periodically, and following repair, on each instrument for accuracy, linearity, and geometry

dependence, as appropriate for the use of the instrument; and make adjustments when necessary; and

ii. Check each instrument for constancy and proper operation at the beginning of each day of use.

d. Nothing in this section relieves the licensee from complying with applicable FDA, other Federal, and State requirements governing radioactive drugs.

11. **Reserved**

12. **Manufacture and Distribution of Sources or Devices Containing Radioactive Material for Medical Use**. An application for a specific license to manufacture and distribute sources and devices containing radioactive material to persons licensed pursuant to Subchapter 7 for use as a calibration, transmission, or reference source or for the uses listed in 1.7.52, 1.7.62, 1.7.64, and 1.7.82 of these regulations will be approved if:

a. the applicant satisfies the general requirements in 1.3.9 of this section;

b. the applicant submits sufficient information regarding each type of source or device pertinent to an evaluation of its radiation safety, including:

i. the radioactive material contained, its chemical and physical form, and amount,

ii. details of design and construction of the source or device,

iii. procedures for, and results of, prototype tests to demonstrate that the source or device will maintain its integrity under stresses likely to be encountered in normal use and accidents,

iv. for devices containing radioactive material, the radiation profile of a prototype device,

v. details of quality control procedures to assure that production sources and devices meet the standards of the design and prototype tests,

vi. procedures and standards for calibrating sources and devices,

vii. legend and methods for labeling sources and devices as to their radioactive content, and

viii. instructions for handling and storing the source or device from the radiation safety standpoint; these instructions are to be included on a durable label attached to the source or device or attached to a

permanent storage container for the source or device; provided, that instructions which are too lengthy for such label may be summarized on the label and printed in detail on a brochure which is referenced on the label;

c. the label affixed to the source or device, or to the permanent storage container for the source or device, contains information on the radionuclide, quantity, and date of assay, and a statement that the named source or device is approved by the Agency for distribution to persons licensed to use radioactive material identified in 1.7.28, 1.7.52, 1.7.62, and 1.7.64 of these regulations, as appropriate, or under equivalent licenses of the Nuclear Regulatory Commission, an Agreement State, or a Licensing State;

d. in the event the applicant desires that the source or device be required to be tested for leakage of radioactive material at intervals longer than 6 months, the applicant shall include in the application sufficient information to demonstrate that such longer interval is justified by performance characteristics of the source or device or similar sources or devices and by design features that have a significant bearing on the probability or consequences of leakage of radioactive material from the source; and

e. in determining the acceptable interval for test of leakage of radioactive material, the Agency will consider information that includes, but is not limited to:

i. primary containment or source capsule,

ii. protection of primary containment,

iii. method of sealing containment,

iv. containment construction materials,

v. form of contained radioactive material,

vi. maximum temperature withstood during prototype tests,

vii. maximum pressure withstood during prototype tests,

viii. maximum quantity of contained radioactive material,

ix. radiotoxicity of contained radioactive material, and

x. operating experience with identical sources or devices or similarly designed and constructed sources or devices.

13. **Requirements for License to Manufacture and Distribute Industrial Products Containing Depleted Uranium for Mass-Volume Applications**.

a. An application for a specific license to manufacture industrial products and devices containing depleted uranium for use pursuant to 1.3.5(4) or equivalent regulations of the Nuclear Regulatory Commission or an Agreement State will be approved if:

i. the applicant satisfies the general requirements specified in 1.3.9;

ii. the applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling or marking, proposed uses, and potential hazards of the industrial product or device to provide reasonable assurance that possession, use, or transfer of the depleted uranium in the product or device is not likely to cause any individual to receive, in 1 year, a radiation dose in excess of 10 percent of the annual limits specified in 1.4.6(1) of these regulations; and

iii. the applicant submits sufficient information regarding the industrial product or device and the presence of depleted uranium for a mass-volume application in the product or device to provide reasonable assurance that unique benefits will accrue to the public because of the usefulness of the product or device.

b. In the case of an industrial product or device whose unique benefits are questionable, the Agency will approve an application for a specific license under 1.3.12(13) only if the product or device is found to combine a high degree of utility and low probability of uncontrolled disposal and dispersal of significant quantities of depleted uranium into the environment.

c. The Agency may deny any application for a specific license under 1.3.12(13) if the end use(s) of the industrial product or device cannot be reasonably foreseen.

d. Each person licensed pursuant to 1.3.12(13)(a) shall:

i. maintain the level of quality control required by the license in the manufacture of the industrial product or device, and in the installation of the depleted uranium into the product or device;

ii. label or mark each unit to:

i. identify the manufacturer of the product or device and the number of the license under which the product or device was manufactured, the fact that the product or device

contains depleted uranium, and the quantity of depleted uranium in each product or device; and

ii. state that the receipt, possession, use, and transfer of the product or device are subject to a general license or the equivalent and the regulations of the U.S. Nuclear Regulatory Commission or an Agreement State;

iii. assure that the depleted uranium before being installed in each product or device has been impressed with the following legend clearly legible through any plating or other covering: "Depleted Uranium";

i. furnish a copy of the general license contained in 1.3.5(4) and a copy of the Agency Form, "Registration Certificate - Use of Depleted Uranium Under General License," to each person to whom the licensee transfers depleted uranium in a product or device for use pursuant to the general license contained in 1.3.5(4), or

ii. furnish a copy of the general license contained in the Nuclear Regulatory Commission's or Agreement State's regulation equivalent to 1.3.5(4) and a copy of the U.S. Nuclear Regulatory Commission's or Agreement State's certificate, or alternatively, furnish a copy of the general license contained in 1.3.5(4) and a copy of Agency Form, "Registration Certificate - Use of Depleted Uranium Under General License," to each person to whom the licensee transfers depleted uranium in a product or device for use pursuant to the general license of the U.S. Nuclear Regulatory Commission or an Agreement State, with a note explaining that use of the product or device is regulated by the U.S. Nuclear Regulatory Commission or an Agreement State under requirements substantially the same as those in 1.3.5(4);

iv. report to the Agency all transfers of industrial products or devices to persons for use under the general license in 1.3.5(4). Such report shall identify each general licensee by name and address, an individual by name and/or position who may constitute a point of contact between the Agency and the general licensee, the type and model number of device transferred, and the quantity of depleted uranium contained in the product or device. The report shall be submitted within 30 days after the end of each calendar quarter in which such a product or device is transferred to the generally licensed person. If no transfers have been made to persons

generally licensed under 1.3.5(4) during the reporting period, the report shall so indicate.

i. report to the Nuclear Regulatory Commission all transfers of industrial products or devices to persons for use under the general license in 1.3.5(5) of these regulations;

ii. report to the responsible State agency all transfers of devices manufactured and distributed pursuant to 1.3.12(13) for use under a general license in that State's regulations equivalent to 1.3.5(4);

iii. such report shall identify each general licensee by name and address, an individual by name and/or position who may constitute a point of contact between the agency and the general licensee, the type and model number of the device transferred, and the quantity of depleted uranium contained in the product or device. The report shall be submitted within 30 days after the end of each calendar quarter in which such product or device is transferred to the generally licensed person;

iv. if no transfers have been made to Nuclear Regulatory Commission licensees during the reporting period, this information shall be reported to the Nuclear Regulatory Commission, and

v. if no transfers have been made to general licensees within a particular Agreement State during the reporting period, this information shall be reported to the responsible Agreement State agency upon the request of that agency; and

v. keep records showing the name, address, and point of contact for each general licensee to whom the licensee transfers depleted uranium in industrial products or devices for use pursuant to the general license provided in 1.3.5(5) or equivalent regulations of the Nuclear Regulatory Commission or an Agreement State. The records shall be maintained for a period of 2 years and shall show the date of each transfer, the quantity of depleted uranium in each product or device transferred, and compliance with the report requirements of this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.13 **Reserved**

Rule 1.3.14 **Issuance of Specific Licenses**.

1. Upon a determination that an application meets the requirements of the Act and the regulations of the Agency, the Agency will issue a specific license authorizing the proposed activity in such form and containing such conditions and limitations as it deems appropriate or necessary.

2. The Agency may incorporate in any license at the time of issuance, or thereafter by appropriate rule, regulation, or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use, and transfer of radioactive material subject to this section as it deems appropriate or necessary in order to:

   a. minimize danger to public health and safety or property;

   b. require such reports and keeping of such records, and to provide for such inspections of activities under the license as may be appropriate or necessary; and

   c. prevent loss or theft of material subject to this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.15 **Specific Terms and Conditions of License**.

1. Each license issued pursuant to the regulations in this section and the regulations in Subchapters 5, 7, 11, 12, and 14 shall be subject to all the provisions of the Act, now or hereafter in effect, and to all rules, regulations, and orders of the Agency.

2. No license issued or granted pursuant to the regulations in this section and Subchapters 5, 7, 11, 12, and 14 nor any right to possess or utilize radioactive material granted by any license shall be transferred, assigned, or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person unless the Agency shall, after securing full information, find that the transfer is in accordance with the provisions of the Act, now or hereafter in effect, and to all valid rules, regulations, and orders of the Agency, and shall give its consent in writing.

3. Each person licensed by the Agency pursuant to the regulations in this section and Subchapters 5, 7, 11, 12, and 14 shall confine use and possession of the material licensed to the locations and purposes authorized in the license.

4. Each licensee shall notify the Agency in writing when the licensee decided to permanently discontinue all activities involving materials authorized under the license.

   a. Each licensee shall notify the Agency in writing immediately following the filing of a voluntary or involuntary petition for bankruptcy under any Chapter of Title 11 (Bankruptcy) of the United States Code by or against:

i. the licensee;

ii. an entity (as that term is defined in 11 U.S.C. 101(14)) controlling the licensee or listing the license or licensee as property of the estate; or

iii. an affiliate (as that term is defined in 11 U.S.C. 101(2)) of the licensee.

b. The notification shall indicate:

i. the bankruptcy court in which the petition for bankruptcy was filed; and

ii. the date of the filing of the petition.

5. Licensees required to submit emergency plans by 1.3.7(8) shall follow the emergency plan approved by the Agency. The licensee may change the approved emergency plan without Agency approval only if the changes do not decrease the effectiveness of the plan. The licensee shall furnish the change to the Agency and to affected offsite response organizations within six months after the change is made. Proposed changes that decrease, or potentially decrease, the effectiveness of the approved emergency plan may not be implemented without prior application to and prior approval by the Agency.

6. **Security Requirements for Portable Gauges**. Each portable gauge licensee shall use a minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal, whenever portable gauges are not under the control and constant surveillance of the licensee.

7. **Serialization of Nationally Tracked Sources**. Each licensee who manufactures a nationally tracked source after February 6, 2007 shall assign a unique serial number to each nationally tracked source. Serial numbers must be composed only of alpha-numeric characters

8. Each licensee preparing technetium-99m radiopharmaceuticals from molybdenum-99/technetium-99m generators or rubidium-82 from strontium-82/rubidium-82 generators shall test the generator eluates for molybdenum-99 breakthrough or strontium-82 and strontium-85 contamination, respectively, in accordance with 1.7.41 of these regulations. The licensee shall record the results of each test and retain each record for 3 years after the record is made.

9. **Positron Emission Tomography (PET)**.

a. Authorization under 1.3.8(9) to produce Positron Emission Tomography (PET) radioactive drugs for noncommercial transfer to medical use licensees in its consortium does not relieve the licensee from complying

with applicable FDA, other Federal, and State requirements governing radioactive drugs.

b. Each licensee authorized under 1.3.8(9) to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium shall:

i. Satisfy the labeling requirements in 1.3.12(10)(a)(iv) for each PET radioactive drug transport radiation shield and each syringe, vial, or other container used to hold a PET radioactive drug intended for noncommercial distribution to members of its consortium.

ii. Possess and use instrumentation to measure the radioactivity of the PET radioactive drugs intended for noncommercial distribution to members of its consortium and meet the procedural, radioactivity measurement, instrument test, instrument check, and instrument adjustment requirements in 1.3.12(10)(c) .

c. A licensee that is a pharmacy authorized under 1.3.8(9) to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium shall require that any individual that prepares PET radioactive drugs shall be:

i. an authorized nuclear pharmacist that meets the requirements in 1.3.12(10)(b)(ii), or

ii. an individual under the supervision of an authorized nuclear pharmacist as specified in 1.7.15 of these regulations.

d. A pharmacy, authorized under 1.3.8(9) to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium that allows an individual to work as an authorized nuclear pharmacist, shall meet the requirements of 1.3.12(10)(b)(v).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.16 **Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas.**

1. Each specific license expires at the end of the day on the expiration date stated in the license unless the licensee has filed an application for renewal under 1.3.17 not less than 30 days before the expiration date stated in the existing license. If an application for renewal has been filed at least 30 days prior to the expiration date stated in the existing license, the existing license expires at the end of the day on which the Agency makes a final determination to deny the renewal application or, if the determination states an expiration date, the expiration date stated in the determination.

2. Each specific license revoked by the Agency expires at the end of the day on the date of the Agency's final determination to revoke the license, or on the expiration date stated in the determination, or as otherwise provided by Agency Order.

3. Each specific license continues in effect, beyond the expiration date if necessary, with respect to possession of radioactive material until the Agency notifies the licensee in writing that the license is terminated. During this time, the licensee shall:

   a. Limit actions involving radioactive material to those related to decommissioning; and

   b. Continue to control entry to restricted areas until they are suitable for release in accordance with Agency requirements.

4. Within 60 days of the occurrence of any of the following, each licensee shall provide notification to the Agency in writing of such occurrence, and either begin decommissioning its site, or any separate building or outdoor area that contains residual radioactivity so that the building or outdoor area is suitable for release in accordance with Agency requirements, or submit within 12 months of notification a decommissioning plan, if required by 1.3.16(6)(a), and begin decommissioning upon approval of that plan if:

   a. The license has expired pursuant to 1.3.16(1) or (2); or

   b. The licensee has decided to permanently cease principal activities, as defined in this section, at the entire site or in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with Agency requirements; or

   c. No principal activities under the license have been conducted for a period of 24 months; or

   d. No principal activities have been conducted for a period of 24 months in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with Agency requirements.

5. Coincident with the notification required by 1.3.16(4), the licensee shall maintain in effect all decommissioning financial assurances established by the licensee pursuant to 1.3.9(7) in conjunction with a license issuance or renewal or as required by this section. The amount of the financial assurance must be increased, or may be decreased, as appropriate, to cover the detailed cost estimate for decommissioning established pursuant to 1.3.16(6)(d)(v).

a. Any licensee who has not provided financial assurance to cover the detailed cost estimate submitted with the decommissioning plan shall do so within 180 days of the effective date of these regulations.

b. Following approval of the decommissioning plan, a licensee may reduce the amount of the financial assurance as decommissioning proceeds and radiological contamination is reduced at the site with the approval of the Agency.

6. The Agency may grant a request to extend the time periods established in 1.3.16(4) if the Agency determines that this relief is not detrimental to the public health and safety and is otherwise in the public interest. The request must be submitted no later than 30 days before notification pursuant to 1.3.16(4). The schedule for decommissioning set forth in 1.3.16(4) may not commence until the Agency has made a determination on the request.

a. A decommissioning plan must be submitted if required by license condition or if the procedures and activities necessary to carry out decommissioning of the site or separate building or outdoor area have not been previously approved by the Agency and these procedures could increase potential health and safety impacts to workers or to the public, such as in any of the following cases:

i. Procedures would involve techniques not applied routinely during cleanup or maintenance operations;

ii. Workers would be entering areas not normally occupied where surface contamination and radiation levels are significantly higher than routinely encountered during operation;

iii. Procedures could result in significantly greater airborne concentrations of radioactive materials than are present during operation; or

iv. Procedures could result in significantly greater releases of radioactive material to the environment than those associated with operation.

b. The Agency may approve an alternate schedule for submittal of a decommissioning plan required pursuant to 1.3.16(4) if the Agency determines that the alternative schedule is necessary to the effective conduct of decommissioning operations and presents no undue risk from radiation to the public health and safety and is otherwise in the public interest.

c. Procedures such as those listed in 1.3.16(6)(a) with potential health and safety impacts may not be carried out prior to approval of the decommissioning plan.

d. The proposed decommissioning plan for the site or separate building or outdoor area must include:

i. A description of the conditions of the site or separate building or outdoor area sufficient to evaluate the acceptability of the plan;

ii. A description of planned decommissioning activities;

iii. A description of methods used to ensure protection of workers and the environment against radiation hazards during decommissioning.

iv. A description of the planned final radiation survey; and

v. An updated detailed cost estimate for decommissioning, comparison of that estimate with present funds set aside for decommissioning, and a plan for assuring the availability of adequate funds for completion of decommissioning.

vi. For decommissioning plans calling for completion of decommissioning later than 24 months after plan approval, the plan shall include a justification for the delay based on the criteria in 1.3.16(7).

e. The proposed decommissioning plan will be approved by the Agency if the information therein demonstrates that the decommissioning will be completed as soon as practicable and that the health and safety of workers and the public will be adequately protected.

i. Except as provided in 1.3.16(7), licensees shall complete decommissioning of the site or separate building or outdoor area as soon as practicable but no later than 24 months following the initiation of decommissioning.

ii. Except as provided in 1.3.16(7), when decommissioning involves the entire site, the licensee shall request license termination as soon as practicable but no later than 24 months following the initiation of decommissioning.

7. The Agency may approve a request for an alternative schedule for completion of decommissioning of the site or separate building or outdoor area, and license termination if appropriate, if the Agency determines that the alternative is warranted by consideration of the following:

a. Whether it is technically feasible to complete decommissioning within the allotted 24-month period;

b. Whether sufficient waste disposal capacity is available to allow completion of decommissioning within the allotted 24-month period;

c. Whether a significant volume reduction in wastes requiring disposal will be achieved by allowing short-lived radionuclides to decay;

d. Whether a significant reduction in radiation exposure to workers can be achieved by allowing short-lived radionuclides to decay; and

e. Other site-specific factors which the Agency may consider appropriate on a case-by-base basis, such as the regulatory requirements of other government agencies, lawsuits, ground-water treatment activities, monitored natural ground-water restoration, actions that could result in more environmental harm than deferred cleanup, and other factors beyond the control of the licensee.

8. As the final step in decommissioning, the licensee shall:

a. Certify the disposition of all licensed material, including accumulated wastes, by submitting a completed Agency Form, "Certification of Disposition of Materials" or equivalent information; and

b. Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey unless the licensee demonstrates that the premises are suitable for release in accordance with the criteria for decommissioning in 1.4.64, 1.4.65 or 1.4.66. The licensee shall, as appropriate:

i. Report levels of gamma radiation in units of millisieverts (microroentgen) per hour at one meter from surfaces, and report levels of radioactivity, including alpha and beta, in units of disintegrations per minute or megabecquerels (microcuries) per 100 square centimeters-removable and fixed-for surfaces, megabecquerels (microcuries) per milliliter for water, and becquerels (picocuries) per gram for solids such as soils or concrete; and

ii. Specify the survey instrument(s) used and certify that each instrument is properly calibrated and tested.

9. Specific licenses, including expired licenses, will be terminated by written notice to the licensee when the Agency determines that:

a. Radioactive material has been properly disposed;

b. Reasonable effort has been made to eliminate residual radioactive contamination, if present; and

i. A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with the criteria for decommissioning in 1.4.64, 1.4.65, or 1.4.66.; or

ii. Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in 1.4.64, 1.4.65, or 1.4.66.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.17 **Renewal of Licenses**.

1. Applications for renewal of specific licenses shall be filed in accordance with 1.3.8.

2. In any case in which a licensee, not less than 30 days prior to expiration of the existing license, has filed an application in proper form for renewal or for a new license authorizing the same activities, such existing license shall not expire until final action by the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.18 **Amendment of Licenses at Request of Licensee**.: Applications for amendment of a license shall be filed in accordance with 1.3.8 and shall specify the respects in which the licensee desires the license to be amended and the grounds for such amendment.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.19 **Agency Action on Applications to Renew or Amend**. In considering an application by a licensee to renew or amend the license, the Agency will apply the criteria set forth in 1.3.9, and 1.3.11, and in Subchapters 1, 4, 5, 7, 10, 13, 11, 12, or 14 of these regulations as applicable.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.20 **Records**.

1. Each person who receives radioactive material pursuant to a license issued pursuant to these regulations shall keep records showing the receipt, transfer, and disposal of the radioactive material as follows:

a. The licensee shall retain each record of receipt of radioactive material as long as the material is possessed and for three years following transfer or disposal of the material.

b. The licensee who transferred the material shall retain each record of transfer for three years after each transfer unless a specific requirement in another section of the regulations dictates otherwise.

c. The licensee who disposed of the material shall retain each record of disposal of radioactive material until the Agency terminates each license that authorizes disposal of the material.

2. The licensee shall retain each record that is required by these regulations or by license condition for the period specified by the appropriate regulation or license condition. If a retention period is not otherwise specified by regulation or license condition, the record must be retained until the Agency terminates each license that authorizes the activity that is subject to the recordkeeping requirement.

3. Records which must be maintained pursuant to these regulations may be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by Agency regulations. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

4. If licensed activities are transferred or assigned in accordance with 1.3.15(2), each licensee authorized to possess radioactive material, with a half-life greater than 120 days, in an unsealed form, shall transfer the following records to the new licensee and the new licensee will be responsible for maintaining these records until the license is terminated:

a. Records of disposal of licensed material made under 1.4.36 (including burials authorized before May 9, 1986), 1.4.37, 1.4.38, 1.4.39; and

b. Records required by 1.4.37(2).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.21 **Reserved**.

Rule 1.3.22 **Reserved**.

Rule 1.3.23 **Reserved**.

Rule 1.3.24 **Transfer of Material.**

1. No licensee shall transfer radioactive material except as authorized pursuant to 1.3.24.

2. Except as otherwise provided in the license and subject to the provisions of 1.3.24(3) and (4), any licensee may transfer radioactive material:

   a. to the Agency;[18]

   b. to the U.S. Department of Energy;

   c. to any person exempt from the regulations in the section to the extent permitted under such exemption;

   d. to any person authorized to receive such material under terms of a general license or its equivalent, or a specific license or equivalent licensing document, issued by the Agency, the Nuclear Regulatory Commission, any Agreement State or any Licensing State, or to any person otherwise authorized to receive such material by the Federal Government or any agency thereof, the Agency, an Agreement State, or a Licensing State; or

   e. as otherwise authorized by the Agency in writing.

3. Before transferring radioactive material to a specific licensee of the Agency, the Nuclear Regulatory Commission, an Agreement State or a Licensing State, or to a general licensee who is required to register with the Agency, the Nuclear Regulatory Commission, an Agreement State or a Licensing State prior to receipt of the radioactive material, the licensee transferring the material shall verify that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred.

4. Any of the following methods for the verification required by 1.3.24(3) is acceptable:

   a. The transferor may possess and read a current copy of the transferee's specific license or registration certificate.

   b. The transferor may possess a written certification by the transferee that the transferee is authorized by license or registration certificate to receive the type, form, and quantity of radioactive material to be transferred, specifying the license or registration certificate number, issuing agency, and expiration date.

   c. For emergency shipments, the transferor may accept oral certification by the transferee that the transferee is authorized by license or registration certificate to receive the type, form, and quantity of radioactive material to be transferred, specifying the license or registration certificate number, issuing agency, and expiration date; provided, that the oral certification is confirmed in writing within 10 days.

[18] A licensee may transfer material to the Agency only after receiving prior approval from the Agency.

d. The transferor may obtain other information compiled by a reporting service from official records of the Agency, the Nuclear Regulatory Commission, the licensing agency of an Agreement State, or a Licensing State regarding the identity of licensees and the scope and expiration dates of licenses and registration.

e. When none of the methods of verification described in 1.3.24(4)(a) through (d) are readily available or when a transferor desires to verify that information received by one of such methods is correct or up-to-date, the transferor may obtain and record confirmation from the Agency, the Nuclear Regulatory Commission, or the licensing agency of an Agreement State, or a Licensing State that the transferee is licensed to receive the radioactive material.

5. Shipment and transport of radioactive material shall be in accordance with the provisions of Subchapter 13 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.25 **Modification and Revocation of Licenses.**

1. The terms and conditions of all licenses shall be subject to amendment, revision, or modification or the license may be suspended or revoked by reason of amendments to the Act, or by reason of rules, regulations, and orders issued by the Agency.

2. Any license may be revoked, suspended, or modified, in whole or in part, for any material false statement in the application or any statement of fact required under provisions of the Act, or because of conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Agency to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and conditions of the Act, or of the license, or of any rule, regulation, or order of the Agency.

3. Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended, or revoked unless, prior to the institution of proceedings therefore, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.3.26 **Reciprocal Recognition of Licenses for Byproduct, Source, Naturally Occurring and Accelerator-Produced Radioactive Material and Special Nuclear Material in Quantities Not Sufficient to Form a Critical Mass.**

1. Subject to these regulations, any person who holds a specific license from the Nuclear Regulatory Commission, an Agreement State, or a Licensing State, and issued by the agency having jurisdiction where the licensee maintains an office for directing the licensed activity and at which radiation safety records are normally maintained, is hereby granted a general license to conduct the activities authorized in such licensing document within this State, except for areas of exclusive federal jurisdiction, for a period not in excess of 180 days in any calendar year provided that:

   a. the licensing document does not limit the activity authorized by such document to specified installations or locations;

   b. the out-of-state licensee notifies the Agency in writing at least 3 days prior to engaging in such activity. Such notification shall indicate the location, period, and type of proposed possession and use within the State, and shall be accompanied by a copy of the pertinent licensing document and an annual fee as provided in Section 45-14-31 of the Act. If, for a specific case, the 3 day period would impose an undue hardship on the out-of-state licensee, the licensee may, upon application to the Agency, obtain permission to proceed sooner. The Agency may waive the requirement for filing additional written notifications during the remainder of the calendar year following the receipt of the initial notification from a person engaging in activities under the general license provided in 1.3.26(1);

   c. the out-of-state licensee complies with all applicable regulations of the Agency and with all the terms and conditions of the licensing document, except any such terms and conditions which may be inconsistent with applicable regulations of the Agency;

   d. the out-of-state licensee supplies such other information as the Agency may request; and

   e. the out-of-state licensee shall not transfer or dispose of radioactive material possessed or used under the general license provided in 1.3.26(1) except by transfer to a person specifically licensed by the Agency or by the Nuclear Regulatory Commission, an Agreement State, or a Licensing State to receive such material,

2. Notwithstanding the provisions of 1.3.26(1), any person who holds a specific license issued by the Nuclear Regulatory Commission, an Agreement State, or a Licensing State authorizing the holder to manufacture, transfer, install, or service a device described in 1.3.6(4)(a) within areas subject to the jurisdiction of the licensing body is hereby granted a general license to install, transfer, demonstrate, or service such a device in this State provided that:

   a. such person shall file a report with the Agency within 30 days after the end of each calendar quarter in which any device is transferred to or

installed in this State. Each such report shall identify each general licensee to whom such device is transferred by name and address, the type of device transferred, and the quantity and type of radioactive material contained in the device;

b. the device has been manufactured, labeled, installed, and serviced in accordance with applicable provisions of the specific license issued to such person by the Nuclear Regulatory Commission, an Agreement State, or a Licensing State;

c. such person shall assure that any labels required to be affixed to the device under regulations of the authority which licensed manufacture of the device bear a statement that "Removal of the label is prohibited"; and

d. the holder of the specific license shall furnish to each general licensee to whom he transfers such device or on whose premises the licensee installs such device a copy of the general license contained in 1.3.6(4) or in equivalent regulations of the agency having jurisdiction over the manufacture and distribution of the device.

3. The Agency may withdraw, limit, or qualify its acceptance of any specific license or equivalent licensing document issued by the Nuclear Regulatory Commission or an Agreement State, or any product distributed pursuant to such licensing document, upon determining that such action is necessary in order to prevent undue hazard to public health and safety or property.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX A

Exempt Concentrations

Concentration Element (atomic number)	Radionuclide	Column I Gas concentration GBq/m^3	 µCi/ml	Column II Liquid and solid GBq/m^3	 µCi/ml
Antimony (51)	Sb-122			$1.1x10^{-2}$	$3x10^{-4}$
	Sb-124			$7.4x10^{-3}$	$2x10^{-4}$
	Sb-125			$3.7x10^{-2}$	$1x10^{-3}$
Argon (18)	Ar-37	$3.7x10^{-2}$	$1x10^{-3}$		
	Ar-41	$1.5x10^{-5}$	$4x10^{-7}$		
Arsenic (33)	As-73			$1.9x10^{-1}$	$5x10^{-3}$
	As-74			$1.9x10^{-2}$	$5x10^{-4}$
	As-76			$7.4x10^{-3}$	$2x10^{-4}$
	As-77			$3.0x10^{-2}$	$8x10^{-4}$
Barium (56)	Ba-131			$7.4x10^{-2}$	$2x10^{-3}$
	Ba-140			$1.1x10^{-2}$	$3x10^{-4}$
Beryllium (4)	Be-7			$7.4x10^{-1}$	$2x10^{-2}$
Bismuth (83)	Bi-206			$1.5x10^{-2}$	$4x10^{-4}$
Bromine (35)	Br-82	$1.5x10^{-5}$	$4x10^{-7}$	$1.1x10^{-1}$	$3x10^{-3}$
Cadmium (48)	Cd-109			$7.4x10^{-2}$	$2x10^{-3}$
	Cd-115m			$1.1x10^{-2}$	$3x10^{-4}$
	Cd-115			$1.1x10^{-2}$	$3x10^{-4}$
Calcium (20)	Ca-45			$3.3x10^{-3}$	$9x10^{-5}$
	Ca-47			$1.9x10^{-2}$	$5x10^{-4}$
Carbon (6)	C-14	$3.7x10^{-5}$	$1x10^{-6}$	$3.0x10^{-1}$	$8x10^{-3}$
Cerium (58)	Ce-141			$3.3x10^{-2}$	$9x10^{-4}$
	Ce-143			$1.5x10^{-2}$	$4x10^{-4}$
	Ce-144			$3.7x10^{-3}$	$1x10^{-4}$
Cesium (55)	Cs-131			$7.4x10^{-1}$	$2x10^{-2}$
	Cs-134m			$2.2x10^{+0}$	$6x10^{-2}$
	Cs-134			$3.3x10^{-3}$	$9x10^{-5}$
Chlorine (17)	Cl-38	$3.3x10^{-5}$	$9x10^{-7}$	$1.5x10^{-1}$	$4x10^{-3}$
Chromium (24)	Cr-51			$7.4x10^{-1}$	$2x10^{-2}$
Cobalt (27)	Co-57			$1.9x10^{-1}$	$5x10^{-3}$
	Co-58			$3.7x10^{-2}$	$1x10^{-3}$
	Co-60			$1.9x10^{-2}$	$5x10^{-4}$

Copper (29)	Cu-64			$1.1x10^{-1}$	$3x10^{-3}$
Dysprosium (66)	Dy-165			$1.5x10^{-1}$	$4x10^{-3}$
	Dy-166			$1.5x10^{-2}$	$4x10^{-4}$
Erbium (68)	Er-169			$3.3x10^{-2}$	$9x10^{-4}$
	Er-171			$3.7x10^{-2}$	$1x10^{-3}$
Europium (63)	Eu-152(9.2 h)			$2.2x10^{-2}$	$6x10^{-4}$
	Eu-155			$7.4x10^{-2}$	$2x10^{-3}$
Fluorine (9)	F-18	$7.4x10^{-5}$	$2x10^{-6}$	$3.0x10^{-1}$	$8x10^{-3}$
Gadolinium (64)	Gd-153			$7.4x10^{-2}$	$2x10^{-3}$
	Gd-159			$3.0x10^{-2}$	$8x10^{-4}$
Gallium (31)	Ga-72			$1.5x10^{-2}$	$4x10^{-4}$
Germanium (32)	Ge-71			$7.4x10^{-1}$	$2x10^{-2}$
Gold (79)	Au-196			$7.4x10^{-2}$	$2x10^{-3}$
	Au-198			$1.9x10^{-2}$	$5x10^{-4}$
	Au-199			$7.4x10^{-2}$	$2x10^{-3}$
Hafnium (72)	Hf-181			$2.6x10^{-2}$	$7x10^{-4}$
Hydrogen (1)	H-3	$1.9x10^{-4}$	$5x10^{-6}$	$1.1x10^{+0}$	$3x10^{-2}$
Indium (49)	In-113m			$3.7x10^{-1}$	$1x10^{-2}$
	In-114m			$7.4x10^{-3}$	$2x10^{-4}$
Iodine (53)	I-126	$1.1x10^{-7}$	$3x10^{-9}$	$7.4x10^{-4}$	$2x10^{-5}$
	I-131	$1.1x10^{-7}$	$3x10^{-9}$	$7.4x10^{-4}$	$2x10^{-5}$
	I-132	$3.0x10^{-6}$	$8x10^{-8}$	$2.2x10^{-2}$	$6x10^{-4}$
	I-133	$3.7x10^{-7}$	$1x10^{-8}$	$2.6x10^{-3}$	$7x10^{-5}$
	I-134	$7.4x10^{-6}$	$2x10^{-7}$	$3.7x10^{-2}$	$1x10^{-3}$
Iridium (77)	Ir-190			$7.4x10^{-2}$	$2x10^{-3}$
	Ir-192			$1.5x10^{-2}$	$4x10^{-4}$
	Ir-194			$1.1x10^{-2}$	$3x10^{-4}$
Iron (26)	Fe-55			$3.0x10^{-1}$	$8x10^{-3}$
	Fe-59			$2.2x10^{-2}$	$6x10^{-4}$
Krypton (36)	Kr-85m	$3.7x10^{-5}$	$1x10^{-6}$		
	Kr-85	$1.1x10^{-4}$	$3x10^{-6}$		
Lanthanum (57)	La-140			$7.4x10^{-3}$	$2x10^{-4}$
Lead (82)	Pb-203			$1.5x10^{-1}$	$4x10^{-3}$
Lutetium (71)	Lu-177			$3.7x10^{-2}$	$1x10^{-3}$
Manganese (25)	Mn-52			$1.1x10^{-2}$	$3x10^{-4}$
	Mn-54			$3.7x10^{-2}$	$1x10^{-3}$
	Mn-56			$3.7x10^{-2}$	$1x10^{-3}$
Mercury (80)	Hg-197m			$7.4x10^{-2}$	$2x10^{-3}$
	Hg-197			$1.1x10^{-1}$	$3x10^{-3}$
	Hg-203			$7.4x10^{-3}$	$2x10^{-4}$
Molybdenum (42)	Mo-99			$2.2x10^{-2}$	$2x10^{-3}$
Neodymium (60)	Nd-147			$2.2x10^{-2}$	$6x10^{-4}$
	Nd-149			$1.1x10^{-1}$	$3x10^{-3}$
Nickel (28)	Ni-65			$3.7x10^{-2}$	$1x10^{-3}$

Niobium (Columbium) (41)	Nb-95			$3.7x10^{-2}$	$1x10^{-3}$
	Nb-97			$3.3x10^{-1}$	$9x10^{-3}$
Osmium (76)	Os-185			$2.6x10^{-2}$	$7x10^{-4}$
	Os-191m			$1.1x10^{+0}$	$3x10^{-2}$
	Os-191			$7.4x10^{-2}$	$2x10^{-3}$
	Os-193			$2.2x10^{-2}$	$6x10^{-4}$
Palladium (46)	Pd-103			$1.1x10^{-1}$	$3x10^{-3}$
	Pd-109			$3.3x10^{-2}$	$9x10^{-4}$
Phosphorus (15)	P-32			$7.4x10^{-3}$	$2x10^{-4}$
Platinum (78)	Pt-191			$3.7x10^{-2}$	$1x10^{-3}$
	Pt-193m			$3.7x10^{-1}$	$1x10^{-2}$
	Pt-197m			$3.7x10^{-1}$	$1x10^{-2}$
	Pt-197			$3.7x10^{-2}$	$1x10^{-3}$
Potassium (19)	K-42			$1.1x10^{-1}$	$3x10^{-3}$
Praseodymium (59)	Pr-142			$1.1x10^{-2}$	$3x10^{-4}$
	Pr-143			$1.9x10^{-2}$	$5x10^{-4}$
Promethium (61)	Pm-147			$7.4x10^{-2}$	$2x10^{-3}$
	Pm-149			$1.5x10^{-2}$	$4x10^{-4}$
Rhenium (75)	Re-183			$2.2x10^{-1}$	$6x10^{-3}$
	Re-186			$3.3x10^{-2}$	$9x10^{-4}$
	Re-188			$2.2x10^{-2}$	$6x10^{-4}$
Rhodium (45)	Rh-103m			$3.7x10^{+0}$	$1x10^{-1}$
	Rh-105			$3.7x10^{-2}$	$1x10^{-3}$
Rubidium (37)	Rb-86			$2.6x10^{-2}$	$7x10^{-4}$
Ruthenium (44)	Ru-97			$1.5x10^{-1}$	$4x10^{-3}$
	Ru-103			$3.0x10^{-2}$	$8x10^{-4}$
	Ru-105			$3.7x10^{-2}$	$1x10^{-3}$
	Ru-106			$3.7x10^{-3}$	$1x10^{-4}$
Samarium (62)	Sm-153			$3.0x10^{-2}$	$8x10^{-4}$
Scandium (21)	Sc-46			$1.5x10^{-2}$	$4x10^{-4}$
	Sc-47			$3.3x10^{-2}$	$9x10^{-4}$
	Sc-48			$1.1x10^{-2}$	$3x10^{-4}$
Selenium (34)	Se-75			$1.1x10^{-1}$	$3x10^{-3}$
Silicon (14)	Si-31			$3.3x10^{-1}$	$9x10^{-3}$
Silver (47)	Ag-105			$3.7x10^{-2}$	$1x10^{-3}$
	Ag-110m			$1.1x10^{-2}$	$3x10^{-4}$
	Ag-111			$1.5x10^{-2}$	$4x10^{-4}$
Sodium (11)	Na-24			$7.4x10^{-2}$	$2x10^{-3}$
Strontium (38)	Sr-85			$3.7x10^{-2}$	$1x10^{-3}$
	Sr-89			$3.7x10^{-3}$	$1x10^{-4}$
	Sr-91			$2.6x10^{-2}$	$7x10^{-4}$
	Sr-92			$2.6x10^{-2}$	$7x10^{-4}$
Sulfur (16)	S-35	$3.3x10^{-6}$	$9x10^{-8}$	$2.2x10^{-2}$	$6x10^{-4}$
Tantalum (73)	Ta-182			$1.5x10^{-2}$	$4x10^{-4}$

Technetium (43)	Tc-96m			$3.7x10^{+0}$	$1x10^{-1}$
	Tc-96			$3.7x10^{-2}$	$1x10^{-3}$
Tellurium (52)	Te-125m			$7.4x10^{-2}$	$2x10^{-3}$
	Te-127m			$2.2x10^{-2}$	$6x10^{-4}$
	Te-127			$1.1x10^{-1}$	$3x10^{-3}$
	Te-129m			$1.1x10^{-2}$	$3x10^{-4}$
	Te-131m			$2.2x10^{-2}$	$6x10^{-4}$
	Te-132			$1.1x10^{-2}$	$3x10^{-4}$
Terbium (65)	Tb-160			$1.5x10^{-2}$	$4x10^{-4}$
Thallium (81)	Tl-200			$1.5x10^{-1}$	$4x10^{-3}$
	Tl-201			$1.1x10^{-1}$	$3x10^{-3}$
	Tl-202			$3.7x10^{-2}$	$1x10^{-3}$
	Tl-204			$3.7x10^{-2}$	$1x10^{-3}$
Thulium (69)	Tm-170			$1.9x10^{-2}$	$5x10^{-4}$
	Tm-171			$1.9x10^{-1}$	$5x10^{-3}$
Tin (50)	Sn-113			$3.3x10^{-2}$	$9x10^{-4}$
	Sn-125			$7.4x10^{-3}$	$2x10^{-4}$
Tungsten (Wolfram) (74)	W-181			$1.5x10^{-1}$	$4x10^{-3}$
	W-187			$2.6x10^{-2}$	$7x10^{-4}$
Vanadium (23)	V-48			$1.1x10^{-2}$	$3x10^{-4}$
Xenon (54)	Xe-131m	$1.5x10^{-4}$	$4x10^{-6}$		
	Xe-133	$1.1x10^{-4}$	$3x10^{-6}$		
	Xe-135	$3.7x10^{-5}$	$1x10^{-6}$		
Ytterbium (70)	Yb-175			$3.7x10^{-2}$	$1x10^{-3}$
Yttrium (39)	Y-90			$7.4x10^{-3}$	$2x10^{-4}$
	Y-91m			$1.1x10^{+0}$	$3x10^{-2}$
	Y-91			$1.1x10^{-2}$	$3x10^{-4}$
	Y-92			$2.2x10^{-2}$	$6x10^{-4}$
	Y-93			$1.1x10^{-2}$	$3x10^{-4}$
Zinc (30)	Zn-65			$3.7x10^{-2}$	$1x10^{-3}$
	Zn-69m			$2.6x10^{-2}$	$7x10^{-4}$
	Zn-69			$7.4x10^{-1}$	$2x10^{-2}$
Zirconium (40)	Zr-95			$2.2x10^{-2}$	$6x10^{-4}$
	Zr-97			$7.4x10^{-3}$	$2x10^{-4}$
Beta and/or gamma emitting radioactive material not listed above with half-life of less than 3 years.		$3.7x10^{-9}$	$1x10^{-10}$	$3.7x10^{-5}$	$1x10^{-6}$

Note 1: Many radionuclides transform into other radionuclides which are also radioactive. In expressing the concentrations in Appendix A, the activity stated is that of the parent radionuclide and takes into account the radioactive decay products.

Note 2: For purposes of 1.3.3 where there is involved a combination of radionuclides, the limit for the combination should be derived as follows: Determine for each radionuclide in the product the ratio between the radioactivity concentration present in the product and the exempt radioactivity concentration established in Appendix A for the specific radionuclide when not in combination. The sum of such ratios may not exceed "1".

Example: $\frac{\text{Concentration of Radionuclide A in Product}}{\text{Exempt concentration of Radionuclide A}} + \frac{\text{Concentration of Radionuclide B in Product}}{\text{Exempt concentration of Radionuclide B}} \leq 1$

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX B

Exempt Quantities of Radionuclides

Radionuclides		kBq	µCi
Antimony-122	Sb 122	3,700	100
Antimony-124	Sb 124	370	10
Antimony-125	Sb 125	370	10
Arsenic-73	As 73	3,700	100
Arsenic-74	As 74	370	10
Arsenic-76	As 76	370	10
Arsenic-77	As 77	3,700	100
Barium-131	Ba 131	370	10
Barium-133	Ba 133	370	10
Barium-140	Ba 140	370	10
Bismuth-210	Bi 210	37	1
Bromine-82	Br 82	370	10
Cadmium-109	Cd 109	370	10
Cadmium-115m	Cd 115m	370	10
Cadmium-115	Cd 115	3,700	100
Calcium-45	Ca 45	370	10
Calcium-47	Ca 47	370	10
Carbon-14	C 14	3,700	100
Cerium-141	Ce 141	3,700	100
Cerium-143	Ce 143	3,700	100
Cerium-144	Ce 144	37	1
Cesium-129	Cs 129	3,700	100
Cesium-131	Cs 131	37,000	1,000
Cesium-134m	Cs 134m	3,700	100
Cesium-134	Cs 134	37	1
Cesium-135	Cs 135	370	10
Cesium-136	Cs 136	370	10
Cesium-137	Cs 137	370	10
Chlorine-36	Cl 36	370	10
Chlorine-38	Cl 38	370	10
Chromium-51	Cr 51	37,000	1,000
Cobalt-57	Co 57	3,700	100
Cobalt-58m	Co 58m	370	10
Cobalt-58	Co 58	370	10
Cobalt-60	Co 60	37	1
Copper-64	Cu 64	3,700	100
Dysprosium-165	Dy 165	370	10
Dysprosium-166	Dy 166	3,700	100

Radionuclides		**kBq**	**µCi**
Erbium-169	Er 169	3,700	100
Erbium-171	Er 171	3,700	100
Europium-152	Eu 152 9.2h	3,700	100
Europium-152	Eu 152 13 yr	37	1
Europium-154	Eu 154	37	1
Europium-155	Eu 155	370	10
Fluorine-18	F 18	37,000	1,000
Gadolinium-153	Gd 153	370	10
Gadolinium-159	Gd 159	3,700	100
Gallium-67	Ga 67	3,700	100
Gallium-72	Ga 72	370	10
Germanium-68	Ge 68	370	10
Germanium-71	Ge 71	3,700	100
Gold-195	Au 195	370	10
Gold-198	Au 198	3,700	100
Gold-199	Au 199	3,700	100
Hafnium-181	Hf 181	370	10
Holmium-166	Ho 166	3,700	100
Hydrogen-3	H 3	37,000	1,000
Indium-111	In 111	3,700	100
Indium-113m	In 113m	3,700	100
Indium-114m	In 114m	370	10
Indium-115m	In 115m	3,700	100
Indium-115	In 115	370	10
Iodine-123	I 123	3,700	100
Iodine-125	I 125	37	1
Iodine-126	I 126	37	1
Iodine-129	I 129	3.7	0.1
Iodine-131	I 131	37	1
Iodine-132	I 132	370	10
Iodine-133	I 133	37	1
Iodine-134	I 134	370	10
Iodine-135	I 135	370	10
Iridium-192	Ir 192	370	10
Iridium-194	Ir 194	3,700	100
Iron-52	Fe 52	370	10
Iron-55	Fe 55	3,700	100
Iron-59	Fe 59	370	10
Krypton-85	Kr 85	3,700	100
Krypton-87	Kr 87	370	10
Lanthanum-140	La 140	370	10
Lutetium-177	Lu 177	3,700	100

Radionuclides		**kBq**	**µCi**
Manganese-52	Mn 52	37	10
Manganese-54	Mn 54	370	10
Manganese-56	Mn 56	370	10
Mercury-197m	Hg 197m	3,700	100
Mercury-197	Hg 197	3,700	100
Mercury-203	Hg 203	370	10
Molybdenum-99	Mo 99	3,700	100
Neodymium-147	Nd 147	3,700	100
Neodymium-149	Nd 149	3,700	100
Nickel-59	Ni 59	3,700	100
Nickel-63	Ni 63	370	10
Nickel-65	Ni 65	3,700	100
Niobium-93m	Nb 93m	370	10
Niobium-95	Nb 95	370	10
Niobium-97	Nb 97	370	10
Osmium-185	Os 185	370	10
Osmium-191m	Os 191m	3,700	100
Osmium-191	Os 191	3,700	100
Osmium-193	Os 193	3,700	100
Palladium-103	Pd 103	3,700	100
Palladium-109	Pd 109	3,700	100
Phosphorus-32	P 32	370	10
Platinum-191	Pt 191	3,700	100
Platinum-193m	Pt 193m	3,700	100
Platinum-193	Pt 193	3,700	100
Platinum-197m	Pt 197m	3,700	100
Platinum-197	Pt 197	3,700	100
Polonium-210	Po 210	3.7	0.1
Potassium-42	K 42	370	10
Potassium-43	K 43	370	10
Praseodymium-142	Pr 142	3,700	100
Praseodymium-143	Pr 143	3,700	100
Promethium-147	Pm 147	370	10
Promethium-149	Pm 149	370	10
Rhenium-186	Re 186	3,700	100
Rhenium-188	Re 188	3,700	100
Rhodium-103m	Rh 103m	3,700	100
Rhodium-105	Rh 105	3,700	100
Rubidium-81	Rb 81	370	10
Rubidium-86	Rb 86	370	10
Rubidium-87	Rb 87	370	10
Ruthenium-97	Ru 97	3,700	100

Radionuclides		**kBq**	**µCi**
Ruthenium-103	Ru 103	370	10
Ruthenium-105	Ru 105	370	10
Ruthenium-106	Ru 106	37	1
Samarium-151	Sm 151	370	10
Samarium-153	Sm 153	3,700	100
Scandium-46	Sc 46	370	10
Scandium-47	Sc 47	3,700	100
Scandium-48	Sc 48	370	10
Selenium-75	Se 75	370	10
Silicon-31	Si 31	3,700	100
Silver-105	Ag 105	370	10
Silver-110m	Ag 110m	37	1
Silver-111	Ag 111	3,700	100
Sodium-22	Na 22	370	10
Sodium-24	Na 24	370	10
Strontium-85	Sr 85	370	10
Strontium-89	Sr 89	37	1
Strontium-90	Sr 90	3.7	0.1
Strontium-91	Sr 91	370	10
Strontium-92	Sr 92	370	10
Sulphur-35	S 35	3,700	100
Tantalum-182	Ta 182	370	10
Technetium-96	Tc 96	370	10
Technetium-97m	Tc 97m	3,700	100
Technetium-97	Tc 97	3,700	100
Technetium-99m	Tc 99m	3,700	100
Technetium-99	Tc 99	370	10
Tellurium-125m	Te 125m	370	10
Tellurium-127m	Te 127m	370	10
Tellurium-127	Te 127	3,700	100
Tellurium-129m	Te 129m	370	10
Tellurium-129	Te 129	3,700	100
Tellurium-131m	Te 131m	370	10
Tellurium-132	Te 132	370	10
Terbium-160	Tb 160	370	10
Thallium-200	Tl 200	3,700	100
Thallium-201	Tl 201	3,700	100
Thallium-202	Tl 202	3,700	100
Thallium-204	Tl 204	370	10
Thulium-170	Tm 170	370	10
Thulium-171	Tm 171	370	10
Tin-113	Sn 113	370	10

Radionuclides		**kBq**	**µCi**
Tin-125	Sn 125	370	10
Tungsten-181	W 181	370	10
Tungsten-185	W 185	370	10
Tungsten-187	W 187	3,700	100
Vanadium-48	V 48	370	10
Xenon-131m	Xe 131m	37,000	1,000
Xenon-133	Xe 133	3,700	100
Xenon-135	Xe 135	3,700	100
Ytterbium-175	Yb 175	3,700	100
Yttrium-87	Y 87	370	10
Yttrium-88	Y 88	370	10
Yttrium-90	Y 90	370	10
Yttrium-91	Y 91	370	10
Yttrium-92	Y 92	3,700	100
Yttrium-93	Y 93	3,700	100
Zinc-65	Zn 65	370	10
Zinc-69m	Zn 69m	3,700	100
Zinc-69	Zn 69	37,000	1,000
Zirconium-93	Zr 93	370	10
Zirconium-95	Zr 95	370	10
Zirconium-97	Zr 97	370	10
Any radioactive material not listed above other than alpha-emitting radioactive material		3.7	0.1

Note 1: For purposes of 1.3.9(6)(f)(ii) where there is involved a combination of radionuclides, the limit for the combination should be derived as follows:

Determine the amount of each radionuclide possessed and 1,000 times the amount in Appendix B for each of those radionuclides when not in combination. The sum of the ratios of those quantities may not exceed 1.

Example:

$$\frac{\text{Amt. of radionuclide A possessed}}{\text{1000 x Appendix B quantity for radionuclide A}} + \frac{\text{Amt. of radionuclide B possessed}}{\text{1000 x Appendix B quantity for radionuclide B}} \leq 1$$

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX C

Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release.

Radioactive Material	Release fraction	Quantity (curies)
Actinium-228	0.001	4,000
Americium-241	.001	2
Americium-242	.001	2
Americium-243	.001	2
Antimony-124	.01	4,000
Antimony-126	.01	6,000
Barium-133	.01	10,000
Barium-140	.01	30,000
Bismuth-207	.01	5,000
Bismuth-210	.01	600
Cadmium-109	.01	1,000
Cadmium-113	.01	80
Calcium-45	.01	20,000
Californium-252	.001	9 (20 mg)
Carbon-14	.01	50,000
	Non CO	
Cerium-141	.01	10,000
Cerium-144	.01	300
Cesium-134	.01	2,000
Cesium-137	.01	3,000
Chlorine-36	.5	100
Chromium-51	.01	300,000
Cobalt-60	.001	5,000
Copper-64	.01	200,000
Curium-242	.001	60
Curium-243	.001	3
Curium-244	.001	4
Curium-245	.001	2
Europium-152	.01	500
Europium-154	.01	400
Europium-155	.01	3,000
Germanium-68	.01	2,000
Gadolinium-153	.01	5,000
Gold-198	.01	30,000
Hafnium-172	.01	400
Hafnium-181	.01	7,000
Holmium-166m	.01	100

Radioactive Material	Release fraction	Quantity (curies)
Hydrogen-3	.5	20,000
Iodine-125	.5	10
Iodine-131	.5	10
Indium-114m	.01	1,000
Iridium-192	.001	40,000
Iron-55	.01	40,000
Iron-59	.01	7,000
Krypton-85	1.0	6,000,000
Lead-210	.01	8
Manganese-56	.01	60,000
Mercury-203	.01	10,000
Molybdenum-99	.01	30,000
Neptunium-237	.001	2
Nickel-63	.01	20,000
Niobium-94	.01	300
Phosphorus-32	.5	100
Phosphorus-33	.5	1,000
Polonium-210	.01	10
Potassium-42	.01	9,000
Promethium-145	.01	4,000
Promethium-147	.01	4,000
Radium-226	.0001	100
Ruthenium-106	.01	200
Samarium-151	.01	4,000
Scandium-46	.01	3,000
Selenium-75	.01	10,000
Silver-110m	.01	1,000
Sodium-22	.01	9,000
Sodium-24	.01	10,000
Strontium-89	.01	3,000
Strontium-90	.01	90
Sulfur-35	.5	900
Technetium-99	.01	10,000
Technetium-99m	.01	400,000
Tellurium-127m	.01	5,000
Tellurium-129m	.01	5,000
Terbium-160	.01	4,000
Thulium-170	.01	4,000
Tin-113	.01	10,000
Tin-123	.01	3,000
Tin-126	.01	3,000

Radioactive Material	Release fraction	Quantity (curies)
Titanium-44	.01	100
Vanadium-48	.01	7,000
Xenon-133	1.0	900,000
Yttrium-91	.01	2,000
Zinc-65	.01	5,000
Zirconium-93	.01	400
Zirconium-95	.01	5,000
Any other beta-gamma emitter	.01	10,000
Mixed fission products	.01	1,000
Mixed corrosion products	.01	10,000
Contaminated equipment beta-gamma	.001	10,000
Irradiated material, any form other than solid noncombustible	.01	1,000
Irradiated material, solid noncombustible	.001	10,000
Mixed radioactive waste, beta-gamma	.01	1,000
Packaged mixed waste, beta-gamma[1]	.001	10,000
Any other alpha emitter	.001	2
Contaminated equipment, alpha	.0001	20
Packaged waste, alpha [1]	.0001	20
Combinations of radioactive materials listed above [2]		

[1] Waste packaged in Type B containers does not require an emergency plan.

[2] For combinations of radioactive materials, consideration of the need for an emergency plan is required if the sum of the ratios of the quantity of each radioactive material authorized to the quantity listed for that material in Appendix C exceeds one.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX D

Criteria Relating to Use of Financial Tests and Parent Company Guarantees for Providing Reasonable Assurance of Funds for Decommissioning.

I. Introduction

An applicant or licensee may provide reasonable assurance of the availability of funds for decommissioning based on obtaining a parent company guarantee that funds will be available for decommissioning costs and on a demonstration that the parent company passes a financial test. This appendix establishes criteria for passing the financial test and for obtaining the parent company guarantee.

II. Financial Test

A. To pass the financial test, the parent company must meet the criteria of either paragraph A.1 or A.2 of this section:

(1) The parent company must have:

(i) Two of the following three ratios: A ratio of total liabilities to net worth less than 2.0; a ratio of the sum of net income plus depreciation, depletion, and amortization to total liabilities greater than 0.1; and a ratio of current assets to current liabilities greater than 1.5; and

(ii) Net working capital and tangible net worth each at least six times the current decommissioning cost estimates for the total of all facilities or parts thereof (or prescribed amount if a certification is used); and

(iii) Tangible net worth of at least $10 million; and

(iv) Assets located in the United States amounting to at least 90 percent of total assets or at least six times the current decommissioning cost estimates for the total of all facilities or parts thereof (or prescribed amount if a certification is used).

(2) The parent company must have:

(i) A current rating for its most recent bond issuance of AAA, AA, A or BBB as issued by Standard and Poor's or Aaa, Aa, A, or Baa as issued by Moody's and

(ii) Tangible net worth at least six times the current decommissioning cost estimate for the total of all facilities or parts thereof (or prescribed amount if a certification is used); and

(iii) Tangible net worth of at least $10 million; and

(iv) Assets located in the United States amounting to at least 90 percent of total assets or at least six times the current decommissioning cost estimates for the total of all facilities or parts thereof (or prescribed amount if certification is used).

B. The parent company's independent certified public accountant must have compared the data used by the parent company in the financial test, which is derived from the independently audited, year end financial statements for the latest fiscal year, with the amounts in such financial statement. In connection with that procedure, the licensee shall inform the Agency within 90 days of any matters coming to the auditor's attention which cause the auditor to believe that the data specified in the financial test should be adjusted and that the company no longer passes the test.

C. (1) After the initial financial test, the parent company must repeat the passage of the test within 90 days after the close of each succeeding fiscal year.

(2) If the parent company no longer meets the requirements of paragraph A of this section, the licensee must send notice to the Agency of intent to establish alternate financial assurance as specified in the Agency's regulations. The notice must be sent by certified mail within 90 days after the end of the fiscal year for which the year end financial data show that the parent company no longer meets the financial test requirements. The licensee must provide alternate financial assurance within 120 days after the end of such fiscal year.

III. Parent Company Guarantee

The terms of a parent company guarantee which an applicant or licensee obtains must provide that:

A. The parent company guarantee will remain in force unless the guarantor sends notice of cancellation by certified mail to the licensee and the Agency. Cancellation may not occur, however, during the 120 days beginning on the date of receipt of the notice of cancellation by both the licensee and the Agency, as evidenced by the return receipts.

B. If the licensee fails to provide alternate financial assurance as specified in the Agency's regulations within 90 days after receipt by the licensee and Agency of a notice of cancellation of the parent company guarantee from the guarantor, the guarantor will provide such alternative financial assurance in the name of the licensee.

C. The parent company guarantee and financial test provisions must remain in effect until the Agency has terminated the license.

D. If a trust is established for decommissioning costs, the trustee and trust must be acceptable to the Agency. An acceptable trustee includes an appropriate State or Federal government agency or an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX E

Criteria Relating to Use of Financial Tests and Self-Guarantees for Providing Reasonable Assurance of Funds for Decommissioning.

I. Introduction

An applicant or licensee may provide reasonable assurance of the availability of funds for decommissioning based on furnishing its own guarantee that funds will be available for decommissioning costs and on a demonstration that the company passes the financial test of Section II of this appendix. The terms of the self-guarantee are in Section III of this appendix. This appendix establishes criteria for passing the financial test for the self-guarantee and establishes the terms for a self-guarantee.

II. Financial Test

A. To pass the financial test, a company must meet all of the following criteria:

(1) Tangible net worth at least 10 times the total current decommissioning cost estimate for the total of all facilities or parts thereof (or the current amount required if certification is used).

(2) Assets located in the United States amounting to at least 90 percent of total assets or at least 10 times the total current decommissioning cost estimate for the total of all facilities or parts thereof (or the current amount required if certification is used).

(3) A current rating for its most recent bond issuance of AAA, AA, or A as issued by Standard and Poors (S&P), or Aaa, Aa, or A as issued by Moodys.

B. To pass the financial test, a company must meet all of the following additional requirements:

(1) The company must have at least one class of equity securities registered under the Securities Exchange Act of 1934.

(2) The company's independent certified public accountant must have compared the data used by the company in the financial test which is derived from the independently audited, year end financial statements for the latest fiscal year, with the amounts in such financial statement. In connection with that procedure, the licensee shall inform the Agency within 90 days of any matters coming to the attention of the auditor that cause the auditor to believe that the data specified in the financial test should be adjusted and that the company no longer passes the test.

(3) After the initial financial test, the company must repeat passage of the test within 90 days after the close of each succeeding fiscal year.

C. If the licensee no longer meets the requirements of Section II.A. of this appendix, the licensee must send immediate notice to the Agency of its intent to establish alternate financial assurance as specified in the Agency's regulations within 120 days of such notice.

III. Company Self-Guarantee

The terms of a self-guarantee which an applicant or licensee furnishes must provide that:

A. The guarantee will remain in force unless the licensee sends notice of cancellation by certified mail to the Agency. Cancellation may not occur, however, during the 120 days beginning on the date of receipt of the notice of cancellation by the Agency, as evidenced by the return receipt.

B. The licensee shall provide alternative financial assurance as specified in the Agency's regulations within 90 days following receipt by the Agency of a notice of cancellation of the guarantee.

C. The guarantee and financial test provisions must remain in effect until the Agency has terminated the license or until another financial assurance method acceptable to the Agency has been put in effect by the licensee.

D. The licensee will promptly forward to the Agency and the licensee's independent auditor all reports covering the latest fiscal year filed by the licensee with the Securities and Exchange Commission pursuant to the requirements of section 13 of the Securities and Exchange Act of 1934.

E. If, at any time, the licensee's most recent bond issuance ceases to be rated in any category of "A" or above by either Standard and Poors or Moodys, the licensee will provide notice in writing of such fact to the Agency within 20 days after publication of the change by the rating service. If the licensee's most recent bond issuance ceases to be rated in any category of A or above by both Standard and Poors and Moodys, the licensee no longer meets the requirements of Section II.A. of this appendix.

F. The applicant or licensee must provide to the Agency a written guarantee (a written commitment by a corporate officer) which states that the licensee will fund and carry out the required decommissioning activities or, upon issuance of an order by the Agency, the licensee will set up and fund a trust in the amount of the current cost estimates for decommissioning.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX F

Criteria Relating to Use of Financial Tests and Self-Guarantees for Providing Reasonable Assurance of Funds for Decommissioning by Commercial Companies That Have no Outstanding Rated Bonds.

I. Introduction

An applicant or licensee may provide reasonable assurance of the availability of funds for decommissioning based on furnishing its own guarantee that funds will be available for decommissioning costs and on a demonstration that the company passes the financial test of Section II of this appendix. The terms of the self-guarantee are in Section III of this appendix. This appendix establishes criteria for passing the financial test for the self-guarantee and establishes the terms for a self-guarantee**.**

II. Financial Test

A. To pass the financial test a company must meet the following criteria:

(1) Tangible net worth greater than $10 million, or at least 10 times the total current decommissioning cost estimate (or the current amount required if certification is used), whichever is greater, for all decommissioning activities for which the company is responsible as self-guaranteeing licensee and as parent-guarantor.

(2) Assets located in the United States amounting to at least 90 percent of total assets or at least 10 times the total current decommissioning cost estimate (or the current amount required if certification is used) for all decommissioning activities for which the company is responsible as self-guaranteeing licensee and as parent-guarantor.

(3) A ratio of cash flow divided by total liabilities greater than 0.15 and a ratio of total liabilities divided by net worth less than 1.5.

B. In addition, to pass the financial test, a company must meet all of the following requirements:

(1) The company's independent certified public accountant must have compared the data used by the company in the financial test, which is required to be derived from the independently audited year end financial statement based on United States generally accepted accounting practices for the latest fiscal year, with the amounts in such financial statement. In connection with that procedure, the licensee shall inform Agency within 90 days of any matters that may cause the auditor to believe that the data specified in the financial test should be adjusted and that the company no longer passes the test.

(2) After the initial financial test, the company must repeat passage of the test within 90 days after the close of each succeeding fiscal year.

(3) If the licensee no longer meets the requirements of paragraph II.A of this appendix, the licensee must send notice to the Agency of intent to establish alternative financial assurance as specified in Agency regulations. The notice must be sent by certified mail, return receipt requested, within 90 days after the end of the fiscal year for which the year end financial data show that the licensee no longer meets the financial test requirements. The licensee must provide alternative financial assurance within 120 days after the end of such fiscal year.

III. Company Self-Guarantee

The terms of a self-guarantee which an applicant or licensee furnishes must provide that:

A. The guarantee shall remain in force unless the licensee sends notice of cancellation by certified mail, return receipt requested, to the Agency. Cancellation may not occur until an alternative financial assurance mechanism is in place.

B. The licensee shall provide alternative financial assurance as specified in the regulations within 90 days following receipt by the Agency of a notice of cancellation of the guarantee.

C. The guarantee and financial test provisions must remain in effect until the Agency has terminated the license or until another financial assurance method acceptable to the Agency has been put in effect by the licensee.

D. The applicant or licensee must provide to the Agency a written guarantee (a written commitment by a corporate officer) which states that the licensee will fund and carry out the required decommissioning activities or, upon issuance of an order by the Agency, the licensee will set up and fund a trust in the amount of the current cost estimates for decommissioning.

SOURCE: Miss. Code Ann. §45-14-11

Subchapter 4 Standards For Protection Against Radiation

Rule 1.4.1 **Purpose.** This section establishes standards for protection against ionizing radiation resulting from activities conducted pursuant to licenses or registrations issued by the Agency. These regulations are issued pursuant to the Mississippi Radiation Protection Law of 1976.

The requirements of this section are designed to control the receipt, possession, use, transfer, and disposal of sources of radiation by any licensee or registrant so the total dose to an individual, including doses resulting from all sources of radiation other than background radiation, does not exceed the standards for protection against radiation prescribed in this section. However, nothing in this section shall be construed as limiting actions that may be necessary to protect health and safety.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.2 **Scope.** Except as specifically provided in other sections of these regulations, this section applies to persons licensed or registered by the Agency to receive, possess, use, transfer, or dispose of sources of radiation. The limits in this section do not apply to doses due to background radiation, to exposure of patients to radiation for the purpose of medical diagnosis or therapy, to exposure from individuals administered radioactive material and released in accordance with 1.7.33, or to exposure from voluntary participation in medical research programs.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.3 **Definitions.** As used in Subchapter 4:

1. “Air-purifying respirator” means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2. "Annual limit on intake" (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table I, Columns 1 and 2, of Appendix B of this section.

3. “Assigned protection factor (APF)” means the expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the ambient airborne concentration by the APF.

4. “Atmosphere-supplying respirator” means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

5. "Class" means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D, Days, of less than 10 days, for Class W, Weeks, from 10 to 100 days , and for Class Y, Years, of greater than 100 days. For purposes of these regulations, "lung class" and "inhalation class" are equivalent terms.

6. “Constraint (dose constraint)” means a value above which specified licensee actions are required.

7. "Declared pregnant woman" means a woman who has voluntarily informed the licensee or registrant, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

8. “Demand respirator” means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

9. "Derived air concentration" (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI. For purposes of these regulations, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in Table I, Column 3, of Appendix B.

10. "Derived air concentration-hour" (DAC-hour) means the product of the concentration of radioactive material in air, expressed as a fraction or multiple of the derived air concentration for each radionuclide, and the time of exposure to that radionuclide, in hours. A licensee or registrant may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 sievert).

11. “Disposable respirator” means a respirator for which maintenance is not intended and that is designed to be discarded after excessive breathing resistance, sorbent exhaustion, physical damage, or end-of-service-life renders it unsuitable for use. Examples of this type of respirator are a disposable half-mask respirator or a disposable escape-only self-contained breathing apparatus (SCBA).

12. "Dosimetry processor" means an individual or an organization that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

13. “Filtering facepiece (dust mask)” means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium, not equipped with elastomeric sealing surfaces and adjustable straps.

14. “Fit factor” means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

15. “Fit test” means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

16. “Helmet” means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

17. “Hood” means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

18. “Loose-fitting facepiece” means a respiratory inlet covering that is designed to form a partial seal with the face.

19. "Inhalation class" [see "Class"].

20. "Lung class" [see "Class"].

21. “Negative pressure respirator (tight fitting)” means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

22. "Nonstochastic effect" means a health effect, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect. For purposes of these regulations, "deterministic effect" is an equivalent term.

23. "Planned special exposure" means an infrequent exposure to radiation, separate from and in addition to the annual occupational dose limits.

24. “Positive pressure respirator” means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

25. “Powered air-purifying respirator (PAPR)” means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

26. “Pressure demand respirator” means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

27. “Qualitative fit test (QLFT)” means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

28. “Quantitative fit test (QNFT)” means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

29. "Quarter" means a period of time equal to one-fourth of the year observed by the licensee, approximately 13 consecutive weeks, providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

30. "Reference Man" means a hypothetical aggregation of human physical and physiological characteristics determined by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base. A description of the Reference Man is contained in the International Commission on Radiological Protection report, ICRP Publication 23, "Report of the Task Group on Reference Man."

31. "Respiratory protective equipment" means an apparatus, such as a respirator, used to reduce an individual's intake of airborne radioactive materials.

32. "Sanitary sewerage" means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee or registrant.

33. “Self-contained breathing apparatus (SCBA)” means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

34. "Stochastic effect" means a health effect that occurs randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects. For purposes of these regulations, "probabilistic effect" is an equivalent term.

35. “Supplied-air respirator (SAR)” or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

36. “Tight-fitting facepiece” means a respiratory inlet covering that forms a complete seal with the face.

37. “User seal check (fit check)” means an action conducted by the respirator user to determine if the respirator is properly seated to the face. Examples include negative pressure check, positive pressure check, irritant smoke check, or isoamyl acetate check.

38. "Very high radiation area" means 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 500 rads (5 grays) in 1 hour at 1 meter from a source of radiation or from any surface that the radiation penetrates.[19]

39. "Weighting factor" w_T for an organ or tissue (T) means the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

Organ or Tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30[a]
Whole Body	1.00[b]

[a] *0.30 results from 0.06 for each of 5 "remainder" organs, excluding the skin and the lens of the eye, that receive the highest doses.*

[b] *For the purpose of weighting the external whole body dose, for adding it to the internal dose, a single weighting factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.*

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.4 **Implementation.** Any existing license or registration condition that is more restrictive than Subchapter 4 remains in force until there is an amendment or renewal of the license or registration.

[19] At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather than units of dose equivalent, sievert and rem.

1. If a license or registration condition exempts a licensee or registrant from a provision of Subchapter 4 in effect on or before August 9, 1996, it also exempts the licensee or registrant from the corresponding provision of Subchapter 4.

2. If a license or registration condition cites provisions of Subchapter 4 in effect prior to August 9, 1996, which do not correspond to any provisions of Subchapter 4, the license or registration condition remains in force until there is an amendment or renewal of the license or registration that modifies or removes this condition.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.5 **Radiation Protection Programs.**

1. Each licensee or registrant shall develop, document, and implement a radiation protection program sufficient to ensure compliance with the provisions of this section. See 1.4.44 for recordkeeping requirements relating to these programs.

2. The licensee or registrant shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).

3. The licensee or registrant shall, at intervals not to exceed 12 months, review the radiation protection program content and implementation.

4. To implement the ALARA requirements of 1.4.5(2), and notwithstanding the requirements in 1.4.14 of this section, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in 1.4.56 and promptly take appropriate corrective action to ensure against recurrence.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.6 **Occupational Dose Limits for Adults.**

1. The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to 1.4.11, to the following dose limits:

   a. A annual limit, which is the more limiting of:

      i. the total effective dose equivalent being equal to 5 rems (0.05 sievert); or

ii. the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 sievert).

b. The assigned shallow-dose equivalent must be the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure.

c. The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities which are:

i. a lens dose equivalent of 15 rems (0.15 sievert); and

ii. a shallow dose equivalent of 50 rems (0.5 sievert) to the skin of the whole body or to the skin of any extremity.

2. Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current year and during the individual's lifetime. See 1.4.11(5)(a) and (b).

3. When the external exposure is determined by measurement with an external personal monitoring device, the deep-dose equivalent must be used in place of the effective dose equivalent, unless the effective dose equivalent is determined by a dosimetry method approved by the Agency. The assigned deep dose equivalent must be for the part of the body receiving the highest exposure. The assigned shallow dose equivalent must be the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure. The deep dose equivalent, lens dose equivalent and shallow dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.

4. Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Table I of Appendix B of this section and may be used to determine the individual's dose and to demonstrate compliance with the occupational dose limits. See 1.4.49.

5. Notwithstanding the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity. See footnote 3 of Appendix B of this section.

6. The licensee or registrant shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person. See 1.4.10(5).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.7 Compliance with Requirements for Summation of External and Internal Doses.

1. If the licensee is required to monitor pursuant to both 1.4.18(1) and (2), the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee or registrant is required to monitor only pursuant to 1.4.18(1) or only pursuant to 1.4.18(2), then summation is not required to demonstrate compliance with the dose limits. The licensee may demonstrate compliance with the requirements for summation of external and internal doses pursuant to 1.4.7(2), (3), and (4). The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.

2. Intake by Inhalation. If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

   a. the sum of the fractions of the inhalation ALI for each radionuclide; or

   b. the total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000; or

   c. the sum of the calculated committed effective dose equivalents to all significantly irradiated organs or tissues (T) calculated from bioassay data using appropriate biological models and expressed as a fraction of the annual limit. For purposes of this requirement, an organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factors, w_T, and the committed dose equivalent, $H_{T,50}$, per unit intake is greater than 10 percent of the maximum weighted value of H_{50}, that is, $w_{THT,50}$, per unit intake for any organ or tissue.

3. Intake by Oral Ingestion. If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than 10 percent of the applicable oral ALI, the licensee or registrant shall account for this intake and include it in demonstrating compliance with the limits.

4. Intake through Wounds or Absorption through Skin. The licensee shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption. The intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be evaluated or accounted for pursuant to 1.4.7(4).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.8 **Determination of External Dose from Airborne Radioactive Material.**

1. Licensees shall, when determining the dose from airborne radioactive material, include the contribution to the deep dose equivalent, lens dose equivalent, and

shallow dose equivalent from external exposure to the radioactive cloud. See Appendix B of this section, footnotes 1 and 2.

2. Airborne radioactivity measurements and DAC values shall not be used as the primary means to assess the deep dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep dose equivalent to an individual shall be based upon measurements using instruments or individual monitoring devices.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.9 **Determination of Internal Exposure.**

1. For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required pursuant to 1.4.18, take suitable and timely measurements of:

   a. concentrations of radioactive materials in air in work areas; or

   b. quantities of radionuclides in the body; or

   c. quantities of radionuclides excreted from the body; or

   d. combinations of these measurements.

2. Unless respiratory protective equipment is used, as provided in 1.4.24, or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

3. When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual is known, the licensee may:

   a. use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

   b. upon prior approval of the Agency, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material, for example, aerosol size distribution or density; and

   c. separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide to the committed effective dose equivalent. See Appendix B of this section.

4. If the licensee chooses to assess intakes of Class Y material using the measurements given in 1.4.9(1)(b) or (c), the licensee may delay the recording and reporting of the assessments for periods up to 7 months, unless otherwise required by 1.4.55 or 1.4.56. This delay permits the licensee to make additional measurements basic to the assessments.

5. If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours shall be either:

   a. the sum of the ratios of the concentration to the appropriate DAC value, that is, D, W, or Y, from Appendix B of this section for each radionuclide in the mixture; or

   b. the ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

6. If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.

7. When a mixture of radionuclides in air exists, a licensee may disregard certain radionuclides in the mixture if:

   a. the licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in 1.4.6 and in complying with the monitoring requirements in 1.4.18(2); and

   b. the concentration of any radionuclide disregarded is less than 10 percent of its DAC; and

   c. the sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

8. When determining the committed effective dose equivalent, the following information may be considered:

9. In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 5 rems (0.05 sievert) for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

10. For an ALI and the associated DAC determined by the nonstochastic organ dose limit of 50 rems (0.5 sievert), the intake of radionuclides that would result in a committed effective dose equivalent of 5 rems (0.05 sievert), that is, the stochastic ALI, is listed in parentheses in Table I of Appendix B of this section. The licensee may, as a simplifying assumption, use the stochastic ALI to determine committed

effective dose equivalent. However, if the licensee uses the stochastic ALI, the licensee shall also demonstrate that the limit in 1.4.6(1)(a)(ii) is met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.10 **Determination of Prior Occupational Dose.**

1. For each individual who is likely to receive in a year, an occupational dose requiring monitoring pursuant to 1.4.18, the licensee or registrant shall:

   a. determine the occupational radiation dose received during the current year; and

   b. attempt to obtain the records of lifetime cumulative occupational radiation dose.

2. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine:

   a. the internal and external doses from all previous planned special exposures; and

   b. all doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual; and

   c. all lifetime cumulative occupational radiation dose.

3. In complying with the requirements of 1.4.10(1), a licensee or registrant may:

   a. accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year; and

   b. accept, as the record of lifetime cumulative radiation dose, an up-to-date Agency Form RH-4 or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant; and

   c. obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

4. **Determination of Prior Occupational Dose.**

a. The licensee or registrant shall record the exposure history, as required by 1.4.10(1), on Agency Form RH-4, or other clear and legible record, of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing Agency Form RH-4 or equivalent. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on Agency Form RH-4 or equivalent indicating the periods of time for which data are not available.

b. Licensees are not required to reevaluate the separate external dose equivalents and internal committed dose equivalents or intakes of radionuclides assessed pursuant to the regulations in this section in effect before August 9, 1996. Further, occupational exposure histories obtained and recorded on Agency Form RH-4 or equivalent before August 9, 1996, would not have included effective dose equivalent, but may be used in the absence of specific information on the intake of radionuclides by the individual.

5. If the licensee is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee shall assume:

a. In establishing administrative controls pursuant to 1.4.10(1) for the current year, that the allowable dose limit for the individual is reduced by 12.5 millisieverts (1.25 rems) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and

b. That the individual is not available for planned special exposures.

6. The licensee shall retain the records on Agency Form RH-4 or equivalent until the Agency terminates each pertinent license or registration requiring this record. The licensee shall retain records used in preparing Agency Form RH-4 or equivalent for 3 years after the record is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.11 **Planned Special Exposures.** A licensee or registrant may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in 1.4.6 provided that each of the following conditions is satisfied:

1. The licensee or registrant authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the dose estimated to result from the planned special exposure are unavailable or impractical.

2. The licensee or registrant, and employer if the employer is not the licensee or registrant, specifically authorizes the planned special exposure, in writing, before the exposure occurs.

3. Before a planned special exposure, the licensee or registrant ensures that each individual involved is:

    a. informed of the purpose of the planned operation; and

    b. informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and

    c. instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

4. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant ascertains prior doses as required by 1.4.10(2) during the lifetime of the individual for each individual involved.

5. Subject to 1.4.6(2), the licensee or registrant shall not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed:

    a. the numerical values of any of the dose limits in 1.4.6(1) in any year; and

    b. five times the annual dose limits in 1.4.6(1) during the individual's lifetime.

6. The licensee or registrant maintains records of the conduct of a planned special exposure in accordance with 1.4.48 and submits a written report in accordance with 1.4.57.

7. The licensee or registrant records the best estimate of the dose resulting from the planned special exposure in the individual's record and informs the individual, in writing, of the dose within 30 days from the date of the planned special exposure. The dose from planned special exposures shall not be considered in controlling future occupational dose of the individual pursuant to 1.4.6(1) but shall be included in evaluations required by 1.4.11(4) and 1.4.11(5).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.12 **Occupational Dose Limits for Minors.** The annual occupational dose limits for minors are 10 percent of the annual occupational dose limits specified for adult workers in 1.4.6.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.13 **Dose Equivalent to an Embryo/Fetus.**

1. The licensee or registrant shall ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 millisieverts). See 1.4.49 for recordkeeping requirements.

2. The licensee or registrant shall make efforts to avoid substantial variation[20] above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in 1.4.13(1).

3. The dose equivalent to an embryo/fetus shall be taken as the sum of:

   a. the deep dose equivalent to the declared pregnant woman; and

   b. the dose equivalent to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

4. If by the time the woman declares pregnancy to the licensee or registrant, the dose equivalent to the embryo/fetus has exceeded 0.5 rem (5 millisieverts), or is within 0.05 rem (0.5 mSv) of this dose, the licensee or registrant shall be deemed to be in compliance with 1.4.13(1) if the additional dose to the embryo/fetus does not exceed 0.05 rem (0.5 millisievert) during the remainder of the pregnancy.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.14 **Dose Limits for Individual Members of the Public.**

1. Each licensee or registrant shall conduct operations so that:

   a. the total effective dose equivalent to individual members of the public from the licensed or registered operation does not exceed 0.1 rem (1 millisievert) in a year, exclusive of the dose contributions from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with 1.7.33 of these regulations from voluntary participation in medical research programs, and from

[20] The National Council on Radiation Protection and Measurements recommended in NCRP Report No. 91 "Recommendations on Limits for Exposure to Ionizing Radiation" (June 1, 1987) that no more than 0.05 rem (0.5 millisievert) to the embryo/fetus be received in any one month.

b. the licensee's disposal of radioactive material into sanitary sewerage in accordance with 1.4.37[21]; and

c. the dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with 1.7.33 of these regulations does not exceed 0.002 rem (0.02 millisievert) in any one hour.

2. If the licensee or registrant permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

3. Notwithstanding 1.4.14(1)(a), a licensee may permit visitors to an individual who cannot be released, under 1.7.33, to receive a radiation dose greater than 0.1 rem (1 mSv) if:

a. The radiation dose received does not exceed 0.5 rem (5 mSv); and

b. The authorized user, as defined in Subchapter 7, has determined before the visit that it is appropriate.

4. A licensee, registrant, or an applicant for a license or registration may apply for prior Agency authorization to operate up to an annual dose limit for an individual member of the public of 0.5 rem (5 millisieverts). This application shall include the following information:

a. demonstration of the need for and the expected duration of operations in excess of the limit in 1.4.14(1); and

b. the licensee's or registrant's program to assess and control dose within the 0.5 rem (5 millisieverts) annual limit; and

c. the procedures to be followed to maintain the dose ALARA.

5. In addition to the requirements of Subchapter 4, a licensee subject to the provisions of the U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190 shall comply with those standards.

6. The Agency may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee or registrant may release in effluents in order to restrict the collective dose.

SOURCE: Miss. Code Ann. §45-14-11

[21] Retrofitting shall not be required for locations within facilities where only radiation machines existed prior to August 9, 1996, and met the previous requirements of 0.5 rem (5 millisieverts) in a year.

Rule 1.4.15 **Compliance with Dose Limits for Individual Members of the Public.**

1. The licensee or registrant shall make or cause to be made surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in 1.4.14.

2. A licensee or registrant shall show compliance with the annual dose limit in 1.4.14 by:

   a. demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed or registered operation does not exceed the annual dose limit; or

   b. demonstrating that:

      i. the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table II of Appendix B of this section; and

      ii. if an individual were continually present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 millisievert) in an hour and 0.05 rem (0.5 millisievert) in a year.

3. Upon approval from the Agency, the licensee may adjust the effluent concentration values in Appendix B of this section, Table II, for members of the public, to take into account the actual physical and chemical characteristics of the effluents, such as, aerosol size distribution, solubility, density, radioactive decay equilibrium, and chemical form.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.16 **Testing for Leakage or Contamination of Sealed Sources.**

1. The licensee in possession of any sealed source shall assure that:

   a. Each sealed source, except as specified in 1.4.16(2), is tested for leakage or contamination and the test results are received before the sealed source is put into use unless the licensee has a certificate from the transferor indicating that the sealed source was tested within 6 months before transfer to the licensee.

   b. Each sealed source that is not designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed 6 months or at alternative intervals approved by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission.

c. Each sealed source that is designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed 3 months or at alternative intervals approved by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission.

d. For each sealed source that is required to be tested for leakage or contamination, at any other time there is reason to suspect that the sealed source might have been damaged or might be leaking, the licensee shall assure that the sealed source is tested for leakage or contamination before further use.

e. Tests for leakage for all sealed sources, except brachytherapy sources manufactured to contain radium, shall be capable of detecting the presence of 0.005 microcurie (185 becquerels) of radioactive material on a test sample. Test samples shall be taken from the sealed source or from the surfaces of the container in which the sealed source is stored or mounted on which one might expect contamination to accumulate. For a sealed source contained in a device, test samples are obtained when the source is in the "off" position.

f. The test for leakage for brachytherapy sources manufactured to contain radium shall be capable of detecting an absolute leakage rate of 0.001 microcurie (37 becquerels) of radon-222 in a 24 hour period when the collection efficiency for radon-222 and its daughters has been determined with respect to collection method, volume and time.

g. Tests for contamination from radium daughters shall be taken on the interior surface of brachytherapy source storage containers and shall be capable of detecting the presence of 0.005 microcurie (185 becquerels) of a radium daughter which has a half-life greater than 4 days.

2. A licensee need not perform test for leakage or contamination on the following sealed sources

a. sealed sources containing only radioactive material with a half-life of less than 30 days;

b. sealed sources containing only radioactive material as a gas;

c. sealed sources containing 100 microcuries (3.7 megabecquerels) or less of beta or photon-emitting material or 10 microcuries (370 kilobecquerels) or less of alpha-emitting material;

d. sealed sources containing only hydrogen-3;

e. seeds of iridium-192 encased in nylon ribbon; and

f. sealed sources, except teletherapy and brachytherapy sources, which are stored, not being used and identified as in storage. The licensee shall, however, test each such sealed source for leakage or contamination and receive the test results before any use or transfer unless it has been tested for leakage or contamination within 6 months before the date of use or transfer.

3. Tests for leakage or contamination from sealed sources shall be performed by persons specifically authorized by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission to perform such services.

4. Test results shall be kept in units of microcurie or becquerel and maintained for inspection by the Agency.

5. The following shall be considered evidence that a sealed source is leaking:

a. The presence of 0.005 microcurie (185 becquerels) or more of removable contamination on any test sample.

b. Leakage of 0.001 microcurie (37 becquerels) of radon-222 per 24 hours for brachytherapy sources manufactured to contain radium.

c. The presence of removable contamination resulting from the decay of 0.005 microcurie (185 becquerels) or more of radium.

6. The licensee shall immediately withdraw a leaking sealed source from use and shall take action to prevent the spread of contamination. The leaking sealed source shall be repaired or disposed of in accordance with this section.

7. Reports of test results for leaking or contaminated sealed sources shall be made pursuant to 1.4.61.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.17 **General.**

1. Each licensee or registrant shall make, or cause to be made, surveys that:

a. are necessary for the licensee or registrant to comply with Subchapter 4; and

b. are necessary under the circumstances to evaluate:

i. the magnitude and extent of radiation levels; and

ii. concentrations or quantities of radioactive material; and

iii. the potential radiological hazards.

2. The licensee or registrant shall ensure that instruments and equipment used for quantitative radiation measurements, for example, dose rate and effluent monitoring, are calibrated at intervals not to exceed 12 months unless a more frequent interval is specified in another section of these regulations for the radiation measured.

3. All personnel dosimeters, except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to any extremity, that require processing to determine the radiation dose and that are used by licensees and registrants to comply with 1.4.6, with other applicable provisions of these regulations, or with conditions specified in a license or registration shall be processed and evaluated by a dosimetry processor:

   a. holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and

   b. approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

4. The licensee or registrant shall ensure that adequate precautions are taken to prevent a deceptive exposure of an individual monitoring device.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.18 **Conditions Requiring Individual Monitoring of External and Internal Occupational Dose.** Each licensee or registrant shall monitor exposures from sources of radiation at levels sufficient to demonstrate compliance with the occupational dose limits of this section. As a minimum:

1. Each licensee or registrant shall monitor occupational exposure to radiation and shall supply and require the use of individual monitoring devices by:

   a. adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the limits in 1.4.6(1); and

   b. minors likely to receive, in 1 year from sources of radiation external to the body, a deep dose equivalent in excess of 0.1 rem (1mSv), a lens dose equivalent in excess of 0.15 rem (1.5 mSv), or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem (5 mSv); and

c. declared pregnant women likely to receive during the entire pregnancy, from sources of radiation external to the body, a deep dose equivalent in excess of 0.1 rem (1 mSv)[22]; and

d. individuals entering a high or very high radiation area.

2. Each licensee shall monitor, to determine compliance with 1.4.9, the occupational intake of radioactive material by and assess the committed effective dose equivalent to:

a. adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI in Table I, Columns 1 and 2, of Appendix B of this section; and

b. minors likely to receive, in 1 year, a committed effective dose equivalent in excess of 0.1 rem (1 mSv); and

c. declared pregnant women likely to receive, during the entire pregnancy, a committed effective dose equivalent in excess of 0.1 rem (1 mSv).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.19 **Control of Access to High Radiation Areas.**

1. The licensee or registrant shall ensure that each entrance or access point to a high radiation area has one or more of the following features:

a. a control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep dose equivalent of 0.1 rem (1 millisievert) in 1 hour at 30 centimeters from the source of radiation from any surface that the radiation penetrates; or

b. a control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or

c. entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

2. In place of the controls required by 1.4.19(1) for a high radiation area, the licensee or registrant may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

3. The licensee or registrant may apply to the Agency for approval of alternative methods for controlling access to high radiation areas.

[22] All of the occupational doses in 1.1.6 continue to be applicable to the declared pregnant worker as long as the embryo/fetus dose limit is not exceeded.

4. The licensee or registrant shall establish the controls required by 1.4.19(1) and (3) in a way that does not prevent individuals from leaving a high radiation area.

5. The licensee is not required to control each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation provided that:

   a. the packages do not remain in the area longer than 3 days; and

   b. the dose rate at 1 meter from the external surface of any package does not exceed 0.01 rem (0.1 millisievert) per hour.

6. The licensee is not required to control entrance or access to rooms or other areas in hospitals solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who are taking the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the established limits in this section and to operate within the ALARA provisions of the licensee's radiation protection program.

7. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a high radiation area as described in 1.4.19 if the registrant has met all the specific requirements for access and control specified in other applicable sections of these regulations, such as, Subchapter 5 for industrial radiography, Subchapter 6 for x-rays in the healing arts, Subchapter 9 for particle accelerators and Subchapter 14 for therapeutic radiation machines.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.20 **Control of Access to Very High Radiation Areas.**

1. In addition to the requirements in 1.4.19, the licensee or registrant shall institute measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour at 1 meter from a source of radiation or any surface through which the radiation penetrates. This requirement does not apply to rooms or areas in which diagnostic x-ray systems are the only source of radiation, or to non-self-shielded irradiators.

2. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a very high radiation area as described in 1.4.20(1) if the registrant has met all the specific requirements for access and control specified in other applicable sections of these regulations, such as, Subchapter 5 for industrial radiography, Subchapter 6 for x-rays in the healing

arts, Subchapter 9 for particle accelerators and Subchapter 14 for therapeutic radiation machines.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.21 **Control of Access to Very High Radiation Areas—Irradiators.**

1. Rule 1.4.21 applies to licensees with sources of radiation in non-self-shielded irradiators. Rule 1.4.21 does not apply to sources of radiation that are used in teletherapy, in industrial radiography, or in completely self-shielded irradiators in which the source of radiation is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual.

2. Each area in which there may exist radiation levels in excess of 5 grays (500 rads) in 1 hour at 1 meter from a source of radiation that is used to irradiate materials shall meet the following requirements:

   a. Each entrance or access point shall be equipped with entry control devices which:

      i. function automatically to prevent any individual from inadvertently entering a very high radiation area; and

      ii. permit deliberate entry into the area only after a control device is actuated that causes the radiation level within the area, from the source of radiation, to be reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour; and

      iii. prevent operation of the source of radiation if it would produce radiation levels in the area that could result in a deep dose equivalent to an individual in excess of 0.1 rem (1 millisievert) in 1 hour.

   b. Additional control devices shall be provided so that, upon failure of the entry control devices to function as required by 1.4.21(2)(a):

      i. the radiation level within the area, from the source of radiation, is reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour; and

      ii. conspicuous visible and audible alarm signals are generated to make an individual attempting to enter the area aware of the hazard and at least one other authorized individual, who is physically present, familiar with the activity, and prepared to render or

summon assistance, aware of the failure of the entry control devices.

c. The licensee shall provide control devices so that, upon failure or removal of physical radiation barriers other than the sealed source's shielded storage container

i. the radiation level from the source of radiation is reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour; and

ii. conspicuous visible and audible alarm signals are generated to make potentially affected individuals aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier.

d. When the shield for stored sealed sources is a liquid, the licensee shall provide means to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding.

e. Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of 1.4.21(2)(c) and (d).

f. Each area shall be equipped with devices that will automatically generate conspicuous visible and audible alarm signals to alert personnel in the area before the source of radiation can be put into operation and in time for any individual in the area to operate a clearly identified control device, which must be installed in the area and which can prevent the source of radiation from being put into operation.

g. Each area shall be controlled by use of such administrative procedures and such devices as are necessary to ensure that the area is cleared of personnel prior to each use of the source of radiation.

h. Each area shall be checked by a radiation measurement to ensure that, prior to the first individual's entry into the area after any use of the source of radiation, the radiation level from the source of radiation in the area is below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour.

i. The entry control devices required in 1.4.21(2)(a) shall be tested for proper functioning. See 1.4.52 for recordkeeping requirements.

i. Testing shall be conducted prior to initial operation with the source of radiation on any day, unless operations were continued uninterrupted from the previous day.

ii. Testing shall be conducted prior to resumption of operation of the source of radiation after any unintentional interruption.

iii. The licensee shall submit and adhere to a schedule for periodic tests of the entry control and warning systems.

j. The licensee shall not conduct operations, other than those necessary to place the source of radiation in safe condition or to affect repairs on controls, unless control devices are functioning properly.

k. Entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, shall be controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through these portals. Exit portals for irradiated materials shall be equipped to detect and signal the presence of any loose radioactive material that is carried toward such an exit and automatically to prevent loose radioactive material from being carried out of the area.

3. Licensees, or applicants for licenses for sources of radiation within the purview of 1.4.21(2) which will be used in a variety of positions or in locations, such as open fields or forests, that make it impracticable to comply with certain requirements of 1.4.21(2), such as those for the automatic control of radiation levels, may apply to the Agency for approval of alternative safety measures. Alternative safety measures shall provide personnel protection at least equivalent to those specified in 1.4.21(2). At least one of the alternative measures shall include an entry-preventing interlock control based on a measurement of the radiation that ensures the absence of high radiation levels before an individual can gain access to the area where such sources of radiation are used.

4. The entry control devices required by 1.4.21(2) and (3) shall be established in such a way that no individual will be prevented from leaving the area.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.22 **Use of Process or Other Engineering Controls.** The licensee shall use, to the extent practicable, process or other engineering controls, such as, containment, decontamination, or ventilation, to control the concentrations of radioactive material in air.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.23 **Use of Other Controls.**

1. When it is not practicable to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee or registrant shall, consistent with maintaining the total effective dose equivalent ALARA, increase monitoring and limit intakes by one or more of the following means:

   a. control of access; or

   b. limitation of exposure times; or

   c. use of respiratory protection equipment; or

   d. other controls.

2. If the licensee performs an ALARA analysis to determine whether or not respirators should be used, the licensee may consider safety factors other than radiological factors. The licensee should also consider the impact of respirator use on workers' industrial health and safety.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.24 **Use of Individual Respiratory Protection Equipment.**

1. If the licensee uses respiratory protection equipment to limit intakes pursuant to 1.4.23:

   a. Except as provided in 1.4.25(1)(b), the licensee shall use only respiratory protection equipment that is tested and certified or had certification extended by the National Institute for Occupational Safety and Health.

   b. If the licensee wishes to use equipment that has not been tested or certified by the National Institute for Occupational Safety and Health, or for which there is no schedule for testing or certification, the licensee shall submit an application for authorized use of that equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

   c. The licensee shall implement and maintain a respiratory protection program that includes:

      i. air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate doses; and

ii. surveys and bioassays, as appropriate, to evaluate actual intakes; and

iii. testing of respirators for operability (user seal check for face sealing devices and functional check for others) immediately prior to each use; and

iv. written procedures regarding selection, fitting, issuance, maintenance, and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and recordkeeping; and

v. determination by a physician prior to initial fitting of respirators, and either every 12 months thereafter, or periodically at a frequency determined by a physician that the individual user is medically fit to use the respiratory protection equipment.

vi. fit testing, with fit factor > 10 times the APF for negative pressure devices, and a fit factor > 500 for any positive pressure, continuous flow, and pressure-demand devices, before the first field use of tight fitting, face-sealing respirators and periodically thereafter at a frequency not to exceed 1 year. Fit testing must be performed with the facepiece operating in the negative pressure mode.

d. The licensee shall issue a written policy statement on respirator usage covering:

i. the use of process or other engineering controls, instead of respirators; and

ii. the routine, nonroutine, and emergency use of respirators; and

iii. the length of periods of respirator use and relief from respirator use.

e. The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

f. The licensee shall also consider limitations appropriate to the type and mode of use. When selecting respiratory devices the licensee shall provide for vision correction, adequate communication, low temperature work environments, and the concurrent use of other safety or radiological protection equipment. The licensee shall use equipment in such a way as not to interfere with the proper operation of the respirator.

g. Standby rescue persons are required whenever one-piece atmosphere-supplying suits, or any combination of supplied air respiratory protection device and personnel protective equipment are used from which an unaided individual would have difficulty extricating himself or herself. The standby persons must be equipped with respiratory protection devices or other apparatus appropriate for the potential hazards. The standby rescue persons shall observe or otherwise maintain continuous communication with the workers (visual, voice, signal line, telephone, radio, or other suitable means), and be immediately available to assist them in case of a failure of the air supply or for any other reason that requires relief from distress. A sufficient number of standby rescue persons must be immediately available to assist all users of this type of equipment and to provide effective emergency rescue if needed.

h. Atmosphere-supplying respirators must be supplied with respirable air of grade D quality or better as defined by the Compressed Gas Association in publication G-7.1, "Commodity Specification for Air," 1997 and included in the regulations of the Occupational Safety and Health Administration (29 CFR 1910.134(i)(1)(ii)(A) through (E). Grade D quality air criteria include:

i. Oxygen content (v/v) of 19.5-23.5%;

ii. Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

iii. Carbon monoxide (CO) content of 10 ppm or less;

iv. Carbon dioxide content of 1,000 ppm or less; and

v. Lack of noticeable odor.

i. The licensee shall ensure that no objects, materials or substances, such as facial hair, or any conditions that interfere with the face-facepiece seal or valve function, and that are under the control of the respirator wearer, are present between the skin of the wearer's face and the sealing surface of a tight-fitting respirator facepiece.

2. In estimating the dose to individuals from intake of airborne radioactive materials, the concentration of radioactive material in the air that is inhaled when respirators are worn is initially assumed to be the ambient concentration in air without respiratory protection, divided by the assigned protection factor. If the dose is later found to be greater than the estimated dose, the corrected value must be used. If the dose is later found to be less than the estimated dose, the corrected value may be used.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.25 **Further Restrictions on the Use of Respiratory Protection Equipment.** The Agency may impose restrictions in addition to the provisions of 1.4.23, 1.4.24, and Appendix A of this section in order to:

1. Ensure that the respiratory protection program of the licensee is adequate to limit doses to individuals from intakes of airborne radioactive materials consistent with maintaining total effective dose equivalent ALARA; and

2. Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.26 **Application for Use of Higher Assigned Protection Factors.** The licensee shall obtain authorization from the Agency before assigning respiratory protection factors in excess of those specified in Appendix A of this section of this section. The Agency may authorize a licensee to use higher assigned protection factors on receipt of an application that

1. describes the situation for which a need exists for higher protection factors; and

2. demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.27 **Security of Stored Sources of Radiation.** The licensee or registrant shall secure from unauthorized removal or access licensed or registered sources of radiation that are stored in controlled or unrestricted areas.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.28 **Control of Sources of Radiation not in Storage.**

1. The licensee shall control and maintain constant surveillance of licensed radioactive material that is in a controlled or unrestricted area and that is not in storage or in a patient.

2. The registrant shall maintain control of radiation machines that are in a controlled or unrestricted area and that are not in storage.

SOURCE: Miss. Code Ann. §45-14-11

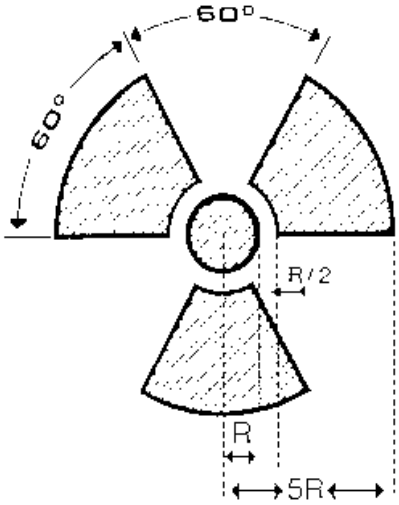
Rule 1.4.29 **Caution Signs.**

1. Standard Radiation Symbol. Unless otherwise authorized by the Agency, the symbol prescribed by 1.4.29 shall use the colors magenta, or purple, or black on yellow background. The symbol prescribed is the three-bladed design as follows:

a. Cross-hatched area is to be magenta, or purple, or black, and

b. the background is to be yellow.

RADIATION SYMBOL



2. Exception to Color Requirements for Standard Radiation Symbol. Notwithstanding the requirements of 1.4.29(1), licensees or restraints are authorized to label sources, source holders, or device components containing sources of radiation that are subjected to high temperatures, with conspicuously etched or stamped radiation caution symbols and without a color requirement.

3. Additional Information on Signs and Labels. In addition to the contents of signs and labels prescribed in this section, the licensee or registrant shall provide, on or near the required signs and labels, additional information, as appropriate, to make individuals aware of potential radiation exposures and to minimize the exposures.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.30 **Posting Requirements.**

1. Posting of Radiation Areas. The licensee or registrant shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

2. Posting of High Radiation Areas. The licensee or registrant shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

3. Posting of Very High Radiation Areas. The licensee or registrant shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

4. Posting of Airborne Radioactivity Areas. The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

5. Posting of Areas or Rooms in Which Licensed Material is Used or Stored. The licensee shall post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to Subchapter 4 with a conspicuous sign or signs bearing the

radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.31 **Exceptions to Posting Requirements**

1. A licensee or registrant is not required to post caution signs in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

   a. the sources of radiation are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to sources of radiation in excess of the limits established in this section; and

   b. the area or room is subject to the licensee's or registrant's control.

2. Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to 1.4.30 provided that the patient could be released from licensee control pursuant to 1.7.33 of these regulations.

3. A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at 30 centimeters from the surface of the sealed source container or housing does not exceed 0.005 rem (0.05 millisievert) per hour.

4. A room or area is not required to be posted with a caution sign because of the presence of radiation machines used solely for diagnosis in the healing arts.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.32 **Labeling Containers and Radiation Machines.**

1. The licensee shall ensure that each container of licensed material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label shall also provide information, such as the radionuclides present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment, to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposures.

2. Each licensee shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

3. Each registrant shall ensure that each radiation machine is labeled in a conspicuous manner which cautions individuals that radiation is produced when it is energized.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.33 **Exemptions to Labeling Requirements.** A licensee is not required to label:

1. containers holding licensed material in quantities less than the quantities listed in Appendix C of this section ; or

2. containers holding licensed material in concentrations less than those specified in Table III of Appendix B of this section; or

3. containers attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established by this section; or

4. containers when they are in transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation[23]; or

5. containers that are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record. Examples of containers of this type are containers in locations such as water-filled canals, storage vaults, or hot cells. The record shall be retained as long as the containers are in use for the purpose indicated on the record; or

6. installed manufacturing or process equipment, such as piping and tanks.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.34 **Procedures for Receiving and Opening Packages.**

1. Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in 1.13.2 and Appendix A of Subchapter 13, shall make arrangements to receive:

   a. the package when the carrier offers it for delivery; or

   b. the notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

2. Each licensee shall:

[23] Labeling of packages containing radioactive materials is required by the U. S. Department of Transportation if the amount and type of radioactive material exceed the limits for an excepted quantity or article as defined by U. S. Department of Transportation Regulations CFR173.403(m), CFR173.403 (w), and 173.421-424.

a. monitor the external surfaces of a labeled[24] package for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in 1.1.2; and

b. monitor the external surfaces of a labeled [6] package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in 1.13.2 and Appendix A of Subchapter 13; and

c. monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

3. The licensee shall perform the monitoring required by 1.4.34(2) as soon as practicable after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

4. The licensee shall immediately notify the final delivery carrier and the Agency by telephone or facsimile, when:

a. removable radioactive surface contamination exceeds the limits of 1.13.15(9); or

b. external radiation levels exceed the limits of 1.13.15(10) and 1.13.15(11).

5. Each licensee shall:

a. establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

b. ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.

6. Licensees transferring special form sources in vehicles owned or operated by the licensee to and from a work site are exempt from the contamination monitoring requirements of 1.4.34(2), but are not exempt from the monitoring requirement in 1.4.34(2) for measuring radiation levels that ensures that the source is still properly lodged in its shield.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.35 **Waste Disposal General Requirements.**

1. A licensee shall dispose of licensed material only:

[24] Labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U. S. Department of Transportation Regulations CFR 172.403 and 172.436.440

a. by transfer to an authorized recipient as provided in 1.4.40 or in Subchapter 3 or 11, or to the U.S. Department of Energy; or

b. by decay in storage; or

c. by release in effluents within the limits in 1.4.14; or

d. as authorized pursuant to 1.4.36, 1.4.37, 1.4.38, 1.4.39 or 1.4.42.

2. A person shall be specifically licensed to receive waste containing licensed material from other persons for:

a. treatment prior to disposal; or

b. treatment or disposal by incineration; or

c. decay in storage; or

d. disposal at a land disposal facility licensed pursuant to these regulations; or

e. storage until transferred to a storage or disposal facility authorized to receive the waste.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.36 **Method for Obtaining Approval of Proposed Disposal Procedures.** A licensee or applicant for a license may apply to the Agency for approval of proposed procedures, not otherwise authorized in these regulations, to dispose of licensed material generated in the licensee's operations. Each application shall include:

1. a description of the waste containing licensed material to be disposed of, including the physical and chemical properties that have an impact on risk evaluation, and the proposed manner and conditions of waste disposal; and

2. an analysis and evaluation of pertinent information on the nature of the environment; and

3. the nature and location of other potentially affected facilities; and

4. analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.37 **Disposal by Release into Sanitary Sewerage.**

1. A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:

a. the material is readily soluble, or is readily dispersible biological material, in water; and

b. the quantity of licensed radioactive material that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table III of Appendix B of this section; and

c. if more than one radionuclide is released, the following conditions must also be satisfied:

i. the licensee shall determine the fraction of the limit in Table III of Appendix B of this section represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table III of Appendix B of this section; and

ii. the sum of the fractions for each radionuclide required by 1.4.37(1)(c)(i) does not exceed unity; and

d. the total quantity of licensed radioactive material that the licensee releases into the sanitary sewerage in a year does not exceed 5 curies (185 gigabecquerels) of hydrogen-3, 1 curie (37 gigabecquerels) of carbon-14, and 1 curie (37 gigabecquerels) of all other radioactive materials combined.

2. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in 1.4.37(1).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.38 **Treatment or Disposal by Incineration.** A licensee may treat or dispose of licensed material by incineration only in the amounts and forms specified in 1.4.39 or as specifically approved by the Agency pursuant to 1.4.36.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.39 **Disposal of Specific Wastes.**

1. A licensee may dispose of the following licensed material as if it were not radioactive:

a. 0.05 microcurie (1.85 kilobecquerels) or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; and

b. 0.05 microcurie (1.85 kilobecquerels) or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

2. A licensee shall not dispose of tissue pursuant to 1.4.39(1)(b) in a manner that would permit its use either as food for humans or as animal feed.

3. The licensee shall maintain records in accordance with 1.4.51.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.40 **Transfer for Disposal and Manifests.**

1. The requirements of 1.4.40 and Appendix D of this section are designed to:

   a. Control transfers of low-level radioactive waste by any waste generator, waste collector, or waste processor licensee, as defined in this section, who ships low-level waste either directly, or indirectly through a waste collector or waste processor, to a licensed low-level waste land disposal facility (as defined in Appendix D of this section);

   b. Establish a manifest tracking system; and

   c. Supplement existing requirements concerning transfers and recordkeeping for those wastes.

2. Any licensee shipping radioactive waste intended for ultimate disposal at a licensed land disposal facility must document the information required on NRC(s Uniform Low-Level Radioactive Waste Manifest and transfer this recorded manifest information to the intended consignee in accordance with Appendix D of this section.

3. Each shipment manifest shall include a certification by the waste generator as specified in Section II of Appendix D of this section.

4. Each person involved in the transfer for disposal and disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in Section III of Appendix D of this section.

5. Any licensee shipping byproduct material as defined in paragraphs (3), (4) and (5) of the definition of byproduct material set forth in 1.1.2 intended for ultimate disposal at a land disposal facility licensed under 10 CFR Part 61 must document the information required on the NRC's Uniform Low-Level Radioactive Waste Manifest and transfer this recorded manifest information to the intended consignee in accordance with Appendix D to this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.41 **Compliance with Environmental and Health Protection Regulations.** Nothing in Subchapter 4 relieves the licensee from complying with other applicable

Federal, State and local regulations governing any other toxic or hazardous properties of materials that may be disposed of under these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.42 **Disposal of Certain Byproduct Material.**

1. Licensed material as defined in paragraphs (3), (4) and (5) of the definition of byproduct material set forth in 1.1.2 may be disposed of in accordance with 10 CFR Part 61, even though it is not defined as low-level radioactive waste. Therefore, any licensed byproduct material being disposed of at a facility, or transferred for ultimate disposal at a facility licensed under 10 CFR Part 61, must meet the requirements of 1.4.40.

2. A licensee may dispose of byproduct material, as defined in paragraphs (3), (4) and (5) of the definition of byproduct material set forth in 1.1.2, at a disposal facility authorized to dispose of such material in accordance with any Federal or State solid or hazardous waste law, including the Solid Waste Disposal Act, as authorized under the Energy Policy Act of 2005.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.43 **Records: General Provisions.**

1. Each licensee or registrant shall use the special units curie, rad, rem and roentgen, or the SI units becquerel, gray, sievert and coulomb per kilogram, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by this section.

2. In the records required by this section, the licensee may record quantities in SI units in parentheses following each of the units specified in 1.4.43(1). However, all quantities must be recorded as stated in 1.4.43(1).

3. Notwithstanding the requirements of 1.4.43(1) when recording information on shipment manifests, as required in 1.4.40(2), information must be recorded in the International System of Units (SI) or in SI and units as specified in 1.4.43(1).The licensee or registrant shall make a clear distinction among the quantities entered on the records required by this section, such as, total effective dose equivalent, total organ dose equivalent, shallow dose equivalent, lens dose equivalent, deep dose equivalent, or committed effective dose equivalent.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.44 **Records of Radiation Protection Programs.**

1. Each licensee or registrant shall maintain records of the radiation protection program, including:

a. the provisions of the program; and

b. audits and other reviews of program content and implementation.

c. The licensee or registrant shall retain the records required by 1.4.44(1)(a) until the Agency terminates each pertinent license or registration requiring the record. The licensee or registrant shall retain the records required by 1.4.44(1)(b) for 3 years after the record is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.45 **Records of Surveys.**

1. Each licensee or registrant shall maintain records showing the results of surveys and calibrations required by 1.4.17 and 1.4.34(2). The licensee or registrant shall retain these records for 3 years after the record is made.

2. The licensee or registrant shall retain each of the following records until the Agency terminates each pertinent license or registration requiring the record:

   a. records of the results of surveys to determine the dose from external sources of radiation used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents; and

   b. records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose; and

   c. records showing the results of air sampling, surveys, and bioassays required pursuant to 1.4.24(1)(c)(i) and 1.4.24(1)(c)(ii); and

   d. records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.46 **Records of Tests for Leakage or Contamination of Sealed Sources.** Records of tests for leakage or contamination of sealed sources required by 1.4.16 shall be kept in units of microcurie or becquerel and maintained for inspection by the Agency for 5 years after the records are made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.47 **Records of Prior Occupational Dose.** The licensee or registrant shall retain the records of prior occupational dose and exposure history as specified in 1.4.10 on Agency Form RH-4 or equivalent until the Agency terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain

records used in preparing Agency Form RH-4 or equivalent for 3 years after the record is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.48 **Records of Planned Special Exposures.**

1. For each use of the provisions of 1.4.11 for planned special exposures, the licensee or registrant shall maintain records that describe:

   a. the exceptional circumstances requiring the use of a planned special exposure; and

   b. the name of the management official who authorized the planned special exposure and a copy of the signed authorization; and

   c. what actions were necessary; and

   d. why the actions were necessary; and

   e. what precautions were taken to assure that doses were maintained ALARA; and

   f. what individual and collective doses were expected to result; and

   g. the doses actually received in the planned special exposure.

2. The licensee or registrant shall retain the records until the Agency terminates each pertinent license or registration requiring these records.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.49 **Records of Individual Monitoring Results.**

1. Recordkeeping Requirement. Each licensee or registrant shall maintain records of doses received by all individuals for whom monitoring was required pursuant to 1.4.18, and records of doses received during planned special exposures, accidents, and emergency conditions. Assessments of dose equivalent and records made using units in effect before the effective date of this section need not be changed. These records shall include, when applicable:

   a. the deep dose equivalent to the whole body, lens dose equivalent, shallow dose equivalent to the skin, and shallow dose equivalent to the extremities; and

   b. the estimated intake of radionuclides, see 1.4.7; and

   c. the committed effective dose equivalent assigned to the intake of radionuclides; and

d. the specific information used to calculate the committed effective dose equivalent pursuant to 1.4.9(1) and (3); and

e. the total effective dose equivalent when required by 1.4.7; and

f. the total of the deep dose equivalent and the committed dose to the organ receiving the highest total dose.

2. Recordkeeping Frequency. The licensee or registrant shall make entries of the records specified in 1.4.49(1) at intervals not to exceed 1 year.

3. Recordkeeping Format. The licensee or registrant shall maintain the records specified in 1.4.49(1) on Agency Form RH-6, in accordance with the instructions for Agency Form RH-6, or in clear and legible records containing all the information required by Agency Form RH-6.

4. The licensee or registrant shall maintain the records of dose equivalent to an embryo/fetus with the records of dose equivalent to the declared pregnant woman. The declaration of pregnancy, including the estimated date of conception, shall also be kept on file, but may be maintained separately from the dose records.

5. The licensee or registrant shall retain each required form or record until the Agency terminates each pertinent license or registration requiring the record.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.50 **Records of Dose to Individual Members of the Public.**

1. Each licensee or registrant shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public. See 1.4.14.

2. The licensee or registrant shall retain the records required by 1.4.50(1) until the Agency terminates each pertinent license or registration requiring the record.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.51 **Records of Waste Disposal.**

1. Each licensee shall maintain records of the disposal of licensed materials made pursuant to 1.4.36, 1.4.37, 1.4.38, 1.4.39, Subchapter 11, and disposal by burial in soil, including burials authorized before May 9, 1986[25].

2. The licensee shall retain the records required by 1.4.51(1) until the Agency terminates each pertinent license requiring the record.

SOURCE: Miss. Code Ann. §45-14-11

[25] A previous subparagraph permitted burial of small quantities of licensed materials in soil before May 9, 1986, without specific Agency authorization.

Rule 1.4.52 **Records of Testing Entry Control Devices for Very High Radiation Areas.**

1. Each licensee or registrant shall maintain records of tests made pursuant to 1.4.21(2)(i) on entry control devices for very high radiation areas. These records must include the date, time, and results of each such test of function.

2. The licensee or registrant shall retain the records required by 1.4.52(1) for 3 years after the record is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.53 **Form of Records.** Each record required by this section shall be legible throughout the specified retention period. The record shall be the original or a reproduced copy or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period or the record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, shall include all pertinent information, such as stamps, initials, and signatures. The licensee or registrant shall maintain adequate safeguards against tampering with and loss of records.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.54 **Reports of Stolen, Lost, or Missing Licensed or Registered Sources of Radiation.**

1. Telephone Reports. Each licensee or registrant shall report to the Agency by telephone as follows:

   a. immediately after its occurrence becomes known to the licensee, stolen, lost, or missing licensed radioactive material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in Appendix C of this section under such circumstances that it appears to the licensee that an exposure could result to individuals in unrestricted areas; or

   b. within 30 days after its occurrence becomes known to the licensee, lost, stolen, or missing licensed radioactive material in an aggregate quantity greater than 10 times the quantity specified in Appendix C of this section that is still missing; or

   c. immediately after its occurrence becomes known to the registrant, a stolen, lost, or missing radiation machine.

2. Written Reports. Each licensee or registrant required to make a report pursuant to 1.4.54(1) shall, within 30 days after making the telephone report, make a written report to the Agency setting forth the following information:

a. a description of the licensed or registered source of radiation involved, including, for radioactive material, the kind, quantity, and chemical and physical form; and, for radiation machines, the manufacturer, model and serial number, type and maximum energy of radiation emitted;

b. a description of the circumstances under which the loss or theft occurred; and

c. a statement of disposition, or probable disposition, of the licensed or registered source of radiation involved; and

d. exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas; and

e. actions that have been taken, or will be taken, to recover the source of radiation; and

f. procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed or registered sources of radiation.

3. Subsequent to filing the written report, the licensee or registrant shall also report additional substantive information on the loss or theft within 30 days after the licensee or registrant learns of such information.

4. The licensee or registrant shall prepare any report filed with the Agency pursuant to 1.4.54 so that names of individuals who may have received exposure to radiation are stated in a separate and detachable portion of the report.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.55 **Notification of Incidents.**

1. Immediate Notification. Notwithstanding other requirements for notification, each licensee or registrant shall immediately report each event involving a source of radiation possessed by the licensee or registrant that may have caused or threatens to cause any of the following conditions:

a. An individual to receive:

i. a total effective dose equivalent of 25 rems (0.25 sievert) or more; or

ii. a lens dose equivalent of 75 rems (0.75 sievert) or more; or

iii. a shallow dose equivalent to the skin or extremities or a total organ dose equivalent of 250 rads (2.5 grays) or more; or

b. The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the occupational ALI. This provision does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures.

2. Twenty-Four Hour Notification. Each licensee or registrant shall, within 24 hours of discovery of the event, report to the Agency each event involving loss of control of a licensed or registered source of radiation possessed by the licensee or registrant that may have caused, or threatens to cause, any of the following conditions:

a. An individual to receive, in a period of 24 hours:

i. a total effective dose equivalent exceeding 5 rems (0.05 sievert); or

ii. a lens dose equivalent exceeding 15 rems (0.15 sievert); or

iii. a shallow dose equivalent to the skin or extremities or a total organ dose equivalent exceeding 50 rems (0.5 sievert) ; or

b. The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake in excess of one occupational ALI. This provision does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures.

3. The licensee or registrant shall prepare each report filed with the Agency pursuant to 1.4.55 so that names of individuals who have received exposure to sources of radiation are stated in a separate and detachable portion of the report.

4. Licensees or registrants shall make the reports required by 1.4.55(1) and (2) to the Agency by telephone, or facsimile to the Agency.

5. The provisions of 1.4.55 do not apply to doses that result from planned special exposures, provided such doses are within the limits for planned special exposures and are reported pursuant to 1.4.57.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.56 **Reports of Exposures, Radiation Levels, and Concentrations of Radioactive Material Exceeding the Constraints or Limits.**

1. Reportable Events. In addition to the notification required by 1.4.55, each licensee or registrant shall submit a written report within 30 days after learning of any of the following occurrences:

a. incidents for which notification is required by 1.4.55; or

b. doses in excess of any of the following:

i. the occupational dose limits for adults in 1.4.6; or

ii. the occupational dose limits for a minor in 1.4.12; or

iii. the limits for an embryo/fetus of a declared pregnant woman in 1.4.13; or

iv. the limits for an individual member of the public in 1.4.14; or

v. any applicable limit in the license or registration; or

vi. the ALARA constraints for air emissions established under 1.4.5(4); or

c. levels of radiation or concentrations of radioactive material in:

i. a restricted area in excess of applicable limits in the license or registration; or

ii. an unrestricted area in excess of 10 times the applicable limit set forth in this section or in the license or registration, whether or not involving exposure of any individual in excess of the limits in 1.4.14; or

d. For licensees subject to the provisions of U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

2. Contents of Reports.

a. Each report required by 1.4.56(1) shall describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

i. estimates of each individual's dose; and

ii. the levels of radiation and concentrations of radioactive material involved; and

iii. the cause of the elevated exposures, dose rates, or concentrations; and

iv. corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, ALARA constraints, generally applicable environmental standards, and associated license or registration conditions.

b. Each report filed pursuant to 1.4.56(1) shall include for each occupationally overexposed individual: the name, Social Security account number, and date of birth. With respect to the limit for the embryo/fetus in 1.4.13, the identifiers should be those of the declared pregnant woman. The report shall be prepared so that this information is stated in a separate and detachable portion of the report.

3. All licensees or registrants who make reports pursuant to 1.4.56(1) shall submit the report in writing to the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.57 **Reports of Planned Special Exposures.** The licensee or registrant shall submit a written report to the Agency within 30 days following any planned special exposure conducted in accordance with 1.4.11, informing the Agency that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by 1.4.48.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.58 **Reports to Individuals of Exceeding Dose Limits.** When a licensee is required, pursuant to the provisions of 1.4.56 or 1.4.57, to report to the Agency any exposure of an identified occupationally exposed individual, or an identified member of the public, to radiation or radioactive material, the licensee shall also provide a copy of the report submitted to the Agency to the individual. This report must be transmitted at a time no later than the transmittal to the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.59 **Notifications and Reports to Individuals.**

1. Requirements for notification and reports to individuals of exposure to radiation or radioactive material are specified in 1.10.4 of these regulations.

2. When a licensee or registrant is required pursuant to 1.4.56 to report to the Agency any exposure of an individual to radiation or radioactive material, the licensee or registrant shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Agency, and shall comply with the provisions of 1.10.14(1).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.60 **Reports of Transactions Involving Nationally Tracked Sources.** Each licensee who manufactures, transfers, receives, disassembles, or disposes of a nationally tracked source shall complete and submit a National Source Tracking Transaction Report as specified in 1.4.60(1) through (5) of this section for each type of transaction.

1. Each licensee who manufactures a nationally tracked source shall complete and submit a National Source Tracking Transaction Report. The report must include the following information:

    a. The name, address, and license number of the reporting licensee;

    b. The name of the individual preparing the report;

    c. The manufacturer, model, and serial number of the source;

    d. The radioactive material in the source;

    e. The initial source strength in becquerels (curies) at the time of manufacture; and

    f. The manufacture date of the source.

2. Each licensee that transfers a nationally tracked source to another person shall complete and submit a National Source Tracking Transaction Report. The report must include the following information:

    a. The name, address, and license number of the reporting licensee;

    b. The name of the individual preparing the report;

    c. The name and license number of the recipient facility and the shipping address;

    d. The manufacturer, model, and serial number of the source or, if not available, other information to uniquely identify the source;

    e. The radioactive material in the source;

    f. The initial or current source strength in becquerels (curies);

    g. The date for which the source strength is reported;

    h. The shipping date;

    i. The estimated arrival date; and

    j. For nationally tracked sources transferred as waste under a Uniform Low-Level Radioactive Waste Manifest, the waste manifest number and the container identification of the container with the nationally tracked source.

3. Each licensee that receives a nationally tracked source shall complete and submit a National Source Tracking Transaction Report. The report must include the following information:

a. The name, address, and license number of the reporting licensee;

b. The name of the individual preparing the report;

c. The name, address, and license number of the person that provided the source;

d. The manufacturer, model, and serial number of the source or, if not available, other information to uniquely identify the source;

e. The radioactive material in the source;

f. The initial or current source strength in becquerels (curies);

g. The date for which the source strength is reported;

h. The date of receipt; and

i. For material received under a Uniform Low-Level Radioactive Waste Manifest, the waste manifest number and the container identification with the nationally tracked source.

4. Each licensee that disassembles a nationally tracked source shall complete and submit a National Source Tracking Transaction Report. The report must include the following information:

a. The name, address, and license number of the reporting licensee;

b. The name of the individual preparing the report;

c. The manufacturer, model, and serial number of the source or, if not available, other information to uniquely identify the source;

d. The radioactive material in the source;

e. The initial or current source strength in becquerels (curies);

f. The date for which the source strength is reported;

g. The disassemble date of the source.

5. Each licensee who disposes of a nationally tracked source shall complete and submit a National Source Tracking Transaction Report. The report must include the following information:

a. The name, address, and license number of the reporting licensee;

b. The name of the individual preparing the report;

c. The waste manifest number;

d. The container identification with the nationally tracked source;

e. The date of disposal; and

f. The method of disposal.

6. The reports discussed in 1.4.60(1) through (5) of this section must be submitted by the close of the next business day after the transaction. A single report may be submitted for multiple sources and transactions. The reports must be submitted to the National Source Tracking System by using:

a. The on-line National Source Tracking System;

b. Electronically using a computer-readable format;

c. By facsimile;

d. By mail to the address on the National Source Tracking Transaction Report Form (NRC Form 748); or

e. By telephone with followup by facsimile or mail.

7. Each licensee shall correct any error in previously filed reports or file a new report for any missed transaction within 5 business days of the discovery of the error or missed transaction. Such errors may be detected by a variety of methods such as administrative reviews or by physical inventories required by regulation. In addition, each licensee shall reconcile the inventory of nationally tracked sources possessed by the licensee against that licensee's data in the National Source Tracking System. The reconciliation must be conducted during the month of January in each year. The reconciliation process must include resolving any discrepancies between the National Source Tracking System and the actual inventory by filing the reports identified by 1.4.60(1) through (5) of this section. By January 31 of each year, each licensee must submit to the National Source Tracking System confirmation that the data in the National Source Tracking System is correct.

8. Each licensee that possesses Category 1 nationally tracked sources shall report its initial inventory of Category 1 nationally tracked sources to the National Source Tracking System by January 31, 2009. Each licensee that possesses Category 2 nationally tracked sources shall report its initial inventory of Category 2 nationally tracked sources to the National Source Tracking System by January 31, 2009. The information may be submitted by using any of the methods identified by 1.4.60(6)(a) through (6)(d) of this section. The initial inventory report must include the following information:

a. The name, address, and license number of the reporting licensee;

b. The name of the individual preparing the report;

c. The manufacturer, model, and serial number of each nationally tracked source or, if not available, other information to uniquely identify the source;

d. The radioactive material in the sealed source;

e. The initial or current source strength in becquerels (curies); and

f. The date for which the source strength is reported.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.61 **Reports of Leaking or Contaminated Sealed Sources.** The licensee shall file a report within 5 days with the Agency if the test for leakage or contamination required pursuant to 1.4.16 indicates a sealed source is leaking or contaminated. The report shall include the equipment involved, the test results and the corrective action taken.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.62 **Vacating Premises.** Each licensee or registrant shall, no less than 30 days before vacating or relinquishing possession or control of premises which may have been contaminated with radioactive material as a result of his activities, notify the Agency in writing of intent to vacate. When deemed necessary by the Agency, the licensee shall decontaminate the premises in such a manner as the Agency may specify.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.63 **Radiological Criteria for License Termination: General Provisions and Scope.**

1. The criteria in this section apply to the decommissioning of facilities licensed under Subchapter 3 of these regulations.

2. After a site has been decommissioned and the license terminated in accordance with the criteria in this section, the Agency will require additional cleanup only if, based on new information, it determines that the criteria of this section were not met and residual radioactivity remaining at the site could result in significant threat to public health and safety.

3. When calculating TEDE to the average member of the critical group the licensee shall determine the peak annual TEDE dose expected within the first 1000 years after decommissioning.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.64 **Radiological Criteria for Unrestricted Use.** A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.65 **Criteria for License Termination Under Restricted Conditions.** A site will be considered acceptable for license termination under restricted conditions if:

1. The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of 1.4.64 would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are ALARA. Determination of the levels which are ALARA must take into account consideration of any detriments, such as traffic accidents, expected to potentially result from decontamination and waste disposal;

2. The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) per year;

3. The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site. Acceptable financial assurance mechanisms are:

    a. funds placed into an account segregated from the licensee's assets and outside licensee's administrative control as described in 1.3.9(7)(f)(i);

    b. surety method, insurance, or other guarantee method as described in 1.3.9(7)(f)(ii);

    c. a statement of intent in the case of Federal, State, or local Government licensees, as described in 1.3.9(7)(f)(iv); or

    d. when a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity.

4. The licensee has submitted a decommissioning plan or License Termination Plan (LTP) to the Agency indicating the licensee's intent to decommission in accordance with 1.3.16(4), and specifying that the licensee intends to

decommission by restricting use of the site. The licensee shall document in the LTP or decommissioning plan how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and incorporated, as appropriate, following analysis of that advice.

a. Licensees proposing to decommission by restricting use of the site shall seek advice from such affected parties regarding the following matters concerning the proposed decommissioning:

i. whether provisions for institutional controls proposed by the licensee;

i. will provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) TEDE per year;

ii. will be enforceable; and

iii. will not impose undue burdens on the local community or other affected parties.

ii. whether the licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site;

b. In seeking advice on the issues identified in 1.4.65(4)(a), the licensee shall provide for:

i. participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

ii. an opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

iii. a publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues; and

5. Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed either:

a. 100 mrem (1 mSv) per year; or

b. 500 mrem (5 mSv) per year provided the licensee:

i. demonstrates that further reductions in residual radioactivity necessary to comply with the 100 mrem/y (1 mSv/y) value of 1.4.65(5)(a) of this section are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm;

ii. makes provisions for durable institutional controls;

iii. provides sufficient financial assurance to enable a responsible government entity or independent third party, including a governmental custodian of a site, both to carry out periodic rechecks of the site no less frequently than every 5 years to assure that the institutional controls remain in place as necessary to meet the criteria of 1.4.65(2) and to assume and carry out responsibilities for any necessary control and maintenance of those controls. Acceptable financial assurance mechanisms are those in 1.4.65(2).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.66 **Alternate Criteria for License Termination.**

1. The Agency may terminate a license using alternate criteria greater than the dose criterion of 1.4.64, 1.4.65(2), and 1.4.65(4)(a)(ii), if the licensee:

a. provides assurance that public health and safety would continue to be protected, and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than the 1 mSv/y (100 mrem/y) limit of Subchapter 4, by submitting an analysis of possible sources of exposure;

b. has employed to the extent practical restrictions on site use according to the provisions of 1.4.65 in minimizing exposures at the site;

c. reduces doses to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal; and

d. has submitted a decommissioning plan or License Termination Plan (LTP) to the Agency indicating the licensee's intent to decommission in accordance with 1.3.16(4), and specifying that the licensee proposes to decommission by use of alternate criteria. The licensee shall document in the decommissioning plan or LTP how the advice of individuals and institutions in the community who may be affected by the

decommissioning has been sought and addressed, as appropriate, following analysis of that advice. In seeking such advice, the licensee shall provide for:

i. participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

ii. an opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

iii. a publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues.

2. The use of alternate criteria to terminate a license requires the approval of the Agency after consideration of the Agency staff's recommendations that will address any comments provided by Federal and other State Agencies and any public comments submitted pursuant to 1.4.67.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.67 **Public Notification and Public Participation.** Upon the receipt of an LTP or decommissioning plan from the licensee, or a proposal by the licensee for release of a site pursuant to 1.4.65 or 1.4.66 , or whenever the Agency deems such notice to be in the public interest, the Agency shall:

1. Notify and solicit comments from:

a. local and State governments in the vicinity of the site and other individuals that could be affected by the decommissioning; and

b. the Mississippi Department of Environmental Quality for cases where the licensee proposes to release a site pursuant to 1.4.66 .

2. Publish a notice in local newspapers, letters to State or local organizations, or other appropriate forum, that is readily accessible to individuals in the vicinity of the site, and solicit comments from affected parties.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.4.68 **Minimization of Contamination.** Applicants for licenses, other than renewals, after the effective date of these regulations, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX A

Protection Factors For Respirators[i]

	Operating mode	Assigned Protection Factors
I. Air Purifying Respirators [Particulate[ii] only][iii]		
Filtering facepiece disposable[iv]	Negative Pressure	([4])
Facepiece, half[v]	Negative Pressure	10
Facepiece, full	Negative Pressure	100
Facepiece, half	Powered air-purifying respirators	50
Facepiece, full	Powered air-purifying respirators	1000
Helmet/hood	Powered air-purifying respirators	1000
Facepiece, loose-fitting	Powered air-purifying respirators	25
II. Atmosphere supplying respirators [particulate, gasses and vapors[vi]]:		
1. Air-line respirators:		
Facepiece, half	Demand	10
Facepiece, half	Continuous Flow	50
Facepiece, half	Pressure Demand	50
Facepiece, full	Demand	100
Facepiece, full	Continuous Flow	1000
Facepiece, full	Pressure Demand	1000
Helmet/hood	Continuous Flow	1000
Facepiece, loose-fitting	Continuous Flow	25
Suit	Continuous Flow	([vii])
2. Self-contained breathing Apparatus (SCBA):		
Facepiece, full	Demand	[viii]100
Facepiece, full	Pressure Demand	[ix]10,000
Facepiece, full	Demand, Recirculating	[8]100
Facepiece, full	Positive Pressure Recirculating	[9]10,000
III. Combination Respirators:		
Any combination of air-purifying and atmosphere-supplying respirators	(1) Assigned protection factor for type and mode of operation as listed above.	

[i] These assigned protection factors apply only in a respiratory protection program that meets the requirements of this section. They are applicable only to airborne radiological hazards and may not be appropriate to circumstances when chemical or other respiratory hazards exist instead of, or in addition to, radioactive hazards. Selection and use of respirators for such circumstances must also comply with Department of Labor regulations. Radioactive contaminants for which the concentration values in Table 1, Column 3 of Appendix B to Subchapter 4 are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

[ii] Air purifying respirators with APF <100 must be equipped with particulate filters that are at least 95 percent efficient. Air purifying respirators with APF = 100 must be equipped with particulate filters that are at least 99 percent efficient. Air purifying respirators with APFs >100 must be equipped with particulate filters that are at least 99.97 percent efficient.

[iii] The licensee may apply to the Agency for the use of an APF greater than 1 for sorbent cartridges as protection against airborne radioactive gases and vapors (e.g., radioiodine).

[iv] Licensees may permit individuals to use this type of respirator who have not been medically screened or fit tested on the device provided that no credit be taken for their use in estimating intake or dose. It is also recognized that it is difficult to perform an effective positive or negative pressure pre-use user seal check on this type of device. All other respiratory protection program requirements listed in 1.4.24 apply. An assigned protection factor has not been assigned for these devices. However, an APF equal to 10 may be used if the licensee can demonstrate a fit factor of at least 100 by use of a validated or evaluated, qualitative or quantitative fit test.

[v] Under-chin type only. No distinction is made in this Appendix between elastomeric half-masks with replaceable cartridges and those designed with the filter medium as an integral part of the facepiece (e.g., disposable or reusable disposable). Both types are acceptable so long as the seal area of the latter contains some substantial type of seal-enhancing material such as rubber or plastic, the two or more suspension straps are adjustable, the filter medium is at least 95 percent efficient and all other requirements of this section are met.

[vi] The assigned protection factors for gases and vapors are not applicable to radioactive contaminants that present an absorption or submersion hazard. For tritium oxide vapor, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of 3 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. Exposure to radioactive noble gases is not considered a significant respiratory hazard, and protective actions for these contaminants should be based on external (submersion) dose considerations.

[vii] No NIOSH approval schedule is currently available for atmosphere supplying suits. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements, with the exception of fit testing, are met.

[viii] The licensee should implement institutional controls to assure that these devices are not used in areas immediately dangerous to life or health (IDLH).

[ix] This type of respirator may be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances. This device may not be used by any individual who experiences perceptible outward leakage of breathing gas while wearing the device.

APPENDIX B

Annual Limits On Intake (Alis) And Derived Air Concentrations (Dacs) Of Radionuclides For Occupational Exposure; Effluent Concentrations; Concentrations For Release To Sanitary Sewerage

Introduction

For each radionuclide, Table I indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μm, micron, and for three classes (D, W, Y) of radioactive material, which refer to their retention (approximately days, weeks or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D if less than 10 days, for W from 10 to 100 days, and for Y greater than 100 days. Table II provides concentration limits for airborne and liquid effluents released to the general environment. Table III provides concentration limits for discharges to sanitary sewerage.

Note:

The values in Tables I, II, and III are presented in the computer "E" notation. In this notation a value of 6E-02 represents a value of 6×10^{-2} or 0.06, 6E+2 represents 6×10^{2} or 600, and 6E+0 represents 6×10^{0} or 6.

Table I "Occupational Values"

Note that the columns in Table I of this appendix captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC," are applicable to occupational exposure to radioactive material.

The ALIs in this appendix are the annual intakes of given radionuclide by "Reference Man" which would result in either (1) a committed effective dose equivalent of 5 rems (0.05 sievert), stochastic ALI, or (2) a committed dose equivalent of 50 rems (0.5 sievert) to an organ or tissue, non-stochastic ALI. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 5 rems (0.05 sievert). The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of w_T are listed under the definition of weighting factor in 1.4.03. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of $w_T = 0.06$ is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following portions of the GI tract—stomach, small intestine, upper large intestine, and lower large intestine—are to be treated as four separate organs.

Note that the dose equivalents for an extremity, skin and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the non-stochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. Abbreviated organ or tissue designations are used:

LLI wall = lower large intestine wall;

St. wall = stomach wall;

Blad wall = bladder wall; and

Bone surf = bone surface.

The use of the ALIs listed first, the more limiting of the stochastic and non-stochastic ALIs, will ensure that non-stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non-stochastic ALI is limiting, use of that non-stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 50 rems (0.5 sievert) dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose equivalent to that organ, not the effective dose. For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity, that is, Σ (intake (in μCi) of each radionuclide/ALI_{ns}) ≤ 1.0. If there is an external deep dose equivalent contribution of H_d, then this sum must be less than $1 - (H_d/50)$, instead of ≤ 1.0.

> Note that the dose equivalents for an extremity, skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by:

$$DAC = ALI(\text{in } \mu Ci)/(2000 \text{ hours per working year} \times 60 \text{ minutes/hour} \times$$

$$2 \times 10^4 \text{ ml per minute}) = [ALI/2.4 \times 10^9]\ \mu Ci/ml,$$

where 2×10^4 ml is the volume of air breathed per minute at work by Reference Man under working conditions of light work.

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. DACs

based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

The ALI and DAC values include contributions to exposure by the single radionuclide named and any in-growth of daughter radionuclides produced in the body by decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external irradiation. See 1.4.7. When an individual is exposed to radioactive materials which fall under several of the translocation classifications of the same radionuclide, such as, Class D, Class W, or Class Y, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radionuclides. For this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

Table II "Effluent Concentrations"

The columns in Table II of this appendix captioned "Effluents," "Air" and "Water" are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of 1.4.15. The concentration values given in Columns 1 and 2 of Table II are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (0.5 millisievert).

Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at or below the dose levels established for individual members of the public. For radionuclides, where the non-stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table II. For this reason, the DAC and airborne effluent limits are not always proportional as was the case in the previous Appendix A of this section.

The air concentration values listed in Table II, Column 1 were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4×10^9, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 5 rems (0.05 sievert) annual occupational dose limit to the 0.1 rem (1 millisievert) limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values, derived for adults, so that they are applicable to other age groups.

For those radionuclides for which submersion, that is external dose, is limiting, the occupational DAC in Table I, Column 3 was divided by 219. The factor of 219 is composed of a

factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^7. The factor of 7.3×10^7 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3×10^5 (ml) which is the annual water intake of Reference Man.

Note 2 of this appendix provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations and releases to sewer, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

Table III "Releases to Sewers"

The monthly average concentrations for release to sanitary sewerage are applicable to the provisions in 1.4.37. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^6 (ml). The factor of 7.3×10^6 (ml) is composed of a factor of 7.3×10^5 (ml), the annual water intake by Reference Man, and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a Reference Man during a year, would result in a committed effective dose equivalent of 0.5 rem (5 millisieverts).

SOURCE: Miss. Code Ann. §45-14-11

List of Elements

Name	Symbol	Atomic No.	Name	Symbol	Atomic No.
Actinium	Ac	89	Francium	Fr	87
Aluminium	Al	13	Gadolinium	Gd	64
Americium	Am	95	Gallium	Ga	31
Antimony	Sb	51	Germanium	Ge	32
Argon	Ar	18	Gold	Au	79
Arsenic	As	33	Hafniim	Hf	72
Astatine	At	85	Holmium	Ho	67
Barium	Ba	56	Hydrogen	H	1
Berkelium	Bk	97	Indium	In	49
Beryllium	Be	4	Iodine	I	53
Bismuth	Bi	83	Iridium	Ir	77
Bromine	Br	35	Iron	Fe	26
Cadmium	Cd	48	Krypton	Kr	36
Calcium	Ca	20	Lanthanum	La	57
Califormium	Cf	98	Lead	Pb	82
Carbon	C	6	Lutetium	Lu	71
Cerium	Ce	58	Magnesium	Mg	12
Cesium	Cs	55	Manganese	Mn	25
Chlorine	Cl	17	Mendelevium	Md	101
Chromium	Cr	24	Mercury	Hg	80
Cobalt	Co	27	Molybdenum	Mo	42
Copper	Cu	29	Neodymium	Nd	60
Curium	Cm	96	Neptunium	Np	93
Dysprosium	Dy	66	Nickel	Ni	28
Einsteinium	Es	99	Niobium	Nb	41
Erbium	Er	68	Nitrogen	N	7
Europium	Eu	63	Osmium	Os	76
Femium	Fm	100	Oxygen	O	8
Fluorine	F	9	Palladium	Pd	46
Phosphorus	P	15	Strontium	Sr	38
Platinum	Pt	78	Sulfur	S	16
Plutonium	Pu	94	Tantaium	Ta	73

Name	Symbol	Atomic No.	Name	Symbol	Atomic No.
Polonium	Po	84	Technetium	Tc	43
Potassium	K	19	Tellurium	Te	52
Praseodymium	Pr	59	Terbium	Tb	65
Promethium	Pm	61	Thallium	Tl	81
Protactinium	Pa	91	Thorium	Th	90
Radium	Ra	88	Thulium	Tm	69
Radon	Rn	86	Tin	Sn	50
Rhenium	Re	75	Titanium	Ti	22
Rhodium	Rh	45	Tungsten	W	74
Rubidium	Rb	37	Uranium	U	92
Ruthenium	Ru	44	Vanadium	V	23
Samarium	Sm	62	Xenon	Xe	54
Scandium	Sc	21	Yterbium	Yb	70
Selenium	Se	34	Yttrium	Y	39
Silicon	Si	14	Zinc	Zn	30
Silver	Ag	47	Zirconium	Zr	40
Sodium	Na	11			

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
1	Hydrogen-3	Water, DAC includes skin absorption	8E+4	8E+4	2E-5	1E-7	1E-3	1E-2
		Gas (HT or T_2) Submersion[1]: Use above values as HT and T_2 oxidize in air and in the body to HTO.						
4	Beryllium-7	W, all compounds except those given for Y	4E+4	2E+4	9E-6	3E-8	6E-4	6E-3
		Y, oxides, halides, and nitrates	-	2E+4	8E-6	3E-8	-	-
4	Beryllium-10	W, see ^{7}Be	1E +3	2E+2	6E-8	2E-10	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{7}Be	-	1E+1	6E-9	2E-11	-	-
6	Carbon-11[2]	Monoxide	-	1E+6	5E-4	2E-6	-	-
		Dioxide	-	6E+5	3E-4	9E-7	-	-
		Compounds	4E+5	4E+5	2E-4	6E-7	6E-3	6E-2
6	Carbon-14	Monoxide	-	2E+6	7E-4	2E-6	-	-
		Dioxide	-	2E+5	9E-5	3E-7	-	-
		Compounds	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
7	Nitrogen[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
8	Oxygen-15[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
9	Fluorine-18[2]	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4	7E+4	3E-5	1E-7	-	-
			St wall	-	-	-	7E-4	7E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			(5E+4)					
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re	-	9E+4	4E-5	1E-7	-	-
		Y, lanthanum fluoride	-	8E+4	3E-5	1E-7	-	-
11	Sodium-22	D, all compounds	4E+2	6E+2	3E-7	9E-10	6E-6	6E-5
11	Sodium-24	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
12	Magnesium-28	D, all compounds except those given for W	7E+2	2E+3	7E-7	2E-9	9E-6	9E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	1E+3	5E-7	2E-9	-	-
13	Aluminum-26	D, all compounds except those given for W	4E+2	6E+1	3E-8	9E-11	6E-6	6E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	9E+1	4E-8	1E-10	-	-
14	Silicon-31	D, all compounds except those given for W and	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		Y						
		W, oxides, hydroxides, carbides, and nitrates	-	3E+4	1E-5	5E-8	-	-
		Y, aluminosilicate glass	-	3E+4	1E-5	4E-8	-	-
14	Silicon-32	D, see ^{31}Si	2E+3	2E+2	1E-7	3E-10	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		W, see ^{31}Si	-	1E+2	5E-8	2E-10	-	-
		Y, see ^{31}Si	-	5E+0	2E-9	7E-12	-	-
15	Phosphorus-32	D, all compounds except phosphates given for W	6E+2	9E+2	4E-7	1E-9	9E-6	9E-5
		W, phosphates of Zn^{2+}, S^{3+}, Mg^{2+}, Fe^{3+}, Bi^{3+}, and lanthanides	-	4E+2	2E-7	5E-10	-	-
15	Phosphorus-33	D, see ^{32}P	6E+3	8E+3	4E-6	1E-8	8E-5	8E-4
		W, see ^{32}P	-	3E+3	1E-6	4E-9	-	-
16	Sulfur-35	Vapor	-	1E+4	6E-6	2E-8	-	-
		D, sulfides and sulfates except those given for W	1E+4	2E+4	7E-6	2E-8	-	-
			LLI wall (8E+3)	-	-	-	1E-4	1E-3
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi,	6E+3	-	-	-	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	-	2E+3	9E-7	3E-9	-	-
17	Chlorine-36	D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	2E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re		2E+2	1E-7	3E-10		
17	Chlorine-38[2]	D, see ^{36}Cl	2E+4	4E+4	2E-5	6E-8		
			St wall (3E+4)				3E-4	3E-3
		W, see ^{36}Cl		5E+4	2E-5	6E-8		
17	Chlorine-39[2]	D, see ^{36}Cl	2E+4	5E+4	2E-5	7E-8		
			St wall (4E+4)				5E-4	5E-3
		W, see ^{36}Cl		6E+4	2E-5	8E-8		
18-	Argon-37	Submersion[1]			1E+0	6E-3		
18	Argon-39	Submersion[1]			2E-4	8E-7		

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
18-	Argon-41	Submersion[1]			3E-6	1E-8		
19	Potassium-40	D, all compounds	3E+2	4E+2	2E-7	6E-10	4E-6	4E-5
19	Potassium-42	D, all compounds	5E+3	5E+3	2E-6	7E-9	6E-5	6E-4
19	Potassium-43	D, all compounds	6E+3	9E+3	4E-6	1E-8	9E-5	9E-4
19	Potassium-44[2]	D, all compounds	2E+4	7E+4	3E-5	9E-8		
			St wall (4E+4)				5E-4	5E-3
19	Potassium-45[2]	D, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (5E+4)				7E-4	7E-3
20	Calcium-41	W, all compounds	3E+3	4E+3	2E-6	-	-	-
			Bone surf (4E+3)	Bone surf (4E+3)		5E-9	6E-5	6E-4
20	Calcium-45	W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
20	Calcium-47	W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5	1E-4
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
21	Scandium-44m	Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5	1E-4
21	Scandium-47	Y, all compounds	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (3E+3)				4E-5	4E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
	-	-	-					
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5	1E-4
21	Scandium-49[2]	Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6	4E-5
		W, oxides, hydroxides, carbides, halides, and nitrates		3E+1	1E-8	4E-11		
		Y, SrTi0		6E+0	2E-9	8E-12		
	-				-	-		
	-				-	-		
22	Titanium-45	D, see ^{44}Ti	9E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{44}Ti	-	4E+4	1E-5	5E-8		
		Y, see ^{44}Ti	-	3E+4	1E-5	4E-8		
23	Vanadium-47[2]	D, all compounds except those given for W	3E+4	8E+4	3E-5	1E-7		
			St wall (3E+4)				4E-4	4E-3
	-	W, oxides, hydroxides, carbides, and halides	-	1E+5	4E-5	1E-7	-	-
23	Vanadium-48	D, see ^{47}V	6E+2	1E+3	5E-7	2E-9	9E-6	9E-5
		W, see ^{47}V	-	6E+2	3E-7	9E-10		

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
23	Vanadium-49	D, see ^{47}V	7E+4	3E+4	1E-5	-	-	-
			LLI wall (9E+4)	Bone surf (3E+4)	-	5E-8	1E-3	1E-2
		W, see ^{47}V	-	2E+4	8E-6	2E-8	-	-
24	Chromium-48	D, all compounds except those given for W and Y	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, halides and nitrates	-	7E+3	3E-6	1E-8	-	-
		Y, oxides and hydroxides	-	7E+3	3E-6	1E-8	-	-
24	Chromium-49[2]	D, see ^{48}Cr	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, see ^{48}Cr	-	1E+5	4E-5	1E-7	-	-
		Y, see ^{48}Cr	-	9E+4	4E-5	1E-7	-	-
24	Chromium-51	D, see ^{48}Cr	4E+4	5E+4	2E-5	6E-8	5E-4	5E-3
		W, see ^{48}Cr	-	2E+4	1E-5	3E-8	-	-
		Y, see ^{48}Cr	-	2E+4	8E-6	3E-8	-	-
25	Manganese-51[2]	D, all compounds except those given for W t	2E+4	5E+4	2E-5	7E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	8E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
25	Manganese-52m[2]	D, see ^{51}Mn	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{51}Mn	-	1E+5	4E-5	1E-7	-	-
25	Manganese-52	D, see ^{51}Mn	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
		W, see ^{51}Mn	-	9E+2	4E-7	1E-9	-	-
25	Manganese-53	D, see ^{51}Mn	5E+4	1E+4	5E-6	-	7E-4	7E-3
				Bone surf (2E+4)	-	3E-8	-	-
		W, see ^{51}Mn	-	1E+4	5E-6	2E-8	-	-
25	Manganese-54	D, see ^{51}Mn	2E+3	9E+2	4E-7	1E-9	3E-5	3E-4
		W, see ^{51}Mn	-	8E+2	3E-7	1E-9	-	-
25	Manganese-56	D, see ^{51}Mn	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{51}Mn	-	2E+4	9E-6	3E-8	-	-
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5	1E-4
		W, oxides, hydroxides and halides,	-	2E+3	1E-6	3E-9	-	-
26	Iron-55	D, see ^{52}Fe	9E+3	2E+3	8E-7	3E-9	1E-4	1E-3
		W, see ^{52}Fe	-	4E+3	2E-6	6E-9	-	-
26	Iron-59	D, see ^{52}Fe	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		W, see ^{52}Fe	-	5E+2	2E-7	7E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
26	Iron-60	D, see ^{52}Fe	3E+1	6E+0	3E-9	9E-12	4E-7	4E-6
		W, see ^{52}Fe	-	2E+1	8E-9	3E-11	-	-
27	Cobalt-55	W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
27	Cobalt-56	W, see ^{55}Co	5E+2	3E+2	1E-7	4E-10	6E-6	6E-5
		Y, see ^{55}Co	4E+2	2E+2	8E-8	3E-10	-	-
27	Cobalt-57	W, see ^{55}Co	8E+3	3E+3	1E-6	4E-9	6E-5	6E-4
		Y, see ^{55}Co	4E+3	7E+2	3E-7	9E-10 -	-	
27	Cobalt-58m	W, see ^{55}Co	6E+4	9E+4	4E-5	1E-7	8E-4	8E-3
		Y, see ^{55}Co	-	6E+4	3E-5	9E-8	-	-
27	Cobalt-58	W, see ^{55}Co	2E+3	1E+3	5E-7	2E-9	2E-5	2E-4
		Y, see ^{55}Co	1E+3	7E+2	3E-7	1E-9	-	-
27	Cobalt-60m[2]	W, see ^{55}Co	1E+6	4E+6	2E-3	6E-6	-	-
			St wall(1E+6)	-	-	-	2E-2	2E-1
		Y, see ^{55}Co	-	3E+6	1E-3	4E-6	-	-
27	Cobalt-60	W, see ^{55}Co	5E+2	2E+2	7E-8	2E-10	3E-6	3E-5
		Y, see ^{55}Co	2E+2	3E+1	1E-8	5E-11	-	-
27	Cobalt-61[2]	W, see ^{55}Co	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		Y, see ^{55}Co	2E+4	6E+4	2E-5	8E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
27	Cobalt-62m[2]	W, see ^{55}Co	4E+4	2E+5	7E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{55}Co	-	2E+5	6E-5	2E-7	-	-
28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		W, oxides, hydroxides, and carbides	-	1E+3	5E-7	2E-9	-	-
		Vapor	-	1E+3	5E-7	2E-9	-	-
28	Nickel-57	D, see ^{56}Ni	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	6E+3	3E-6	9E-9	-	-
28	Nickel-59	D, see ^{56}Ni	2E+4	4E+3	2E-6	5E-9	3E-4	3E-3
		W, see ^{56}Ni	-	7E+3	3E-6	1E-8	-	-
		Vapor	-	2E+3	8E-7	3E-9	-	-
28	Nickel-63	D, see ^{56}Ni	9E+3	2E+3	7E-7	2E-9	1E-4	1E-3
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	8E+2	3E-7	1E-9	-	-
28	Nickel-65	D, see ^{56}Ni	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{56}Ni	-	3E+4	1E-5	4E-8	-	-
		Vapor	-	2E+4	7E-6	2E-8	-	-
28	Nickel-66	D, see ^{56}Ni	4E+2	2E+3	7E-7	2E-9	-	-
			LLI wall (5E+2)	-	-	-	6E-6	6E-5
		W, see ^{56}Ni	-	6E+2	3E-7	9E-10	-	-
		Vapor	-	3E+3	1E-6	4E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
29	Copper-60[2]	D, all compounds except those given for W and Y	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	4E-5	1E-7	-	-
29	Copper-61	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{60}Cu	-	4E+4	2E-5	6E-8	-	-
		Y, see ^{60}Cu	-	4E+4	1E-5	5E-8	-	-
29	Copper-64	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{60}Cu	-	2E+4	1E-5	3E-8	-	-
		Y, see ^{60}Cu	-	2E+4	9E-6	3E-8	-	-
29	Copper-67	D, see ^{60}Cu	5E+3	8E+3	3E-6	1E-8	6E-5	6E-4
		W, see ^{60}Cu	-	5E+3	2E-6	7E-9	-	-
		Y, see ^{60}Cu	-	5E+3	2E-6	6E-9	-	-
30	Zinc-62	Y, all compounds	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
30	Zinc-63[2]	Y, all compounds	2E+4	7E+4	3E-5	9E-8	-	-
			St wall (3E+4)	-	-	-	3E-4	3E-3
30	Zinc-65	Y, all compounds	4E+2	3E+2	1E-7	4E-10	5E-6	5E-5
30	Zinc-69m	Y, all compounds	4E+3	7E+3	3E-6	1E-8	6E-5	6E-4
30	Zinc-69[2]	Y, all compounds	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
30	Zinc-71m	Y, all compounds	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
30	Zinc-72	Y, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
31	Gallium-65[2]	D, all compounds except those given for W	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
		W, oxides, hydroxides carbides, halides, and, nitrates	-	2E+5	8E-5	3E-7	-	-
31	Gallium-66	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	1E-5	1E-4
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-67	D, see ^{65}Ga	7E+3	1E+4	6E-6	2E-8	1E-4	1E-3
		W, see ^{65}Ga	-	1E+4	4E-6	1E-8	-	-
31	Gallium-68[2]	D, see ^{65}Ga	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{65}Ga	-	5E+4	2E-5	7E-8	-	-
31	Gallium-70[2]	D, see ^{65}Ga	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		W, see ^{65}Ga	-	2E+5	8E-5	3E-7	-	-
31	Gallium-72	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-73	D, see ^{65}Ga	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{65}Ga	-	2E+4	6E-6	2E-8	-	-
32	Germanium-66	D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		except those given for W						
		W, oxides, sulfides, and halides	-	2E+4	8E-6	3E-8	-	-
32	Germanium-67[2]	D, see ^{66}Ge	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		W, see ^{66}Ge	-	1E+5	4E-5	1E-7	-	-
32	Germanium-68	D, see ^{66}Ge	5E+3	4E+3	2E-6	5E-9	6E-5	6E-4
		W, see ^{66}Ge	-	1E+2	4E-8	1E-10	-	-
32	Germanium-69	D, see ^{66}Ge	1E+4	2E+4	6E-6	2E-8	2E-4	2E-3
		W, see ^{66}Ge	-	8E+3	3E-6	1E-8	-	-
32	Germanium-71	D, see ^{66}Ge	5E+5	4E+5	2E-4	6E-7	7E-3	7E-2
		W, see ^{66}Ge	-	4E+4	2E-5	6E-8	-	-
32	Germanium-75[2]	D, see ^{66}Ge	4E+4	8E+4	3E-5	1E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see ^{66}Ge	-	8E+4	4E-5	1E-7	-	-
32	Germanium-77	D, see ^{66}Ge	9E+3	1E+4	4E-6	1E-8	1E-4	1E-3
		W, see ^{66}Ge	-	6E+3	2E-6	8E-9	-	-
32	Germanium-78[2]	D, see ^{66}Ge	2E+4	2E+4	9E-6	3E-8	-	-
			St wall (2E+4)				3E-4	3E-3
		W, see ^{66}Ge	-	2E+4	9E-6	3E-8	-	-
33	Arsenic-69[2]	W, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
33	Arsenic-70[2]	W, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4	2E-3
33	Arsenic-71	W, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5	5E-4
33	Arsenic-72	W, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-73	W, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4	1E-3
33	Arsenic-74	W, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5	2E-4
33	Arsenic-76	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-77	W, all compounds	4E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	6E-5	6E-4
33	Arsenic-78[2]	W, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
34	Selenium-70[2]	D, all compounds except those given for W	2E+4	4E+4	2E-5	5E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E-5	6E-8	-	-
34	Selenium-73m[2]	D, see ^{70}Se	6E+4	2E+5	6E-5	2E-7	4E-4	4E-3
		W, see ^{70}Se	3E+4	1E+5	6E-5	2E-7	-	-
34	Selenium-73	D, see ^{70}Se	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
		W, see ^{70}Se	-	2E+4	7E-6	2E-8	-	-
34	Selenium-75	D, see ^{70}Se	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
		W, see ^{70}Se	-	6E+2	3E-7	8E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
34	Selenium-79	D, see ^{70}Se	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
		W, see ^{70}Se	-	6E+2	2E-7	8E-10	-	-
34	Selenium-81m[2]	D, see ^{70}Se	4E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, see ^{70}Se	2E+4	7E+4	3E-5	1E-7	-	-
34	Selenium-81[2]	D, see ^{70}Se	6E+4	2E+5	9E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		W, see ^{70}Se	-	2E+5	1E-4	3E-7	-	-
34	Selenium-83[2]	D, see ^{70}Se	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
		W, see ^{70}Se	3E+4	1E+5	5E-5	2E-7	-	-
35	Bromine-74m[2]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E +4	4E+4	2E-5	5E-8	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl Ge, Sn, Pb, As, Sb, Bi Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	-	4E+4	2E-5	6E-8	-	-
35	Bromine-74[2]	D, see ^{74m}Br	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{74m}Br	-	8E+4	4E-5	1E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
35	Bromine-75[2]	D, see ^{74m}Br	3E+4	5E+4	2E-5	7E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{74m}Br	-	5E+4	2E-5	7E-8	-	-
35	Bromine-76	D, see ^{74m}Br	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
		W, see ^{74m}Br	-	4E+3	2E-6	6E-9	-	-
35	Bromine-77	D, see ^{74m}Br	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
		W, see ^{74m}Br	-	2E+4	8E-6	3E-8	-	-
35	Bromine-80m	D, see ^{74m}Br	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
		W, see ^{74m}Br	-	1E+4	6E-6	2E-8	-	-
35	Bromine-80[2]	D, see ^{74m}Br	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{74m}Br	-	2E+5	9E-5	3E-7	-	-
35	Bromine-82	D, see ^{74m}Br	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see ^{74m}Br	-	4E+3	2E-6	5E-9	-	-
35	Bromine-83	D, see ^{74m}Br	5E+4	6E+4	3E-5	9E-8	-	-
			St wal (7E+4)l	-	-	-	9E-4	9E-3
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-	-
35	Bromine-84[2]	D, see ^{74m}Br	2E+4	6E+4	2E-5	8E-8	-	-
			St wal (3E+4)l	-	-	-	4E-4	4E-3
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-	-
36	Krypton-74[2]	Submersion[1]	-	-	3E-6	1E-8	-	-
36	Krypton-76	Submersion[1]	-	-	9E-6	4E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
36	Krypton-77[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
36	Krypton-79	Submersion[1]	-	-	2E-5	7E-8	-	-
36	Krypton-81	Submersion[1]	-	-	7E-4	3E-6	-	-
36	Krypton-83m[2]	Submersion[1]	-	-	1E-2	5E-5	-	-
36	Krypton-85m	Submersion[1]	-	-	2E-5	1E-7	-	-
36	Krypton-85	Submersion[1]	-	-	1E-4	7E-7	-	-
36	Krypton-87[2]	Submersion[1]	-	-	5E-6	2E-8	-	-
36	Krypton-88	Submersion[1]	-	-	2E-6	9E-9	-	-
37	Rubidium-79[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
37	Rubidium-81m[2]	D, all compounds	2E+5	3E+5	1E-4	5E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
37	Rubidium-82m	D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4	2E-3
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6	9E-5
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5	1E-4
37	Rubidium-88[2]	D, all compounds	2E+4	6E+4	3E-5	9E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			St wall (3E+4)	-	-	-	4E-4	4E-3
37	Rubidium-89[2]	D, all compounds	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
38	Strontium-80[2]	D, all soluble compounds except SrTiO	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		Y, all insoluble compounds and SrTi0	-	1E+4	5E-6	2E-8	-	-
38	Strontium-81[2]	D, see ^{80}Sr	3E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see ^{80}Sr	2E+4	8E+4	3E-5	1E-7	-	-
38	Strontium-82	D, see ^{80}Sr	3E+2	4E+2	2E-7	6E-10	-	-
			LLI wall (2E+2)	-	-	-	3E-6	3E-5
		Y, see ^{80}Sr	2E+2	9E+1	4E-8	1E-10	-	-
38	Strontium-83	D, see ^{80}Sr	3E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, see ^{80}Sr	2E+3	4E+3	1E-6	5E-9	-	-
38	Strontium-85m[2]	D, see ^{80}Sr	2E+5	6E+5	3E-4	9E-7	3E-3	3E-2
		Y, see ^{80}Sr	-	8E+5	4E-4	1E-6	-	-
38	Strontium-85	D, see ^{80}Sr	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
		Y, see ^{80}Sr	-	2E+3	6E-7	2E-9	-	-
38	Strontium-87m	D, see ^{80}Sr	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see ^{80}Sr	4E+4	2E+5	6E-5	2E-7	-	-
38	Strontium-89	D, see ^{80}Sr	6E+2	8E+2	4E-7	1E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see ^{80}Sr	5E+2	1E+2	6E-8	2E-10	-	-
38	Strontium-90	D, see ^{80}Sr	3E+1	2E+1	8E-9	-	-	-
			Bone surf (4E+1)	Bone surf (2E+1)	-	3E-11	5E-7	5E-6
		Y, see ^{80}Sr	-	4E+0	2E-9	6E-12	-	-
38	Strontium-91	D, see ^{80}Sr	2E+3	6E+3	2E-6	8E-9	2E-5	2E-4
		Y, see ^{80}Sr	-	4E+3	1E-6	5E-9	-	-
38	Strontium-92	D, see ^{80}Sr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{80}Sr	-	7E+3	3E-6	9E-9	-	-
39	Yttrium-86m[2]	W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		Y, oxides and hydroxides	-	5E+4	2E-5	8E-8	-	-
39	Yttrium-86	W, see ^{86m}Y	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
		Y, see ^{86m}Y	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-87	W, see ^{86m}Y	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		Y, see ^{86m}Y	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-88	W, see ^{86m}Y	1E+3	3E+2	1E-7	3E-10	1E-5	1E-4
		Y, see ^{86m}Y	-	2E+2	1E-7	3E-10	-	-
39	Yttrium-90m	W, see ^{86m}Y	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
		Y, see ^{86m}Y	-	1E+4	5E-6	2E-8	-	-
39	Yttrium-90	W, see ^{86m}Y	4E+2	7E+2	3E-7	9E-10	-	-
			LLI wall	-	-	-	7E-6	7E-5

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			(5E+2)					
		Y, see ^{86m}Y	-	6E+2	3E-7	9E-10	-	-
39	Yttrium-90m	W, see ^{86m}Y	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
		Y, see ^{86m}Y	-	1E+4	5E-6	2E-8		
39	Yttrium-91	W, see ^{86m}Y	5E+2	2E+2	7E-8	2E-10	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see ^{86m}Y	-	1E+2	5E-8	2E-10	-	-
39	Yttrium-92	W, see ^{86m}Y	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{86m}Y	-	8E+3	3E-6	1E-8	-	-
39	Yttrium-93	W, see ^{86m}Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see ^{86m}Y	-	2E+3	1E-6	3E-9	-	-
39	Yttrium-94[2]	W, see ^{86m}Y	2E+4	8E+4	3E-5	1E-7	-	-
			St.wall (3E+4)	-	-	-	4E-4	4E-3
		Y, see ^{86m}Y	-	8E+4	3E-5	1E-7	-	-
39	Yttrium-95[2]	W, see ^{86m}Y	4E+4	2E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{86m}Y	-	1E+5	6E-5	2E-7	-	-
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		Y, carbide	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-88	D, see ^{86}Zr	4E+3	2E+2	9E-8	3E-10	5E-5	5E-4
		W, see ^{86}Zr	-	5E+2	2E-7	7E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-89	D, see ^{86}Zr	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{86}Zr	-	2E+3	1E-6	3E-9	-	-
		Y, see ^{86}Zr	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-93	D, see ^{86}Zr	1E+3	6E+0	3E-9	-	-	-
			Bone surf (3E+3)	Bone surf (2E+1)	-	2E-11	4E-5	4E-4
		W, see ^{86}Zr	-	2E+1	1E-8	-	-	-
				Bone surf (6E+1)	-	9E-11	-	-
		Y, see ^{86}Zr	-	6E+1	2E-8	-	-	-
				Bone surf (7E+1)	-	9E-11	-	-
40	Zirconium-95	D, see ^{86}Zr	1E+3	1E+2	5E-8	-	2E-5	2E-4
				Bone surf (3E+2)	-	4E-10	-	-
		W, see ^{86}Zr	-	4E+2	2E-7	5E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-97	D, see ^{86}Zr	6E+2	2E+3	8E-7	3E-9	9E-6	9E-5
		W, see ^{86}Zr	-	1E+3	6E-7	2E-9	-	-
		Y, see ^{86}Zr	-	1E+3	5E-7	2E-9	-	-
41	Niobium-88[2]	W, all compounds except those	5E+4	2E+5	9E-5	3E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		given for Y						
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-	-
41	Niobium-89[2] (66 min)	W, see ^{88}Nb	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
		Y, see ^{88}Nb	-	4E+4	2E-5	5E-8	-	-
41	Niobium-89 (122 min)	W, see ^{88}Nb	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see ^{88}Nb	-	2E+4	6E-6	2E-8	-	-
41	Niobium-90	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-93m	W, see ^{88}Nb	9E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+4)	-	-	-	2E-4	2E-3
		Y, see ^{88}Nb	-	2E+2	7E-8	2E-10	-	-
41	Niobium-94	W, see ^{88}Nb	9E+2	2E+2	8E-8	3E-10	1E-5	1E-4
		Y, see ^{88}Nb	-	2E+1	6E-9	2E-11	-	-
41	Niobium-95m	W, see ^{88}Nb	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{88}Nb	-	2E+3	9E-7	3E-9	-	-
41	Niobium-95	W, see ^{88}Nb	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		Y, see ^{88}Nb	-	1E+3	5E-7	2E-9	-	-
41	Niobium-96	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
41	Niobium-97[2]	W, see ^{88}Nb	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see ^{88}Nb	-	7E+4	3E-5	1E-7	-	-
41	Niobium-98[2]	W, see ^{88}Nb	1E+4	5E+4	2E-5	8E-8	2E-4	2E-3
		Y, see ^{88}Nb	-	5E+4	2E-5	7E-8	-	-
42	Molybdenum-90	D, all compounds except those given for Y	4E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, oxides, hydroxides, and MoS	2E+3	5E+3	2E-6	6E-9	-	-
42	Molybdenum-93m	D, see ^{90}Mo	9E+3	2E+4	7E-6	2E-8	6E-5	6E-4
		Y, see ^{90}Mo	4E+3	1E+4	6E-6	2E-8	-	-
42	Molybdenum-93	D, see ^{90}Mo	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		Y, see ^{90}Mo	2E+4	2E+2	8E-8	2E-10	-	-
42	Molybdenum-99	D, see ^{90}Mo	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{90}Mo	1E+3	1E+3	6E-7	2E-9	-	-
42	Molybdenum-101[2]	D, see ^{90}Mo	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{90}Mo	-	1E+5	6E-5	2E-7	-	-
43	Technetium-93m[2]	D, all compounds except those given for W	7E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, and nitrates	-	3E+5	1E-4	4E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
43	Technetium-93	D, see ^{93m}Tc	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		W, see ^{93m}Tc	-	1E+5	4E-5	1E-7	-	-
43	Technetium-94m[2]	D, see ^{93m}Tc	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, see ^{93m}Tc	-	6E+4	2E-5	8E-8	-	-
43	Technetium-94	D, see ^{93m}Tc	9E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	-	2E+4	1E-5	3E-8	-	-
43	Technetium-95m	D, see ^{93m}Tc	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		W, see ^{93m}Tc	-	2E+3	8E-7	3E-9	-	-
43	Technetium-95	D, see ^{93m}Tc	1E+4	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	-	2E+4	8E-6	3E-8	-	-
43	Technetium-96m[2]	D, see ^{93m}Tc	2E+5	3E+5	1E-4	4E-7	2E-3	2E-2
		W, see ^{93m}Tc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-96	D, see ^{93m}Tc	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		W, see ^{93m}Tc	-	2E+3	9E-7	3E-9	-	-
43	Technetium-97m	D, see ^{93m}Tc	5E+3	7E+3	3E-6	-	6E-5	6E-4
				St wall (7E+3)	-	1E-8	-	-
		W, see ^{93m}Tc	-	1E+3	5E-7	2E-9	-	-
43	Technetium-97	D, see ^{93m}Tc	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
		W, see ^{93m}Tc	-	6E+3	2E-6	8E-9	-	-
43	Technetium-98	D, see ^{93m}Tc	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see ^{93m}Tc	-	3E+2	1E-7	4E-10	-	-
43	Technetium-99m	D, see ^{93m}Tc	8E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, see ^{93m}Tc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-99	D, see ^{93m}Tc	4E+3	5E+3	2E-6	-	6E-5	6E-4

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
				St wall (6E+3)	-	8E-9	-	-
-		W, see ^{93m}Tc	-	7E+2	3E-7	9E-10	-	-
43	Technetium-101[2]	D, see ^{93m}Tc	9E+4	3E+5	1E-4	5E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, see ^{93m}Tc	-	4E+5	2E-4	5E-7	-	-
43	Technetium-104[2]	D, see ^{93m}Tc	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see ^{93m}Tc	-	9E+4	4E-5	1E-7	-	-
44	Ruthenium-94[2]	D, all compounds except those given for W and Y	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, halides	-	6E+4	3E-5	9E-8	-	-
		Y, oxides and hydroxides	-	6E+4	2E-5	8E-8	-	-
44	Ruthenium-97	D, see ^{94}Ru	8E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-103	D, see ^{94}Ru	2E+3	2E+3	7E-7	2E-9	3E-5	3E-4
		W, see ^{94}Ru	-	1E+3	4E-7	1E-9	-	-
		Y, see ^{94}Ru	-	6E+2	3E-7	9E-10	-	-
44	Ruthenium-105	D, see ^{94}Ru	5E+3	1E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{94}Ru	-	1E+4	6E-6	2E-8	-	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-106	D, see ^{94}Ru	2E+2	9E+1	4E-8	1E-10	-	-
			LLI wall	-	-	-	3E-6	3E-5

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			(2E+2)					
		W, see ^{94}Ru	-	5E+1	2E-8	8E-11	-	-
		Y, see ^{94}Ru	-	1E+1	5E-9	2E-11	-	-
45	Rhodium-99m	D, all compounds except those given for W and Y	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		W, halides	-	8E+4	3E-5	1E-7	-	-
		Y, oxides and hydroxides	-	7E+4	3E-5	9E-8	-	-
45	Rhodium-99	D, see ^{99m}Rh	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see ^{99m}Rh	-	2E+3	9E-7	3E-9	-	-
		Y, see ^{99m}Rh	-	2E+3	8E-7	3E-9	-	-
45	Rhodium-100	D, see ^{99m}Rh	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see ^{99m}Rh	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{99m}Rh	-	4E+3	2E-6	5E-9	-	-
45	Rhodium-101m	D, see ^{99m}Rh	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see ^{99m}Rh	-	8E+3	4E-6	1E-8	-	-
		Y, see ^{99m}Rh	-	8E+3	3E-6	1E-8	-	-
45	Rhodium-101	D, see ^{99m}Rh	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see ^{99m}Rh	-	8E+2	3E-7	1E-9	-	-
		Y, see ^{99m}Rh	-	2E+2	6E-8	2E-10	-	-
45	Rhodium-102m	D, see ^{99m}Rh	1E+3	5E+2	2E-7	7E-10	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		W, see ^{99m}Rh	-	4E+2	2E-7	5E-10	-	-
		Y, see ^{99m}Rh	-	1E+2	5E-8	2E-10	-	-
45	Rhodium-102	D, see ^{99m}Rh	6E+2	9E+1	4E-8	1E-10	8E-6	8E-5
		W, see ^{99m}Rh	-	2E+2	7E-8	2E-10	-	-
		Y, see ^{99m}Rh	-	6E+1	2E-8	8E-11	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
45	Rhodium-103m[2]	D, see ^{99m}Rh	4E+5	1E+6	5E-4	2E-6	6E-3	6E-2
		W, see ^{99m}Rh	-	1E+6	5E-4	2E-6	-	-
		Y, see ^{99m}Rh	-	1E+6	5E-4	2E-6	-	-
45	Rhodium-105	D, see ^{99m}Rh	4E+3	1E+4	5E-6	2E-8	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see ^{99m}Rh	-	6E+3	3E-6	9E-9	-	-
		Y, see ^{99m}Rh	-	6E+3	2E-6	8E-9	-	-
45	Rhodium-106m	D, see ^{99m}Rh	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see ^{99m}Rh	-	4E+4	2E-5	5E-8	-	-
		Y, see ^{99m}Rh	-	4E+4	1E-5	5E-8	-	-
45	Rhodium-107[2]	D, see ^{99m}Rh	7E+4	2E+5	1E-4	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{99m}Rh	-	3E+5	1E-4	4E-7	-	-
		Y, see ^{99m}Rh	-	3E+5	1E-4	3E-7	-	-
46	Palladium-100	D, all compounds except those given for W and Y	1E+3	1E+3	6E-7	2E-9	2E-5	2E-4
		W, nitrates	-	1E+3	5E-7	2E-9	-	-
		Y, oxides and hydroxides	-	1E+3	6E-7	2E-9	-	-
46	Palladium-101	D, see ^{100}Pd	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see ^{100}Pd	-	3E+4	1E-5	5E-8	-	-
		Y, see ^{100}Pd	-	3E+4	1E-5	4E-8	-	-
46	Palladium-103	D, see ^{100}Pd	6E+3	6E+3	3E-6	9E-9	-	-
			LLI wall (7E+3)	-	-	-	1E-4	1E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		W, see ^{100}Pd	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{100}Pd	-	4E+3	1E-6	5E-9	-	-
46	Palladium-107	D, see ^{100}Pd	3E+4	2E+4	9E-6	-	-	-
			LLI wall (4E+4)	Kidneys (2E+4)	-	3E-8	5E-4	5E-3
		W, see ^{100}Pd	-	7E+3	3E-6	1E-8	-	-
		Y, see ^{100}Pd	-	4E+2	2E-7	6E-10	-	-
46	Palladium-109	D, see ^{100}Pd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		W, see ^{100}Pd	-	5E+3	2E-6	8E-9	-	-
		Y, see ^{100}Pd	-	5E+3	2E-6	6E-9	-	-
47	Silver-102[2]	D, all compounds except those given for W and Y	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
		W, nitrates and sulfides	-	2E+5	9E-5	3E-7	-	-
		Y, oxides and hydroxides	-	2E+5	8E-5	3E-7	-	-
47	Silver-103[2]	D, see ^{102}Ag	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104m[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	4E-4	4E-3
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104[2]	D, see ^{102}Ag	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{102}Ag	-	1E+5	6E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	6E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
47	Silver-105	D, see ^{102}Ag	3E+3	1E+3	4E-7	1E-9	4E-5	4E-4
		W, see ^{102}Ag	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{102}Ag	-	2E+3	7E-7	2E-9	-	-
47	Silver-106m	D, see ^{102}Ag	8E+2	7E+2	3E-7	1E-9	1E-5	1E-4
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-106[2]	D, see ^{102}Ag	6E+4	2E+5	8E-5	3E-7	-	-
			St. Wall (6E+4)	-	-	-	9E-4	9E-3
		W, see ^{102}Ag	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{102}Ag	-	2E+5	8E-5	3E-7	-	-
47	Silver-108m	D, see ^{102}Ag	6E+2	2E+2	8E-8	3E-10	9E-6	9E-5
		W, see ^{102}Ag	-	3E+2	1E-7	4E-10	-	-
		Y, see ^{102}Ag	-	2E+1	1E-8	3E-11	-	-
47	Silver-110m	D, see ^{102}Ag	5E+2	1E+2	5E-8	2E-10	6E-6	6E-5
		W, see ^{102}Ag	-	2E+2	8E-8	3E-10	-	-
		Y, see ^{102}Ag	-	9E+1	4E-8	1E-10	-	-
47	Silver-111	D, see ^{102}Ag	9E+2	2E+3	6E-7	-	-	-
			LLI wall (1E+3)	Liver (2E+3)	-	2E-9	2E-5	2E-4
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-112	D, see ^{102}Ag	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{102}Ag	-	1E+4	4E-6	1E-8	-	-
		Y, see ^{102}Ag	-	9E+3	4E-6	1E-8	-	-
47	Silver-115[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see ^{102}Ag	-	9E+4	4E-5	1E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		Y, see ^{102}Ag	-	8E+4	3E-5	1E-7	-	-
48	Cadmium-104[2]	D, all compounds except those given for W and Y	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-
48	Cadmium-107	D, see ^{104}Cd	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
		W, see ^{104}Cd	-	6E+4	2E-5	8E-8	-	-
		Y, see ^{104}Cd	-	5E+4	2E-5	7E-8	-	-
48	Cadmium-109	D, see ^{104}Cd	3E+2	4E+1	1E-8	-	-	-
			Kidneys (4E+2)	Kidneys (5E+1)	-	7E-11	6E-6	6E-5
		W, see ^{104}Cd	-	1E+2	5E-8	-	-	-
			-	Kidneys (1E+2)	-	2E-10	-	-
		Y, see ^{104}Cd	-	1E+2	5E-8	2E-10	-	-
48	Cadmium-113m	D, see ^{104}Cd	2E+1	2E+0	1E-9	-	-	-
			Kidneys (4E+1)	Kidneys (4E+0)	-	5E-12	5E-7	5E-6
		W, see ^{104}Cd	-	8E+0	4E-9	-	-	-
			-	Kidneys (1E+1)	-	2E-11	-	-
		Y, see ^{104}Cd	-	1E+1	5E-9	2E-11	-	-
48	Cadmium-113	D, see ^{104}Cd	2E+1	2E+0	9E-10	-	-	-
			Kidneys (3E+1)	Kidneys (3E+0)	-	5E-12	4E-7	4E-6
		W, see ^{104}Cd	-	8E+0	3E-9	-	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
				Kidneys				
			-	(1E+1)	-	2E-11	-	-
		Y, see ^{104}Cd	-	1E+1	6E-9	2E-11	-	-
48	Cadmium-115m	D, see ^{104}Cd	3E+2	5E+1	2E-8	-	4E-6	4E-5
				Kidneys				
			-	(8E+1)	-	1E-10	-	-
		W, see ^{104}Cd	-	1E+2	5E-8	2E-10	-	-
		Y, see ^{104}Cd	-	1E+2	6E-8	2E-10	-	-
48	Cadmium-115	D, see ^{104}Cd	9E+2	1E+3	6E-7	2E-9	-	-
			LLI wall (1E+3)	-	-	-	1E-5	1E-4
		W, see ^{104}Cd	-	1E+3	5E-7	2E-9	-	-
		Y, see ^{104}Cd	-	1E+3	6E-7	2E-9	-	-
48	Cadmium-117m	D, see ^{104}Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see ^{104}Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see ^{104}Cd	-	1E+4	6E-6	2E-8	-	-
48	Cadmium-117	D, see ^{104}Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see ^{104}Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see ^{104}Cd	-	1E+4	6E-6	2E-8	-	-
49	Indium-109	D, all compounds except those given for W	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	9E-8	-	-
49	Indium-110[2] (69.1 min)	D, see ^{109}In	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{109}In	-	6E+4	2E-5	8E-8	-	-
49	Indium-110	D, see ^{109}In	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
	(4.9 h)	W, see ^{109}In	-	2E+4	8E-6	3E-8	-	-
49	Indium-111	D, see ^{109}In	4E+3	6E+3	3E-6	9E-9	6E-5	6E-4
		W, see ^{109}In	-	6E+3	3E-6	9E-9	-	-
49	Indium-112[2]	D, see ^{109}In	2E+5	6E+5	3E-4	9E-7	2E-3	2E-2
		W, see ^{109}In	-	7E+5	3E-4	1E-6	-	-
49	Indium-113m[2]	D, see ^{109}In	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		W, see ^{109}In	-	2E+5	8E-5	3E-7	-	-
49	Indium-114m	D, see ^{109}In	3E+2	6E+1	3E-8	9E-11	-	-
			LLI wall (4E+2)	-	-	-	5E-6	5E-5
		W, see ^{109}In	-	1E+2	4E-8	1E-10	-	-
49	Indium-115m	D, see ^{109}In	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{109}In	-	5E+4	2E-5	7E-8	-	-
49	Indium-115	D, see ^{109}In	4E+1	1E+0	6E-10	2E-12	5E-7	5E-6
		W, see ^{109}In	-	5E+0	2E-9	8E-12	-	-
49	Indium-116m[2]	D, see ^{109}In	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{109}In	-	1E+5	5E-5	2E-7	-	-
49	Indium-117m[2]	D, see ^{109}In	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see ^{109}In	-	4E+4	2E-5	6E-8	-	-
49	Indium-117[2]	D, see ^{109}In	6E+4	2E+5	7E-5	2E-7	8E-4	8E-3
		W, see ^{109}In	-	2E+5	9E-5	3E-7	-	-
49	Indium-119m[2]	D, see ^{109}In	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		W, see ^{109}In	-	1E+5	6E-5	2E-7	-	-
50	Tin-110	D, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		except those given for W W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	-	1E+4	5E-6	2E-8	-	-
50	Tin-111[2]	D, see ^{110}Sn	7E+4	2E+5	9E-5	3E-7	1E-3	1E-2
		W, see ^{110}Sn	-	3E+5	1E-4	4E-7	-	-
50	Tin-113	D, see ^{110}Sn	2E+3	1E+3	5E-7	2E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-117m	D, see ^{110}Sn	2E+3	1E+3	5E-7	-	-	-
			LLI wal (2E+3)	Bone surf (2E+3)	-	3E-9	3E-5	3E-4
		W, see ^{110}Sn	-	1E+3	6E-7	2E-9	-	-
50	Tin-119m	D, see ^{110}Sn	3E+3	2E+3	1E-6	3E-9	-	-
			LLI wall (4E+3)	-	-	-	6E-5	6E-4
		W, see ^{110}Sn	-	1E+3	4E-7	1E-9	-	-
50	Tin-121m	D, see ^{110}Sn	3E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-121	D, see ^{110}Sn	6E+3	2E+4	6E-6	2E-8	-	-
			LLI wall (6E+3)	-	-	-	8E-5	8E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		W, see ^{110}Sn	-	1E+4	5E-6	2E-8	-	-
50	Tin-123m[2]	D, see ^{110}Sn	5E+4	1E+5	5E-5	2E-7	7E-4	7E-3
		W, see ^{110}Sn	-	1E+5	6E-5	2E-7	-	-
50	Tin-123	D, see ^{110}Sn	5E+2	6E+2	3E-7	9E-10	-	-
			LLI wall (6E+2)	-	-	-	9E-6	9E-5
		W, see ^{110}Sn	-	2E+2	7E-8	2E-10	-	-
50	Tin-125	D, see ^{110}Sn	4E+2	9E+2	4E-7	1E-9	-	-
			LLI wall (5E+2)	-	-	-	6E-6	6E-5
		W, see ^{110}Sn	-	4E+2	1E-7	5E-10	-	-
50	Tin-126	D, see ^{110}Sn	3E+2	6E+1	2E-8	8E-11	4E-6	4E-5
		W, see ^{110}Sn	-	7E+1	3E-8	9E-11	-	-
50	Tin-127	D, see ^{110}Sn	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		W, see ^{110}Sn	-	2E+4	8E-6	3E-8	-	-
50	Tin-128[2]	D, see ^{110}Sn	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see ^{110}Sn	-	4E+4	1E-5	5E-8	-	-
51	Antimony-115[2]	D, all compounds except those given for W	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	-	3E+5	1E-4	4E-7	-	-
51	Antimony-116m[2]	D, see ^{115}Sb	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{115}Sb	-	1E+5	6E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
51	Antimony-116[2]	D, see ^{115}Sb	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{115}Sb	-	3E+5	1E-4	5E-7	-	-
51	Antimony-117	D, see ^{115}Sb	7E+4	2E+5	9E-5	3E-7	9E-4	9E-3
		W, see ^{115}Sb	-	3E+5	1E-4	4E-7	-	-
51	Antimony-118m	D, see ^{115}Sb	6E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		W, see ^{115}Sb	5E+3	2E+4	9E-6	3E-8	-	-
51	Antimony-119	D, see ^{115}Sb	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{115}Sb	2E+4	3E+4	1E-5	4E-8	-	-
51	Antimony-120[2] (16 min)	D, see ^{115}Sb	1E+5	4E+5	2E-4	6E-7	-	-
			St wall (2E+5)	-	-	-	2E-3	2E-2
		W, see ^{115}Sb	-	5E+5	2E-4	7E-7	-	-
51	Antimony-120 (5.76 d)	D, see ^{115}Sb	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
		W, see ^{115}Sb	9E+2	1E+3	5E-7	2E-9	-	-
51	Antimony-122	D, see ^{115}Sb	8E+2	2E+3	1E-6	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see ^{115}Sb	7E+2	1E+3	4E-7	2E-9	-	-
51	Antimony-124m[2]	D, see ^{115}Sb	3E+5	8E+5	4E-4	1E-6	3E-3	3E-2
		W, see ^{115}Sb	2E+5	6E+5	2E-4	8E-7	-	-
51	Antimony-124	D, see ^{115}Sb	6E+2	9E+2	4E-7	1E-9	7E-6	7E-5
		W, see ^{115}Sb	5E+2	2E+2	1E-7	3E-10	-	-
51	Antimony-125	D, see ^{115}Sb	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
		W, see ^{115}Sb	-	5E+2	2E-7	7E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
51	Antimony-126m[2]	D, see ^{115}Sb	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see ^{115}Sb	-	2E+5	8E-5	3E-7	-	-
51	Antimony-126	D, see ^{115}Sb	6E+2	1E+3	5E-7	2E-9	7E-6	7E-5
		W, see ^{115}Sb	5E+2	5E+2	2E-7	7E-10	-	-
51	Antimony-127	D, see ^{115}Sb	8E+2	2E+3	9E-7	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see ^{115}Sb	7E+2	9E+2	4E-7	1E-9	-	-
51	Antimony-128[2] (10.4 min)	D, see ^{115}Sb	8E+4	4E+5	2E-4	5E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see ^{115}Sb	-	4E+5	2E-4	6E-7	-	-
51	Antimony-128 (9.01 h)	D, see ^{115}Sb	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, see ^{115}Sb	-	3E+3	1E-6	5E-9	-	-
51	Antimony-129	D, see ^{115}Sb	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, see ^{115}Sb	-	9E+3	4E-6	1E-8	-	-
51	Antimony-130[2]	D, see ^{115}Sb	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, see ^{115}Sb	-	8E+4	3E-5	1E-7	-	-
51	Antimony-131[2]	D, see ^{115}Sb	1E+4	2E+4	1E-5	-	-	-
			Thyroid (2E+4)	Thyroid (4E+4)	-	6E-8	2E-4	2E-3
		W, see ^{115}Sb	-	2E+4	1E-5		-	-
			-	Thyroid (4E+4)	-	6E-8	-	-
52	Tellurium-116	D, all compounds except those	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		given for W						
		W, oxides, hydroxides, and nitrates	-	3E+4	1E-5	4E-8	-	-
52	Tellurium-121m	D, see ^{116}Te	5E+2	2E+2	8E-8	-	-	-
			Bone surf (7E+2)	Bone surf (4E+2)	-	5E-10	1E-5	1E-4
		W, see ^{116}Te	-	4E+2	2E-7	6E-10	-	-
52	Tellurium-121	D, see ^{116}Te	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see ^{116}Te	-	3E+3	1E-6	4E-9	-	-
52	Tellurium-123m	D, see ^{116}Te	6E+2	2E+2	9E-8	-	-	-
			Bone surf (1E+3)	Bone surf (5E+2)	-	8E-10	1E-5	1E-4
		W, see ^{116}Te	-	5E+2	2E-7	8E-10	-	-
52	Tellurium-123	D, see ^{116}Te	5E+2	2E+2	8E-8	-	-	-
			Bone surf (1E+3)	Bone surf (5E+2)	-	7E-10	2E-5	2E-4
		W, see ^{116}Te	-	4E+2	2E-7	-	-	-
			-	Bone surf (1E+3)	-	2E-9	-	-
52	Tellurium-125m	D, see ^{116}Te	1E+3	4E+2	2E-7	-	-	-
			Bone surf (1E+3)	Bone surf (1E+3)	-	1E-9	2E-5	2E-4
		W, see ^{116}Te	-	7E+2	3E-7	1E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
52	Tellurium-127m	D, see ^{116}Te	6E+2	3E+2	1E-7	-	9E-6	9E-5
			-	Bone surf (4E+2)	-	6E-10	-	-
		W, see ^{116}Te	-	3E+2	1E-7	4E-10	-	-
52	Tellurium-127	D, see ^{116}Te	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{116}Te	-	2E+4	7E-6	2E-8	-	-
52	Tellurium-129m	D, see ^{116}Te	5E+2	6E+2	3E-7	9E-10	7E-6	7E-5
		W, see ^{116}Te	-	2E+2	1E-7	3E-10	-	-
52	Tellurium-129[2]	D, see ^{116}Te	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see ^{116}Te	-	7E+4	3E-5	1E-7	-	-
52	Tellurium-131m	D, see ^{116}Te	3E+2	4E+2	2E-7	-	-	-
			Thyroid (6E+2)	Thyroid (1E+3)	-	2E-9	8E-6	8E-5
		W, see ^{116}Te	-	4E+2	2E-7	-	-	-
			-	Thyroid (9E+2)	-	1E-9	-	-
52	Tellurium-131[2]	D, see ^{116}Te	3E+3	5E+3	2E-6	-	-	-
			Thyroid (6E+3)	Thyroid (1E+4)	-	2E-8	8E-5	8E-4
		W, see ^{116}Te	-	5E+3	2E-6	-	-	-
			-	Thyroid (1E+4)	-	2E-8	-	-
52	Tellurium-132	D, see ^{116}Te	2E+2	2E+2	9E-8	-	-	-
			Thyroid (7E+2)	Thyroid (8E+2)	-	1E-9	9E-6	9E-5
		W, see ^{116}Te	-	2E+2	9E-8	-	-	-
			-	Thyroid (6E+2)	-	9E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
52	Tellurium-133m[2]	D, see ^{116}Te	3E+3	5E+3	2E-6	-	-	-
			Thyroid (6E+3)	Thyroid (1E+4)	-	2E-8	9E-5	9E-4
		W, see ^{116}Te	-	5E+3	2E-6	-	-	-
			-	Thyroid (1E+4)	-	2E-8	-	-
52	Tellurium-133[2]	D, see ^{116}Te	1E+4	2E+4	9E-6	-	-	-
			Thyroid (3E+4)	Thyroid (6E+4)	-	8E-8	4E-4	4E-3
		W, see ^{116}Te	-	2E+4	9E-6	-	-	-
			-	Thyroid (6E+4)	-	8E-8	-	-
52	Tellurium-134[2]	D, see ^{116}Te	2E+4	2E+4	1E-5	-	-	-
			Thyroid (2E+4)	Thyroid (5E+4)	-	7E-8	3E-4	3E-3
		W, see ^{116}Te	-	2E+4	1E-5	-	-	-
			-	Thyroid (5E+4)	-	7E-8	-	-
53	Iodine-120m[2]	D, all compounds	1E+4	2E+4	9E-6	3E-8	-	-
			Thyroid (1E+4)	-	-	-	2E-4	2E-3
53	Iodine-120[2]	D, all compounds	4E+3	9E+3	4E-6	-	-	-
			Thyroid (8E+3)	Thyroid (1E+4)	-	2E-8	1E-4	1E-3
53	Iodine-121	D, all compounds	1E+4	2E+4	8E-6	-	-	-
			Thyroid (3E+4)	Thyroid (5E+4)	-	7E-8	4E-4	4E-3
53	Iodine-123	D, all compounds	3E+3	6E+3	3E-6	-	-	-
			Thyroid (1E+4)	Thyroid (2E+4)	-	2E-8	1E-4	1E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
53	Iodine-124	D, all compounds	5E+1	8E+1	3E-8	-	-	-
			Thyroid (2E+2)	Thyroid (3E+2)	-	4E-10	2E-6	2E-5
53	Iodine-125	D, all compounds	4E+1	6E+1	3E-8	-	-	-
			Thyroid (1E+2)	Thyroid (2E+2)	-	3E-10	2E-6	2E-5
53	Iodine-126	D, all compounds	2E+1	4E+1	1E-8	-	-	-
			Thyroid (7E+1)	Thyroid (1E+2)	-	2E-10	1E-6	1E-5
53	Iodine-128[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
53	Iodine-129	D, all compounds	5E+0	9E+0	4E-9	-	-	-
			Thyroid (2E+1)	Thyroid (3E+1)	-	4E-11	2E-7	2E-6
53	Iodine-130	D, all compounds	4E+2	7E+2	3E-7	-	-	-
			Thyroid (1E+3)	Thyroid (2E+3)	-	3E-9	2E-5	2E-4
53	Iodine-131	D, all compounds	3E+1	5E+1	2E-8	-	-	-
			Thyroid (9E+1)	Thyroid (2E+2)	-	2E-10	1E-6	1E-5
53	Iodine-132m[2]	D, all compounds	4E+3	8E+3	4E-6	-	-	-
			Thyroid (1E+4)	Thyroid (2E+4)	-	3E-8	1E-4	1E-3
53	Iodine-132	D, all compounds	4E+3	8E+3	3E-6	-	-	-
			Thyroid	Thyroid	-	2E-8	1E-4	1E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			(9E+3)	(1E+4)				
53	Iodine-133	D, all compounds	1E+2	3E+2	1E-7	-	-	-
			Thyroid (5E+2)	Thyroid (9E+2)	-	1E-9	7E-6	7E-5
53	Iodine-134[2]	D, all compounds	2E+4	5E+4	2E-5	6E-8	-	-
			Thyroid (3E+4)	-	-	-	4E-4	4E-3
53	Iodine-135	D, all compounds	8E+2	2E+3	7E-7	-	-	-
			Thyroid (3E+3)	Thyroid (4E+3)	-	6E-9	3E-5	3E-4
54	Xenon-120[2]	Submersion[1]	-	-	1E-5	4E-8	-	-
54	Xenon-121[2]	Submersion[1]	-	-	2E-6	1E-8	-	-
54	Xenon-122	Submersion[1]	-	-	7E-5	3E-7	-	-
54	Xenon-123	Submersion[1]	-	-	6E-6	3E-8	-	-
54	Xenon-125	Submersion[1]	-	-	2E-5	7E-8	-	-
54	Xenon-127	Submersion[1]	-	-	1E-5	6E-8	-	-
54	Xenon-129m	Submersion[1]	-	-	2E-4	9E-7	-	-
54	Xenon-131m	Submersion[1]	-	-	4E-4	2E-6	-	-
54	Xenon-133m	Submersion[1]	-	-	1E-4	6E-7	-	-
54	Xenon-133	Submersion[1]	-	-	1E-4	5E-7	-	-
54	Xenon-135m[2]	Submersion[1]	-	-	9E-6	4E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
54	Xenon-135	Submersion[1]	-	-	1E-5	7E-8	-	-
54	Xenon-138[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
55	Cesium-125[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
55	Cesium-127	D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4	9E-3
55	Cesium-129	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
55	Cesium130[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
55	Cesium-131	D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
55	Cesium-132	D, all compounds	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
55	Cesium-134m	D, all compounds	1E+5	1E+5	6E-5	2E-7	-	-
			St.wall (1E+5)	-	-	-	2E-3	2E-2
55	Cesium-134	D, all compounds	7E+1	1E+2	4E-8	2E-10	9E-7	9E-6
55	Cesium-135m[2]	D, all compounds	1E+5	2E+5	8E-5	3E-7	1E-3	1E-2
55	Cesium-135	D, all compounds	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
55	Cesium-136	D, all compounds	4E+2	7E+2	3E-7	9E-10	6E-6	6E-5
55	Cesium-137	D, all compounds	1E+2	2E+2	6E-8	2E-10	1E-6	1E-5
55	Cesium-138[2]	D, all compounds	2E+4	6E+4	2E-5	8E-8	-	-
			St wall					

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			(3E+4)	-	-	-	4E-4	4E-3
56	Barium-126[2]	D, all compounds	6E+3	2E+4	6E-6	2E-8	8E-5	8E-4
56	Barium-128	D, all compounds	5E+2	2E+3	7E-7	2E-9	7E-6	7E-5
56	Barium-131m[2]	D, all compounds	4E+5	1E+6	6E-4	2E-6	-	-
			St wall (5E+5)	-	-	-	7E-3	7E-2
56	Barium-131	D, all compounds	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
56	Barium-133m	D, all compounds	2E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
56	Barium-133	D, all compounds	2E+3	7E+2	3E-7	9E-10	2E-5	2E-4
56	Barium-135m	D, all compounds	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
56	Barium-139[2]	D, all compounds	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
56	Barium-140	D, all compounds	5E+2	1E+3	6E-7	2E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
56	Barium-141[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
56	Barium142[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
57	Lanthanum-131[2]	D, all compounds except those given for W,	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		W,oxides and hydroxides	-	2E+5	7E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
57	Lanthanum-132	D, see ^{131}La	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-135	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-	-
57	Lanthanum-137	D, see ^{131}La	1E+4	6E+1	3E-8	-	2E-4	2E-3
			-	Liver (7E+1)	-	1E-10	-	-
		W, see ^{131}La	-	3E+2	1E-7	-	-	-
			-	Liver (3E+2)	-	4E-10	-	-
57	Lanthanum-138	D, see ^{131}La	9E+2	4E+0	1E-9	5E-12	1E-5	1E-4
		W, see ^{131}La	-	1E+1	6E-9	2E-11	-	-
57	Lanthanum-140	D, see ^{131}La	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see ^{131}La	-	1E+3	5E-7	2E-9	-	-
57	Lanthanum-141	D, see ^{131}La	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-142[2]	D, see ^{131}La	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{131}La	-	3E+4	1E-5	5E-8	-	-
57	Lanthanum-143[2]	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-	-
58	Cerium-134	W, all compounds except those given for Y	5E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, oxides,	-	7E+2	3E-7	9E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		hydroxides and fluorides,						
58	Cerium-135	W, see ^{134}Ce	2E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		Y, see ^{134}Ce	-	4E+3	1E-6	5E-9	-	-
58	Cerium-137m	W, see ^{134}Ce	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{134}Ce	-	4E+3	2E-6	5E-9	-	-
58	Cerium-137	W, see ^{134}Ce	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		Y, see ^{134}Ce	-	1E+5	5E-5	2E-7	-	-
58	Cerium-139	W, see ^{134}Ce	5E+3	8E+2	3E-7	1E-9	7E-5	7E-4
		Y, see ^{134}Ce	-	7E+2	3E-7	9E-10	-	-
58	Cerium-141	W, see ^{134}Ce	2E+3	7E+2	3E-7	1E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{134}Ce	-	6E+2	2E-7	8E-10	-	-
58	Cerium-143	W, see ^{134}Ce	1E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{134}Ce	-	2E+3	7E-7	2E-9	-	-
58	Cerium-144	W, see ^{134}Ce	2E+2	3E+1	1E-8	4E-11	-	-
			LLI wall (3E+2)	-	-	-	3E-6	3E-5
		Y, see ^{134}Ce	-	1E+1	6E-9	2E-11	-	-
59	Praseodymium-136[2]	W, all compounds except those given for Y	5E+4	2E+5	1E-4	3E-7	-	-
			St wall	-	-	-	1E-3	1E-2

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			(7E+4)					
		Y, oxides, hydroxides carbides, and fluorides,	-	2E+5	9E-5	3E-7	-	-
59	Praseodymium-137[2]	W, see ^{136}Pr	4E+4	2E+5	6E-5	2E-7	5E-4	5E-3
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-138m	W, see ^{136}Pr	1E+4	5E+4	2E-5	8E-8	1E-4	1E-3
		Y, see ^{136}Pr	-	4E+4	2E-5	6E-8	-	-
59	Praseodymium-139	W, see ^{136}Pr	4E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-142m[2]	W, see ^{136}Pr	8E+4	2E+5	7E-5	2E-7	1E-3	1E-2
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-142	W, see ^{136}Pr	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
		Y, see ^{136}Pr	-	2E+3	8E-7	3E-9	-	-
59	Praseodymium-143	W, see ^{136}Pr	9E+2	8E+2	3E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{136}Pr	-	7E+2	3E-7	9E-10	-	-
59	Praseodymium-144[2]	W, see ^{136}Pr	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-145	W, see ^{136}Pr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		Y, see ^{136}Pr	-	8E+3	3E-6	1E-8	-	-
59	Praseodymium-147[2]	W, see ^{136}Pr	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		Y, see ^{136}Pr	-	2E+5	8E-5	3E-7	-	-
60	Neodymium-136[2]	W, all compounds except those given for Y	1E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		Y, oxides, hydroxides, carbides, and fluorides	-	5E+4	2E-5	8E-8	-	-
60	Neodymium-138	W, see ^{136}Nd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		Y, see ^{136}Nd	-	5E+3	2E-6	7E-9	-	-
60	Neodymium-139m	W, see ^{136}Nd	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		Y, see ^{136}Nd	-	1E+4	6E-6	2E-8	-	-
60	Neodymium-139[2]	W, see ^{136}Nd	9E+4	3E+5	1E-4	5E-7	1E-3	1E-2
		Y, see ^{136}Nd	-	3E+5	1E-4	4E-7	-	-
60	Neodymium-141	W, see ^{136}Nd	2E+5	7E+5	3E-4	1E-6	2E-3	2E-2
		Y, see ^{136}Nd	-	6E+5	3E-4	9E-7	-	-
60	Neodymium-147	W, see ^{136}Nd	1E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{136}Nd	-	8E+2	4E-7	1E-9	-	-
60	Neodymium-149[2]	W, see ^{136}Nd	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
		Y, see ^{136}Nd	-	2E+4	1E-5	3E-8	-	-
60	Neodymium-151[2]	W, see ^{136}Nd	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		Y, see ^{136}Nd	-	2E+5	8E-5	3E-7	-	-
61	Promethium-141[2]	W, all compounds except those given for Y	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
		Y, oxides, hydroxides carbides, and fluorides	-	2E+5	7E-5	2E-7	-	-
61	Promethium-143	W, see ^{141}Pm	5E+3	6E+2	2E-7	8E-10	7E-5	7E-4
		Y, see ^{141}Pm	-	7E+2	3E-7	1E-9	-	-
61	Promethium-144	W, see ^{141}Pm	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		Y, see ^{141}Pm	-	1E+2	5E-8	2E-10	-	-
61	Promethium-145	W, see ^{141}Pm	1E+4	2E+2	7E-8	-	1E-4	1E-3
			-	Bone surf (2E+2)	-	3E-10	-	-
		Y, see ^{141}Pm	-	2E+2	8E-8	3E-10	-	-
61	Promethium-146	W, see ^{141}Pm	2E+3	5E+1	2E-8	7E-11	2E-5	2E-4
		Y, see ^{141}Pm	-	4E+1	2E-8	6E-11	-	-
61	Promethium-147	W, see ^{141}Pm	4E+3	1E+2	5E-8	-	-	-
			LLI wall (5E+3)	Bone surf (2E+2)	-	3E-10	7E-5	7E-4
		Y, see ^{141}Pm	-	1E+2	6E-8	2E-10	-	-
61	Promethium-148m	W, see ^{141}Pm	7E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		Y, see ^{141}Pm	-	3E+2	1E-7	5E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
61	Promethium-148	W, see ^{141}Pm	4E+2	5E+2	2E-7	8E-10	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
		Y, see ^{141}Pm	-	5E+2	2E-7	7E-10	-	-
61	Promethium-149	W, see ^{141}Pm	1E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{141}Pm	-	2E+3	8E-7	2E-9	-	-
61	Promethium-150	W, see ^{141}Pm	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see ^{141}Pm	-	2E+4	7E-6	2E-8	-	-
61	Promethium-151	W, see ^{141}Pm	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		Y, see ^{141}Pm	-	3E+3	1E-6	4E-9	-	-
62	Samarium-141m[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
62	Samarium-141[2]	W, all compounds	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
62	Samarium-142[2]	W, all compounds	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
62	Samarium-145	W, all compounds	6E+3	5E+2	2E-7	7E-10	8E-5	8E-4
62	Samarium-146	W, all compounds	1E+1	4E2	1E-11	-	-	-
			Bone surf (3E+1)	Bone surf (6E-2)	-	9E-14	3E-7	3E-6
62	Samarium-147	W, all compounds	2E+1	4E-2	2E-11	-	-	-
			Bone surf (3E+1)	Bone surf (7E-2)	-	1E-13	4E-7	4E-6

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
62	Samarium-151	W, all compounds	1E+4	1E+2	4E-8	-	-	-
			LLI wall (1E+4)l	Bone surf (2E+2)	-	2E-10	2E-4	2E-3
62	Samarium-153	W, all compounds	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
62	Samarium-155[2]	W, all compounds	6E+4	2E+5	9E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
62	Samarium-156	W, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
63	Europium-145	W, all compounds	2E+3	2E+3	8E-7	3E-9	2E-5	2E-4
63	Europium-146	W, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
63	Europium-147	W, all compounds	3E+3	2E+3	7E-7	2E-9	4E-5	4E-4
63	Europium-148	W, all compounds	1E+3	4E+2	1E-7	5E-10	1E-5	1E-4
63	Europium-149	W, all compounds	1E+4	3E+3	1E-6	4E-9	2E-4	2E-3
63	Europium-150 (12.62 h)	W, all compounds	3E+3	8E+3	4E-6	1E-8	4E-5	4E-4
63	Europium-150 (34.2 y)	W, all compounds	8E+2	2E+1	8E-9	3E-11	1E-5	1E-4
63	Europium-152m	W, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
63	Europium-152	W, all compounds	8E+2	2E+1	1E-8	3E-11	1E-5	1E-4
63	Europium-154	W, all compounds	5E+2	2E+1	8E-9	3E-11	7E-6	7E-5

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
63	Europium-155	W, all compounds	4E+3	9E+1	4E-8	-	5E-5	5E-4
			-	Bone surf (1E+2)	-	2E-10	-	-
63	Europium-156	W, all compounds	6E+2	5E+2	2E-7	6E-10	8E-6	8E-5
63	Europium-157	W, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
63	Europium-158[2]	W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
64	Gadolinium-145[2]	D, all compounds except those given for W	5E+4	2E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	6E-4	6E-3
		W, oxides, hydroxides, and fluorides	-	2E+5	7E-5	2E-7	-	-
64	Gadolinium-146	D, see ^{145}Gd	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		W, see ^{145}Gd	-	3E+2	1E-7	4E-10	-	-
64	Gadolinium-147	D, see ^{145}Gd	2E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		W, see ^{145}Gd	-	4E+3	1E-6	5E-9	-	-
64	Gadolinium-148	D, see ^{145}Gd	1E+1	8E+3	3E-12	-	-	-
			Bone surf (2E+1)	Bone surf (2E+2)	-	2E-14	3E-7	3E-6
		W, see ^{145}Gd	-	3E-2	1E-11	-	-	-
			-	Bone surf (6E-2)	-	8E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
64	Gadolinium-149	D, see ^{145}Gd	3E+3	2E+3	9E-7	3E-9	4E-5	4E-4
		W, see ^{145}Gd	-	2E+3	1E-6	3E-9	-	-
64	Gadolinium-151	D, see ^{145}Gd	6E+3	4E+2	2E-7	-	9E-5	9E-4
			-	Bone surf (6E+2)	-	9E-10	-	-
		W, see ^{145}Gd	-	1E+3	5E-7	2E-9	-	-
64	Gadolinium-152	D, see ^{145}Gd	2E+1	1E-2	4E-12	-	-	-
			Bone surf (3E+1)	Bone surf (2E-2)	-	3E-14	4E-7	4E-6
		W, see ^{145}Gd	-	4E-2	2E-11	-	-	-
			-	Bone surf (8E-2)	-	1E-13	-	-
64	Gadolinium-153	D, see ^{145}Gd	5E+3	1E+2	6E-8	-	6E-5	6E-4
			-	Bone surf (2E+2)	-	3E-10	-	-
		W, see ^{145}Gd	-	6E+2	2E-7	8E-10	-	-
64	Gadolinium-159	D, see ^{145}Gd	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{145}Gd	-	6E+3	2E-6	8E-9	-	-
65	Terbium-147[2]	W, all compounds	9E+3	3E+4	1E-5	5E-8	1E-4	1E-3
65	Terbium-149	W, all compounds	5E+3	7E+2	3E-7	1E-9	7E-5	7E-4
65	Terbium-150	W, all compounds	5E+3	2E+4	9E-6	3E-8	7E-5	7E-4
65	Terbium-151	W, all compounds	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
65	Terbium-153	W, all compounds	5E+3	7E+3	3E-6	1E-8	7E-5	7E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
65	Terbium-154	W, all compounds	2E+3	4E+3	2E-6	6E-9	2E-5	2E-4
65	Terbium-155	W, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5	8E-4
65	Terbium-156m (5.0 h)	W, all compounds	2E+4	3E+4	1E-5	4E-8	2E-4	2E-3
65	Terbium-156m (24.4 h)	W, all compounds	7E+3	8E+3	3E-6	1E-8	1E-4	1E-3
65	Terbium-156	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
65	Terbium-157	W, all compounds	5E+4	3E+2	1E-7	-	-	-
			LLI wall (5E+4)	Bone surf (6E+2)	-	8E-10	7E-4	7E-3
65	Terbium-158	W, all compounds	1E+3	2E+1	8E-9	3E-11	2E-5	2E-4
65	Terbium-160	W, all compounds	8E+2	2E+2	9E-8	3E-10	1E-5	1E-4
65	Terbium-161	W, all compounds	2E+3	2E+3	7E-7	2E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
66	Dysprosium-157	W, all compounds	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
66	Dysprosium-159	W, all compounds	1E+4	2E+3	1E-6	3E-9	2E-4	2E-3
66	Dysprosium-165	W, all compounds	1E+4	5E+4	2E-5	6E-8	2E-4	2E-3
66	Dysprosium-166	W, all compounds	6E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
67	Holmium-155[2]	W, all compounds	4E+4	2E+5	6E-5	2E-7	6E-4	6E-3
67	Holmium-157[2]	W, all compounds	3E+5	1E+6	6E-4	2E-6	4E-3	4E-2
67	Holmium-159[2]	W, all compounds	2E+5	1E+6	4E-4	1E-6	3E-3	3E-2
67	Holmium-161	W, all compounds	1E+5	4E+5	2E-4	6E-7	1E-3	1E-2
67	Holmium-162m[2]	W, all compounds	5E+4	3E+5	1E-4	4E-7	7E-4	7E-3
67	Holmium-162[2]	W, all compounds	5E+5	2E+6	1E-3	3E-6	-	-
			St wall (8E+5)	-	-	-	1E-2	1E-1
67	Holmium-164m[2]	W, all compounds	1E+5	3E+5	1E-4	4E-7	1E-3	1E-2
67	Holmium-164[2]	W, all compounds	2E+5	6E+5	3E-4	9E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
67	Holmium-166m	W, all compounds	6E+2	7E+0	3E-9	9E-12	9E-6	9E-5
67	Holmium-166	W, all compounds	9E+2	2E+3	7E-7	2E-9	-	-
			LLI wall (9E+2)	-	-	-	1E-5	1E-4
67	Holmium-167	W, all compounds	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
68	Erbium-161	W, all compounds	2E+4	6E+4	3E-5	9E-8	2E-4	2E-3
68	Erbium-165	W, all compounds	6E+4	2E+5	8E-5	3E-7	9E-4	9E-3
68	Erbium-169	W, all compounds	3E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
68	Erbium-171	W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5	5E-4
68	Erbium-172	W, all compounds	1E+3	1E+3	6E-7	2E-9	-	-
			LLI wall (E+3)	-	-	-	2E-5	2E-4
69	Thulium-162[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
69	Thulium-166	W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5	6E-4
69	Thulium-167	W, all compounds	2E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
69	Thulium-170	W, all compounds	8E+2	2E+2	9E-8	3E-10	-	-
			LLI wall (1E+3)	-	-	-	1E-5	1E-4
69	Thulium-171	W, all compounds	1E+4	3E+2	1E-7	-	-	-
			LLI wall (1E+4)	Bone surf (6E+2)	-	8E-10	2E-4	2E-3
69	Thulium-172	W, all compounds	7E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
69	Thulium-173	W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
69	Thulium-175[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
70	Ytterbium-162[2]	W, all compounds except those given for Y	7E+4	3E+5	1E-4	4E-7	1E-3	1E-2
		Y, oxides, hydroxides, and fluorides	-	3E+5	1E-4	4E-7	-	-
70	Ytterbium-166	W, see ^{162}Yb	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		Y, see ^{162}Yb	-	2E+3	8E-7	3E-9	-	-
70	Ytterbium-167[2]	W, see ^{162}Yb	3E+5	8E+5	3E-4	1E-6	4E-3	4E-2
		Y, see ^{162}Yb	-	7E+5	3E-4	1E-6	-	-
70	Ytterbium-169	W, see ^{162}Yb	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
		Y, see ^{162}Yb	-	7E+2	3E-7	1E-9	-	-
70	Ytterbium-175	W, see ^{162}Yb	3E+3	4E+3	1E-6	5E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		Y, see ^{162}Yb	-	3E+3	1E-6	5E-9	-	-
70	Ytterbium-177[2]	W, see ^{162}Yb	2E+4	5E+4	2E-5	7E-8	2E-4	2E-3
		Y, see ^{162}Yb	-	5E+4	2E-5	6E-8	-	-
70	Ytterbium-178[2]	W, see ^{162}Yb	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		Y, see ^{162}Yb	-	4E+4	2E-5	5E-8	-	-
71	Lutetium-169	W, all compounds except those given for Y	3E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		Y, oxides, hydroxides, and fluorides	-	4E+3	2E-6	6E-9	-	-
71	Lutetium-170	W, see ^{169}Lu	1E+3	2E+3	9E-7	3E-9	2E-5	2E-4
		Y, see ^{169}Lu	-	2E+3	8E-7	3E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
71	Lutetium-171	W, see ^{169}Lu	2E+3	2E+3	8E-7	3E-9	3E-5	3E-4
		Y, see ^{169}Lu	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-172	W, see ^{169}Lu	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
		Y, see ^{169}Lu	-	1E+3	5E-7	2E-9	-	-
71	Lutetium-173	W, see ^{169}Lu	5E+3	3E+2	1E-7	-	7E-5	7E-4
			-	Bone surf (5E+2)	-	6E-10	-	-
		Y, see ^{169}Lu	-	3E+2	1E-7	4E-10	-	-
71	Lutetium-174m	W, see ^{169}Lu	2E+3	2E+2	1E-7	-	-	-
			LLI wall (3E+3)	Bone surf (3E+2)	-	5E-10	4E-5	4E-4
		Y, see ^{169}Lu	-	2E+2	9E-8	3E-10	-	-
71	Lutetium-174	W, see ^{169}Lu	5E+3	1E+2	5E-8	-	7E-5	7E-4
			-	Bone surf (2E+2)	-	3E-10	-	-
		Y, see ^{169}Lu	-	2E+2	6E-8	2E-10	-	-
71	Lutetium-176m	W, see ^{169}Lu	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		Y, see ^{169}Lu	-	2E+4	9E-6	3E-8	-	-
71	Lutetium-176	W, see ^{169}Lu	7E+2	5E+0	2E-9	-	1E-5	1E-4
			-	Bone surf (1E+1)	-	2E-11	-	-
		Y, see ^{169}Lu	-	8E+0	3E-9	1E-11	-	-
71	Lutetium-177m	W, see ^{169}Lu	7E+2	1E+2	5E-8	-	1E-5	1E-4
			-	Bone surf (1E+2)	-	2E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		Y, see ^{169}Lu	-	8E+1	3E-8	1E-10	-	-
71	Lutetium-177	W, see ^{169}Lu	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		Y, see ^{169}Lu	-	2E+3	9E-7	3E-9	-	-
71	Lutetium-178m[2]	W, see ^{169}Lu	5E+4	2E+5	8E-5	3E-7	-	-
			St. Wall (6E+4)	-	-	-	8E-4	8E-3
		Y, see ^{169}Lu	-	2E+5	7E-5	2E-7	-	-
71	Lutetium-178[2]	W, see ^{169}Lu	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		Y, see ^{169}Lu	-	1E+5	5E-5	2E-7	-	-
71	Lutetium-179	W, see ^{169}Lu	6E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see ^{169}Lu	-	2E+4	6E-6	3E-8	-	-
72	Hafnium-170	D, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5	4E-4
		W, oxides, hydroxides, carbides, and nitrates	-	5E+3	2E-6	6E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
72	Hafnium-172	D, see ^{170}Hf	1E+3	9E+0	4E-9	-	2E-5	2E-4
			-	Bone surf (2E+1)	-	3E-11	-	-
		W, see ^{170}Hf	-	4E+1	2E-8	-	-	-
			-	Bone surf (6E+1)	-	8E-11	-	-
72	Hafnium-173	D, see ^{170}Hf	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see ^{170}Hf	-	1E+4	5E-6	2E-8	-	-
72	Hafnium-175	D, see ^{170}Hf	3E+3	9E+2	4E-7	-	4E-5	4E-4
			-	Bone surf (1E+3)	-	1E-9	-	-
		W, see ^{170}Hf	-	1E+3	5E-7	2E-9	-	-
72	Hafnium-177m[2]	D, see ^{170}Hf	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		W, see ^{170}Hf	-	9E+4	4E-5	1E-7	-	-
72	Hafnium-178m	D, see ^{170}Hf	3E+2	1E+0	5E-10	-	3E-6	3E-5
			-	Bone surf (2E+0)	-	3E-12	-	-
		W, see ^{170}Hf	-	5E+0	2E-9	-	-	
			-	Bone surf (9E+0)	-	1E-11	-	-
72	Hafnium-179m	D, see ^{170}Hf	1E+3	3E+2	1E-7	-	1E-5	1E-4
			-	Bone surf (6E+2)	-	8E-10	-	-
		W, see ^{170}Hf	-	6E+2	3E-7	8E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
72	Hafnium-180m	D, see ^{170}Hf	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{170}Hf	-	3E+4	1E-5	4E-8	-	-
72	Hafnium-181	D, see ^{170}Hf	1E+3	2E+2	7E-8	-	2E-5	2E-4
			-	Bone surf (4E+2)	-	6E-10	-	-
		W, see ^{170}Hf	-	4E+2	2E-7	6E-10	-	-
72	Hafnium-182m[2]	D, see ^{170}Hf	4E+4	9E+4	4E-5	1E-7	5E-4	5E-3
		W, see ^{170}Hf	-	1E+5	6E-5	2E-7	-	-
72	Hafnium-182	D, see ^{170}Hf	2E+2	8E-1	3E-10	-	-	-
			Bone surf (4E+2)	Bone surf (2E+0)	-	2E-12	5E-6	5E-5
		W, see ^{170}Hf	-	3E+0	1E-9	-	-	-
			-	Bone surf (7E+0)	-	1E-11	-	-
72	Hafnium-183[2]	D, see ^{170}Hf	2E+4	5E+4	2E-5	6E-8	3E-4	3E-3
		W, see ^{170}Hf	-	6E+4	2E-5	8E-8	-	-
72	Hafnium-184	D, see ^{170}Hf	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see ^{170}Hf	-	6E+3	3E-6	9E-9	-	-
73	Tantalum-172[2]	W, all compounds except those given for Y	4E+4	1E+5	5E-5	2E-7	5E-4	5E-3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	-	1E+5	4E-5	1E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
73	Tantalum-173	W, see ^{172}Ta	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-174[2]	W, see ^{172}Ta	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	-	9E+4	4E-5	1E-7	-	-
73	Tantalum-175	W, see ^{172}Ta	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
		Y, see ^{172}Ta	-	1E+4	6E-6	2E-8	-	-
73	Tantalum-176	W, see ^{172}Ta	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
		Y, see ^{172}Ta	-	1E+4	5E-6	2E-8	-	-
73	Tantalum-177	W, see ^{172}Ta	1E+4	2E+4	8E-6	3E-8	2E-4	2E-3
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-178	W, see ^{172}Ta	2E+4	9E+4	4E-5	1E-7	2E-4	2E-3
		Y, see ^{172}Ta	-	7E+4	3E-5	1E-7	-	-
73	Tantalum-179	W, see ^{172}Ta	2E+4	5E+3	2E-6	8E-9	3E-4	3E-3
		Y, see ^{172}Ta	-	9E+2	4E-7	1E-9	-	-
73	Tantalum-180m	W, see ^{172}Ta	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		Y, see ^{172}Ta	-	6E+4	2E-5	8E-8	-	-
73	Tantalum-180	W, see ^{172}Ta	1E+3	4E+2	2E-7	6E-10	2E-5	2E-4
		Y, see ^{172}Ta	-	2E+1	1E-8	3E-11	-	-
73	Tantalum-182m[2]	W, see ^{172}Ta	2E+5	5E+5	2E-4	8E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
		Y, see ^{172}Ta	-	4E+5	2E-4	6E-7	-	-
73	Tantalum-182	W, see ^{172}Ta	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		Y, see ^{172}Ta	-	1E+2	6E-8	2E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
73	Tantalum-183	W, see ^{172}Ta	9E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{172}Ta	-	1E+3	4E-7	1E-9	-	-
73	Tantalum-184	W, see ^{172}Ta	2E+3	5E+3	2E-6	8E-9	3E-5	3E-4
		Y, see ^{172}Ta	-	5E+3	2E-6	7E-9	-	-
73	Tantalum-185[2]	W, see ^{172}Ta	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	-	6E+4	3E-5	9E-8	-	-
73	Tantalum-186[2]	W, see ^{172}Ta	5E+4	2E+5	1E-4	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, see ^{172}Ta	-	2E+5	9E-5	3E-7	-	-
74	Tungsten-176	D, all compounds	1E+4	5E+4	2E-5	7E-8	1E-4	1E-3
74	Tungsten-177	D, all compounds	2E+4	9E+4	4E-5	1E-7	3E-4	3E-3
74	Tungsten-178	D, all compounds	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
74	Tungsten-179[2]	D, all compounds	5E+5	2E+6	7E-4	2E-6	7E-3	7E-2
74	Tungsten-181	D, all compounds	2E+4	3E+4	1E-5	5E-8	2E-4	2E-3
74	Tungsten-185	D, all compounds	2E+3	7E+3	3E-6	9E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
74	Tungsten-187	D, all compounds	2E+3	9E+3	4E-6	1E-8	3E-5	3E-4
74	Tungsten-188	D, all compounds	4E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
75	Rhenium-177[2]	D, all compounds except those given for W	9E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, oxides, hydroxides, and nitrates	-	4E+5	1E-4	5E-7	-	-
75	Rhenium-178[2]	D, see ^{177}Re	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see ^{177}Re	-	3E+5	1E-4	4E-7	-	-
75	Rhenium-181	D, see ^{177}Re	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
		W, see ^{177}Re	-	9E+3	4E-6	1E-8	-	-
75	Rhenium-182 (12.7 h)	D, see ^{177}Re	7E+3	1E+4	5E-6	2E-8	9E-5	9E-4
		W, see ^{177}Re	-	2E+4	6E-6	2E-8	-	-
75	Rhenium-182 (64.0 h)	D, see ^{177}Re	1E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, see ^{177}Re	-	2E+3	9E-7	3E-9	-	-
75	Rhenium-184m	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see ^{177}Re	-	4E+2	2E-7	6E-10	-	-
75	Rhenium-184	D, see ^{177}Re	2E+3	4E+3	1E-6	5E-9	3E-5	3E-4
		W, see ^{177}Re	-	1E+3	6E-7	2E-9	-	-
75	Rhenium-186m	D, see ^{177}Re	1E+3	2E+3	7E-7	-	-	-
			St wall (2E+3)	St wall (2E+3)	-	3E-9	2E-5	2E-4
		W, see ^{177}Re	-	2E+2	6E-8	2E-10	-	-
75	Rhenium-186	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		W, see ^{177}Re	-	2E+3	7E-7	2E-9	-	-
75	Rhenium-187	D, see ^{177}Re	6E+5	8E+5	4E-4	-	8E-3	8E-2
			-	St wall (9E+5)	-	1E-6	-	-
		W, see ^{177}Re	-	1E+5	4E-5	1E-7	-	-
75	Rhenium-188m[2]	D, see ^{177}Re	8E+4	1E+5	6E-5	2E-7	1E-3	1E-2
		W, see ^{177}Re	-	1E+5	6E-5	2E-7	-	-
75	Rhenium-188	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		W, see ^{177}Re	-	3E+3	1E-6	4E-9	-	-
75	Rhenium-189	D, see ^{177}Re	3E+3	5E+3	2E-6	7E-9	4E-5	4E-4
		W, see ^{177}Re	-	4E+3	2E-6	6E-9	-	-
76	Osmium-180[2]	D, all compounds except those given for W and Y	1E+5	4E+5	2E-4	5E-7	1E-3	1E-2
		W, halides and nitrates	-	5E+5	2E-4	7E-7	-	-
		Y, oxides and hydroxides	-	5E+5	2E-4	6E-7	-	-
76	Osmium-181[2]	D, see ^{180}Os	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{180}Os	-	5E+4	2E-5	6E-8	-	-
		Y, see ^{180}Os	-	4E+4	2E-5	6E-8	-	-
76	Osmium-182	D, see ^{180}Os	2E+3	6E+3	2E-6	8E-9	3E-5	3E-4
		W, see ^{180}Os	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{180}Os	-	4E+3	2E-6	6E-9	-	-
76	Osmium-185	D, see ^{180}Os	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see ^{180}Os	-	8E+2	3E-7	1E-9	-	-
		Y, see ^{180}Os	-	8E+2	3E-7	1E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
76	Osmium-189m	D, see ^{180}Os	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, see ^{180}Os	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{180}Os	-	2E+5	7E-5	2E-7	-	-
76	Osmium-191m	D, see ^{180}Os	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{180}Os	-	2E+4	8E-6	3E-8	-	-
		Y, see ^{180}Os	-	2E+4	7E-6	2E-8	-	-
76	Osmium-191	D, see ^{180}Os	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (3E+3)	-	-	-	3E-5	3E-4
		W, see ^{180}Os	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{180}Os	-	1E+3	6E-7	2E-9	-	-
76	Osmium-193	D, see ^{180}Os	2E+3	5E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
		W, see ^{180}Os	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{180}Os	-	3E+3	1E-6	4E-9	-	-
76	Osmium-194	D, see ^{180}Os	4E+2	4E+1	2E-8	6E-11	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		W, see ^{180}Os	-	6E+1	2E-8	8E-11	-	-
		Y, see ^{180}Os	-	8E+0	3E-9	1E-11	-	-
77	Iridium-182[2]	D, all compounds except those given for W and Y	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		W, halides, nitrates, and metallic iridium	-	2E+5	6E-5	2E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-
77	Iridium-184	D, see ^{182}Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	5E-8	-	-
		Y, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-185	D, see ^{182}Ir	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see ^{182}Ir	-	1E+4	5E-6	2E-8	-	-
		Y, see ^{182}Ir	-	1E+4	4E-6	1E-8	-	-
77	Iridium-186	D, see ^{182}Ir	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see ^{182}Ir	-	6E+3	3E-6	9E-9	-	-
		Y, see ^{182}Ir	-	6E+3	2E-6	8E-9	-	-
77	Iridium-187	D, see ^{182}Ir	1E+4	3E+4	1E-5	5E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-188	D, see ^{182}Ir	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		W, see ^{182}Ir	-	4E+3	1E-6	5E-9	-	-
		Y, see ^{182}Ir	-	3E+3	1E-6	5E-9	-	-
77	Iridium-189	D, see ^{182}Ir	5E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	7E-5	7E-4
		W, see ^{182}Ir	-	4E+3	2E-6	5E-9	-	-
		Y, see ^{182}Ir	-	4E+3	1E-6	5E-9	-	-
77	Iridium-190m[2]	D, see ^{182}Ir	2E+5	2E+5	8E-5	3E-7	2E-3	2E-2
		W, see ^{182}Ir	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{182}Ir	-	2E+5	8E-5	3E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
77	Iridium-190	D, see ^{182}Ir	1E+3	9E+2	4E-7	1E-9	1E-5	1E-4
		W, see ^{182}Ir	-	1E+3	4E-7	1E-9	-	-
		Y, see ^{182}Ir	-	9E+2	4E-7	1E-9	-	-
77	Iridium-192m	D, see ^{182}Ir	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
		W, see ^{182}Ir	-	2E+2	9E-8	3E-10	-	-
		Y, see ^{182}Ir	-	2E+1	6E-9	2E-11	-	-
77	Iridium-192	D, see ^{182}Ir	9E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		W, see ^{182}Ir	-	4E+2	2E-7	6E-10	-	-
		Y, see ^{182}Ir	-	2E+2	9E-8	3E-10	-	-
77	Iridium-194m	D, see ^{182}Ir	6E+2	9E+1	4E-8	1E-10	9E-6	9E-5
		W, see ^{182}Ir	-	2E+2	7E-8	2E-10	-	-
		Y, see ^{182}Ir	-	1E+2	4E-8	1E-10	-	-
77	Iridium-194	D, see ^{182}Ir	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see ^{182}Ir	-	2E+3	9E-7	3E-9	-	-
		Y, see ^{182}Ir	-	2E+3	8E-7	3E-9	-	-
77	Iridium-195m	D, see ^{182}Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see ^{182}Ir	-	2E+4	9E-6	3E-8	-	-
77	Iridium-195	D, see ^{182}Ir	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{182}Ir	-	5E+4	2E-5	7E-8	-	-
		Y, see ^{182}Ir	-	4E+4	2E-5	6E-8	-	-
78	Platinum-186	D, all compounds	1E+4	4E+4	2E-5	5E-8	2E-4	2E-3
78	Platinum-188	D, all compounds	2E+3	2E+3	7E-7	2E-9	2E-5	2E-4
78	Platinum-189	D, all compounds	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
78	Platinum-191	D, all compounds	4E+3	8E+3	4E-6	1E-8	5E-5	5E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
78	Platinum-193m	D, all compounds	3E+3	6E+3	3E-6	8E-9	-	-
			LLI wall (3E+4)	-	-	-	4E-5	4E-4
78	Platinum-193	D, all compounds	4E+4	2E+4	1E-5	3E-8	-	-
			LLI wall (5E+4)	-	-	-	6E-4	6E-3
78	Platinum-195m	D, all compounds	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
78	Platinum-197m[2]	D, all compounds	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
78	Platinum-197	D, all compounds	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
78	Platinum-199[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
78	Platinum-200	D, all compounds	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
79	Gold-193	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, halides and nitrates	-	2E+4	9E-6	3E-8	-	-
		Y, oxides and hydroxides	-	2E+4	8E-6	3E-8	-	-
79	Gold-194	D, see ^{193}Au	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{193}Au	-	5E+3	2E-6	8E-9	-	-
		Y, see ^{193}Au	-	5E+3	2E-6	7E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
79	Gold-195	D, see ^{193}Au	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see ^{193}Au	-	1E+3	6E-7	2E-9	-	-
		Y, see ^{193}Au	-	4E+2	2E-7	6E-10	-	-
79	Gold-198m	D, see ^{193}Au	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see ^{193}Au	-	1E+3	5E-7	2E-9	-	-
		Y, see ^{193}Au	-	1E+3	5E-7	2E-9	-	-
79	Gold-198	D, see ^{193}Au	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see ^{193}Au	-	2E+3	8E-7	3E-9	-	-
		Y, see ^{193}Au	-	2E+3	7E-7	2E-9	-	-
79	Gold-199	D, see ^{193}Au	3E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		W, see ^{193}Au	-	4E+3	2E-6	6E-9	-	
		Y, see ^{193}Au	-	4E+3	2E-6	5E-9	-	
79	Gold-200m	D, see ^{193}Au	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{193}Au	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{193}Au	-	2E+4	1E-6	3E-9	-	-
79	Gold-200[2]	D, see ^{193}Au	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see ^{193}Au	-	8E+4	3E-5	1E-7	-	-
		Y, see ^{193}Au	-	7E+4	3E-5	1E-7	-	-
79	Gold-201[2]	D, see ^{193}Au	7E+4	2E+5	9E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{193}Au	-	2E+5	1E-4	3E-7	-	-
		Y, see ^{193}Au	-	2E+5	9E-5	3E-7	-	-
80	Mercury-193m	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		D, sulfates	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, oxides,	-	8E+3	3E-6	1E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		hydroxides, halides, nitrates, and sulfides						
80	Mercury-193	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		D, see ^{193m}Hg	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{193m}Hg	-	4E+4	2E-5	6E-8	-	-
80	Mercury-194	Vapor	-	3E+1	1E-8	4E-11	-	-
		Organic D	2E+1	3E+1	1E-8	4E-11	2E-7	2E-6
		D, see ^{193m}Hg	8E+2	4E+1	2E-8	6E-11	1E-5	1E-4
		W, see ^{193m}Hg	-	1E+2	5E-8	2E-10	-	-
80	Mercury-195m	Vapor	-	4E+3	2E-6	6E-9	-	-
		Organic D	3E+3	6E+3	3E-6	8E-9	4E-5	4E-4
		D, see ^{193m}Hg	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
		W, see ^{193m}Hg	-	4E+3	2E-6	5E-9	-	-
80	Mercury-195	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		D, see ^{193m}Hg	1E+4	4E+4	1E-5	5E-8	2E-4	2E-3
		W, see ^{193m}Hg	-	3E+4	1E-5	5E-8	-	-
80	Mercury-197m	Vapor	-	5E+3	2E-6	7E-9	-	-
		Organic D	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		D, see ^{193m}Hg	3E+3	7E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{193m}Hg	-	5E+3	2E-6	7E-9	-	-
80	Mercury-197	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	7E+3	1E+4	6E-6	2E-8	9E-5	9E-4
		D, see ^{193m}Hg	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see ^{193m}Hg	-	9E+3	4E-6	1E-8	-	-
80	Mercury-199m[2]	Vapor	-	8E+4	3E-5	1E-7	-	-
		Organic D	6E+4	2E+5	7E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			St wall (1E+5)	-	-	-	1E-3	1E-2
		D, see ^{193m}Hg	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
		W, see ^{193m}Hg	-	2E+5	7E-5	2E-7	-	-
80	Mercury-203	Vapor	-	8E+2	4E-7	1E-9	-	-
		Organic D	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
		D, see ^{193m}Hg	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		W, see ^{193m}Hg	-	1E+3	5E-7	2E-9	-	-
81	Thallium-194m[2]	D, all compounds	5E+4	2E+5	6E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
81	Thallium-194[2]	D, all compounds	3E+5	6E+5	2E-4	8E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
81	Thallium-195[2]	D, all compounds	6E+4	1E+5	5E-5	2E-7	9E-4	9E-3
81	Thallium-197	D, all compounds	7E+4	1E+5	5E-5	2E-7	1E-3	1E-2
81	Thallium-198m[2]	D, all compounds	3E+4	5E+4	2E-5	8E-8	4E-4	4E-3
81	Thallium-198	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
81	Thallium-199	D, all compounds	6E+4	8E+4	4E-5	1E-7	9E-4	9E-3
81	Thallium-200	D, all compounds	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
81	Thallium-201	D, all compounds	2E+4	2E+4	9E-6	3E-8	2E-4	2E-3
81	Thallium-202	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
81	Thallium-204	D, all compounds	2E+3	2E+3	9E-7	3E-9	2E-5	2E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
82	Lead-195m[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	8E-4	8E-3
82	Lead-198	D, all compounds	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
82	Lead-199[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
82	Lead-200	D, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
82	Lead-201	D, all compounds	7E+3	2E+4	8E-6	3E-8	1E-4	1E-3
82	Lead-202m	D, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
82	Lead-202	D, all compounds	1E+2	5E+1	2E-8	7E-11	2E-6	2E-5
82	Lead-203	D, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
82	Lead-205	D, all compounds	4E+3	1E+3	6E-7	2E-9	5E-5	5E-4
82	Lead-209	D, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
82	Lead-210	D, all compounds	6E1 Bone surf (1E+0)	2E1 Bone surf (4E-1)	1E-10 -	- 6E-13	- 1E-8	- 1E-7
82	Lead-211[2]	D, all compounds	1E+4	6E+2	3E-7	9E-10	2E-4	2E-3
82	Lead-212	D, all compounds	8E+1 Bone surf (1E+2)	3E+1 -	1E-8 -	5E-11 -	- 2E-6	- 2E-5
82	Lead-214[2]	D, all compounds	9E+3	8E+2	3E-7	1E-9	1E-4	1E-3
83	Bismuth-200[2]	D, nitrates	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, all other compounds	-	1E+5	4E-5	1E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
83	Bismuth-201[2]	D, see ^{200}Bi	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{200}Bi	-	4E+4	2E-5	5E-8	-	-
83	Bismuth-202[2]	D, see ^{200}Bi	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{200}Bi	-	8E+4	3E-5	1E-7	-	-
83	Bismuth-203	D, see ^{200}Bi	2E+3	7E+3	3E-6	9E-9	3E-5	3E-4
		W, see ^{200}Bi	-	6E+3	3E-6	9E-9	-	-
83	Bismuth-205	D, see ^{200}Bi	1E+3	3E+3	1E-6	3E-9	2E-5	2E-4
		W, see ^{200}Bi	-	1E+3	5E-7	2E-9	-	-
83	Bismuth-206	D, see ^{200}Bi	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see ^{200}Bi	-	9E+2	4E-7	1E-9	-	-
83	Bismuth-207	D, see ^{200}Bi	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-210m	D, see ^{200}Bi	4E+1	5E+0	2E-9	-	-	-
			Kidneys (6E+1)	Kidneys (6E+0)	-	9E-12	8E-7	8E-6
		W, see ^{200}Bi	-	7E-1	3E-10	9E-13	-	-
83	Bismuth-210	D, see ^{200}Bi	8E+2	2E+2	1E-7	-	1E-5	1E-4
			-	Kidneys (4E+2)	-	5E-10	-	-
		W, see ^{200}Bi	-	3E+1	1E-8	4E-11	-	-
83	Bismuth-212[2]	D, see ^{200}Bi	5E+3	2E+2	1E-7	3E-10	7E-5	7E-4
		W, see ^{200}Bi	-	3E+2	1E-7	4E-10	-	-
83	Bismuth-213[2]	D, see ^{200}Bi	7E+3	3E+2	1E-7	4E-10	1E-4	1E-3
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-214[2]	D, see ^{200}Bi	2E+4	8E+2	3E-7	1E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, see ^{200}Bi	-	9E-2	4E-7	1E-9	-	-
84	Polonium-203[2]	D, all compounds except those given for W	3E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, oxides, hydroxides, and nitrates	-	9E+4	4E-5	1E-7	-	-
84	Polonium-205[2]	D, see ^{203}Po	2E+4	4E+4	2E-5	5E-8	3E-4	3E-3
		W, see ^{203}Po	-	7E+4	3E-5	1E-7	-	-
84	Polonium-207	D, see ^{203}Po	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{203}Po	-	3E+4	1E-5	4E-8	-	-
84	Polonium-210	D, see ^{203}Po	3E+0	6E-1	3E-10	9E-13	4E-8	4E-7
		W, see ^{203}Po	-	6E-1	3E-10	9E-13	-	-
85	Astatine-207[2]	D, halides	6E+3	3E+3	1E-6	4E-9	8E-5	8E-4
		W	-	2E+3	9E-7	3E-9	-	-
85	Astatine-211	D, halides	1E+2	8E+1	3E-8	1E-10	2E-6	2E-5
		W	-	5E+1	2E-8	8E-11	-	-
86	Radon-220	With daughters removed	-	2E+4	7E-6	2E-8	-	-
		With daughters present	- (or 12 working level months)	2E+1 (or 1.0 working level)	9E-9	3E-11	-	-
86	Radon-222	With daughters	-	1E+4	4E-6	1E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
		removed						
		With daughters present	-	1E+2 (or 4 working level months)	3E-8 (or 0.33 working level)	1E-10	-	-
87	Francium-222[2]	D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5	3E-4
87	Francium-223[2]	D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
88	Radium-223	W, all compounds	5E+0	7E-1	3E-10	9E-13	-	-
			Bone surf (9E+0)	-	-	-	1E-7	1E-6
88	Radium-224	W, all compounds	8E+0	2E+0	7E-10	2E-12	-	-
			Bone surf (2E+1)	-	-	-	2E-7	2E-6
88	Radium-225	W, all compounds	8E+0	7E-1	3E-10	9E-13	-	-
			Bone surf (2E+1)	-	-	-	2E-7	2E-6
88	Radium-226	W, all compounds	2E+0	6E-1	3E-10	9E-13	-	-
			Bone surf (5E+0)	-	-	-	6E-8	6E-7
88	Radium-227[2]	W, all compounds	2E+4	1E+4	6E-6	-	-	-
			Bone surf (2E+4)	Bone surf (2E+4)	-	3E-8	3E-4	3E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
88	Radium-228	W, all compounds	2E+0	1E+0	5E-10	2E-12	-	-
			Bone surf (4E+0)	-	-	-	6E-8	6E-7
89	Actinium-224	D, all compounds except those given for W and Y	2E+3	3E+1	1E-8	-	-	-
			LLI wall (2E+3)	Bone surf (4E+1)	-	5E-11	3E-5	3E-4
		W, halides and nitrates	-	5E+1	2E-8	7E-11	-	-
		Y, oxides and hydroxides	-	5E+1	2E-8	6E-11	-	-
89	Actinium-225	D, see ^{224}Ac	5E+1	3E-1	1E-10	-	-	-
			LLI wall (5E+1)	Bone surf (5E-1)	-	7E-13	7E-7	7E-6
		W, see ^{224}Ac	-	6E-1	3E-10	9E-13	-	-
		Y, see ^{224}Ac	-	6E-1	3E-10	9E-13	-	-
89	Actinium-226	D, see ^{224}Ac	1E+2	3E+0	1E-9	-	-	-
			LLI wall (1E+2)	Bone surf (4E+0)	-	5E-12	2E-6	2E-5
		W, see ^{224}Ac	-	5E+0	2E-9	7E-12	-	
		Y, see ^{224}Ac	-	5E+0	2E-9	6E-12	-	
						-		

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
89	Actinium-227	D, see ^{224}Ac	2E-1	4E-4	2E-13	-	-	-
			Bone surf (4E-1)	Bone surf (8E-4)	-	1E-15	5E-9	5E-8
		W, see ^{224}Ac	-	2E-3	7E-13	-	-	-
			-	Bone surf (3E-3)	-	4E-15	-	-
		Y, see ^{224}Ac	-	4E-3	2E-12	6E-15	-	-
89	Actinium-228	D, see ^{224}Ac	2E+3	9E+0	4E-9	-	3E-5	3E-4
			-	Bone surf (2E+1)	-	2E-11	-	-
		W, see ^{224}Ac	-	4E+1	2E-8	-	-	-
			-	Bone surf (6E+1)	-	8E-11	-	-
		Y, see ^{224}Ac	-	4E+1	2E-8	6E-11	-	-
90	Thorium-226[2]	W, all compounds except those given for Y	5E+3	2E+2	6E-8	2E-10	-	-
			St wall (5E+3)	-	-	-	7E-5	7E-4
		Y, oxides and hydroxides	-	1E+2	6E-8	2E-10	-	-
90	Thorium-227	W, see ^{226}Th	1E+2	3E-1	1E-10	5E-13	2E-6	2E-5
		Y, see ^{226}Th	-	3E-1	1E-10	5E-13	-	-
90	Thorium-228	W, see ^{226}Th	6E+0	1E-2	4E-12	-	-	-
			Bone surf (1E+1)	Bone surf (2E-2)	-	3E-14	2E-7	2E-6
		Y, see ^{226}Th	-	2E-2	7E-12	2E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
90	Thorium-229	W, see ^{226}Th	6E-1	9E-4	4E-13	-	-	-
			Bone surf (1E+0)	Bone surf (2E-3)	-	3E-15	2E-8	2E-7
		Y, see ^{226}Th	-	2E-3	1E-12	-	-	-
			-	Bone surf (3E-3)	-	4E-15	-	-
90	Thorium-230	W, see ^{226}Th	4E+0	6E-3	3E-12	-	-	-
			Bone surf (9E+0)	Bone surf (2E-2)	-	2E-14	1E-7	1E-6
		Y, see ^{226}Th	-	2E-2	6E-12	-	-	-
			-	Bone surf (2E-2)	-	3E-14	-	-
90	Thorium-231	W, see ^{226}Th	4E+3	6E+3	3E-6	9E-9	5E-5	5E-4
		Y, see ^{226}Th	-	6E+3	3E-6	9E-9	-	-
90	Thorium-232	W, see ^{226}Th	7E-1	1E-3	5E-13	-	-	-
			Bone surf (2E+0)	Bone surf (3E-3)	-	4E-15	3E-8	3E-7
		Y, see ^{226}Th	-	3E-3	1E-12	-	-	-
			-	Bone surf (4E-3)	-	6E-15	-	-
90	Thorium-234	W, see ^{226}Th	3E+2	2E+2	8E-8	3E-10	-	-
			LLI wall (4E+2)	-	-	-	5E-6	5E-5
		Y, see ^{226}Th	-	2E+2	6E-8	2E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
91	Protactinium-227[2]	W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5	5E-4
		Y, oxides and hydroxides	-	1E+2	4E-8	1E-10	-	-
91	Protactinium-228	W, see ^{227}Pa	1E+3	1E+1	5E-9	-	2E-5	2E-4
			-	Bone surf (2E+1)	-	3E-11	-	-
		Y, see ^{227}Pa	-	1E+1	5E-9	2E-11	-	-
91	Protactinium-230	W, see ^{227}Pa	6E+2	5E+0	2E-9	7E-12	-	-
			Bone surf (9E+2)	-	-	-	1E-5	1E-4
		Y, see ^{227}Pa	-	4E+0	1E-9	5E-12	-	-
91	Protactinium-231	W, see ^{227}Pa	2E-1	2E-3	6E-13	-	-	-
			Bone surf (5E-1)	Bone surf (4E-3)	-	6E-15	6E-9	6E-8
		Y, see ^{227}Pa	-	4E-3	2E-12	-	-	-
			-	Bone surf (6E-3)	-	8E-15	-	-
91	Protactinium-232	W, see ^{227}Pa	1E+3	2E+1	9E-9	-	2E-5	2E-4
			-	Bone surf (6E+1)	-	8E-11	-	-
		Y, see ^{227}Pa	-	6E+1	2E-8	-	-	-
			-	Bone surf (7E+1)	-	1E-10	-	-
91	Protactinium-233	W, see ^{227}Pa	1E+3	7E+2	3E-7	1E-9	-	-
			LLI wall	-	-	-	2E-5	2E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			(2E+3)					
		Y, see ^{227}Pa	-	6E+2	2E-7	8E-10	-	-
91	Protactinium-234	W, see ^{227}Pa	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		Y, see ^{227}Pa	-	7E+3	3E-6	9E-9	-	-
92	Uranium-230	D, UF, UOF, UO(NO)	4E+0	4E-1	2E-10	-	-	-
			Bone surf (6E+0)	Bone surf (6E-1)	-	8E-13	8E-8	8E-7
		W, UO, UF, UCl	-	4E-1	1E-10	5E-13	-	-
		Y, UO, UO	-	3E-1	1E-10	4E-13	-	-
92	Uranium-231	D, see ^{230}U	5E+3	8E+3	3E-6	1E-8	-	-
			LLI wall (4E+3)	-	-	-	6E-5	6E-4
		W, see ^{230}U	-	6E+3	2E-6	8E-9	-	-
		Y, see ^{230}U	-	5E+3	2E-6	6E-9	-	-
92	Uranium-232	D, see ^{230}U	2E+0	2E-1	9E-11	-	-	-
			Bone surf (4E+0)	Bone surf (4E-1)	-	6E-13	6E-8	6E-7
		W, see ^{230}U	-	4E-1	2E-10	5E-13	-	-
		Y, see ^{230}U	-	8E-3	3E-12	1E-14	-	-
92	Uranium-233	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-234[3]	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone	Bone	-	3E-12	3E-7	3E-6

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			surf (2E+1)	surf (2E+0)				
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-235[3]	D, see ^{230}U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-236	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-237	D, see ^{230}U	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		W, see ^{230}U	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{230}U	-	2E+3	6E-7	2E-9	-	-
92	Uranium-238[3]	D, see ^{230}U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-239[2]	D, see ^{230}U	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		W, see ^{230}U	-	2E+5	7E-5	2E-7	-	-
		Y, see ^{230}U	-	2E+5	6E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
92	Uranium-240	D, see ^{230}U	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see ^{230}U	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{230}U	-	2E+3	1E-6	3E-9	-	-
92	Uranium-natural[3]	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	9E-13	-	-
		Y, see ^{230}U	-	5E-2	2E-11	9E-14	-	-
93	Neptunium-232[2]	W, all compounds	1E+5	2E+3	7E-7	-	2E-3	2E-2
			-	Bone surf (5E+2)	-	6E-9	-	-
93	Neptunium-233[2]	W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2	1E-1
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
93	Neptunium-235	W, all compounds	2E+4	8E+2	3E-7	-	-	-
			LLI wall (2E+4)	Bone surf (1E+3)	-	2E-9	3E-4	3E-3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0	2E-2	9E-12	-	-	-
			Bone surf (6E+0)	Bone surf (5E-2)	-	8E-14	9E-8	9E-7
93	Neptunium-236 (22.5 h)	W, all compounds	3E+3	3E+1	1E-8	-	-	-
			Bone surf (4E+3)	Bone surf (7E+1)	-	1E-10	5E-5	5E-4

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
93	Neptunium-237	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	1E-14	2E-8	2E-7
93	Neptunium-238	W, all compounds	1E+3	6E+1	3E-8	-	2E-5	2E-4
			-	Bone surf (2E+2)	-	2E-10	-	-
93	Neptunium-239	W, all compounds	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
93	Neptunium-240[2]	W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
94	Plutonium-234	W, all compounds except PuO	8E+3	2E+2	9E-8	3E-10	1E-4	1E-3
		Y, PuO	-	2E+2	8E-8	3E-10	-	-
94	Plutonium-235[2]	W, see ^{234}Pu	9E+5	3E+6	1E-3	4E-6	1E-2	1E-1
		Y, see ^{234}Pu	-	3E+6	1E-3	3E-6	-	-
94	Plutonium-236	W, see ^{234}Pu	2E+0	2E-2	8E-12	-	-	-
			Bone surf (4E+0)	Bone surf (4E-2)	-	5E-14	6E-8	6E-7
		Y, see ^{234}Pu	-	4E-2	2E-11	6E-14	-	-
94	Plutonium-237	W, see ^{234}Pu	1E+4	3E+3	1E-6	5E-9	2E-4	2E-3
		Y, see ^{234}Pu	-	3E+3	1E-6	4E-9	-	-
94	Plutonium-238	W, see ^{234}Pu	9E-1	7E-3	3E-12	-	-	-
			Bone surf	Bone surf	-	2E-14	2E-8	2E-7

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			(2E+0)	(1E-2)				
		Y, see ^{234}Pu	-	2E-2	8E-12	2E-14	-	-
94	Plutonium-239	W, see ^{234}Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf	Bone surf				
			(1E+0)	(1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
				Bone surf				
			-	(2E-2)	-	2E-14	-	-
94	Plutonium-240	W, see ^{234}Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf	Bone surf				
			(1E+0)	(1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
				Bone surf				
			-	(2E-2)	-	2E-14	-	-
94	Plutonium-241	W, see ^{234}Pu	4E+1	3E-1	1E-10	-	-	-
			Bone surf	Bone surf				
			(7E+1)	(6E-1)	-	8E-13	1E-6	1E-5
		Y, see ^{234}Pu	-	8E-1	3E-10	-	-	-
				Bone surf				
			-	(1E+0)	-	1E-12	-	-
94	Plutonium-242	W, see ^{234}Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf	Bone surf				
			(1E+0)	(1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
				Bone surf				
			-		-	2E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
				(2E-2)				
94	Plutonium-243	W, see ^{234}Pu	2E+4	4E+4	2E-5	5E-8	2E-4	2E-3
		Y, see ^{234}Pu	-	4E+4	2E-5	5E-8	-	-
94	Plutonium-244	W, see ^{234}Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf (2E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-245	W, see ^{234}Pu	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		Y, see ^{234}Pu	-	4E+3	2E-6	6E-9	-	-
94	Plutonium-246	W, see ^{234}Pu	4E+2	3E+2	1E-7	4E-10	-	-
			LLI wall (4E+2)	-	-	-	6E-6	6E-5
		Y, see ^{234}Pu	-	3E+2	1E-7	4E-10	-	-
95	Americium-237[2]	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
95	Americium-238[2]	W, all compounds	4E+4	3E+3	1E-6	-	5E-4	5E-3
			-	Bone surf (6E+3)	-	9E-9	-	-
95	Americium-239	W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
95	Americium-240	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
95	Americium-241	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf	Bone surf	-	2E-14	2E-8	2E-7

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
			(1E+0)	(1E-2)				
95	Americium-242m	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-242	W, all compounds	4E+3	8E+1	4E-8	-	5E-5	5E-4
			-	Bone surf (9E+1)	-	1E-10	-	-
95	Americium-243	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-244m[2]	W, all compounds	6E+4	4E+3	2E-6	-	-	-
			St wall (8E+4)	Bone surf (7E+3)	-	1E-8	1E-3	1E-2
95	Americium-244	W, all compounds	3E+3	2E+2	8E-8	-	4E-5	4E-4
			-	Bone surf (3E+2)	-	4E-10	-	-
95	Americium-245	W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-4	4E-3
95	Americium-246m[2]	W, all compounds	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
95	Americium-246[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
96	Curium-238	W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4	2E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
96	Curium-240	W, all compounds	6E+1	6E-1	2E-10	-	-	-
			Bone surf (8E+1)	Bone surf (6E-1)	-	9E-13	1E-6	1E-5
96	Curium-241	W, all compounds	1E+3	3E+1	1E-8	-	2E-5	2E-4
			-	Bone surf (4E+1)	-	5E-11	-	-
96	Curium-242	W, all compounds	3E+1	3E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	4E-13	7E-7	7E-6
96	Curium-243	W, all compounds	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	2E-14	3E-8	3E-7
96	Curium-244	W, all compounds	1E+0	1E-2	5E-12	-	-	-
			Bone surf (3E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
96	Curium-245	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-246	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
96	Curium-247	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-248	W, all compounds	2E-1	2E-3	7E-13	-	-	-
			Bone surf (4E-1)	Bone surf (3E-3)	-	4E-15	5E-9	5E-8
96	Curium-249[2]	W, all compounds	5E+4	2E+4	7E-6	-	7E-4	7E-3
			-	Bone surf (3E+4)	-	4E-8	-	-
96	Curium-250	W, all compounds	4E-2	3E-4	1E-13	-	-	-
			Bone surf (6E-2)	Bone surf (5E-4)	-	8E-16	9E-10	9E-9
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
97	Berkelium-247	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
97	Berkelium-249	W, all compounds	2E+2	2E+0	7E-10	-	-	-
			Bone surf (5E+2)	Bone surf (4E+0)	-	5E-12	6E-6	6E-5
97	Berkelium-250	W, all compounds	9E+3	3E+2	1E-7	-	1E-4	1E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col. 3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
			-	Bone surf (7E+2)	-	1E-9	-	-
98	Californium-244[2]	W, all compounds except those given for Y	3E+4	6E+2	2E-7	8E-10	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		Y, oxides and hydroxides	-	6E+2	2E-7	8E-10	-	-
98	Californium-246	W, see ^{244}Cf	4E+2	9E+0	4E-9	1E-11	5E-6	5E-5
		Y, see ^{244}Cf	-	9E+0	4E-9	1E-11	-	-
98	Californium-248	W, see ^{244}Cf	8E+0	6E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
		Y, see ^{244}Cf	-	1E-1	4E-11	1E-13	-	-
98	Californium-249	W, see ^{244}Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	-	1E-2	4E-12	-	-	-
			-	Bone surf (1E-2)	-	2E-14	-	-
98	Californium-250	W, see ^{244}Cf	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	-	3E-2	1E-11	4E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
98	Californium-251	W, see ^{244}Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	-	1E-2	4E-12	-	-	-
			-	Bone surf (1E-2)	-	2E-14	-	-
98	Californium-252	W, see ^{244}Cf	2E+0	2E-2	8E-12	-	-	-
			Bone surf (5E+0)	Bone surf (4E-2)	-	5E-14	7E-8	7E-7
		Y, see ^{244}Cf	-	3E-2	1E-11	5E-14	-	-
98	Californium-253	W, see ^{244}Cf	2E+2	2E+0	8E-10	3E-12	-	-
			Bone sur (4E+2)	-	-	-	5E-6	5E-5
		Y, see ^{244}Cf	-	2E+0	7E-10	2E-12	-	-
98	Californium-254	W, see ^{244}Cf	2E+0	2E-2	9E-12	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	-	2E-2	7E-12	2E-14	-	-
99	Einsteinium-250	W, all compounds	4E+4	5E+2	2E-7	-	6E-4	6E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-251	W, all compounds	7E+3	9E+2	4E-7	-	1E-4	1E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-253	W, all compounds	2E+2	1E+0	6E-10	2E-12	2E-6	2E-5

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
99	Einsteinium-254m	W, all compounds	3E+2	1E+1	4E-9	1E-11	-	-
			LLI wall (3E+2)	-	-	-	4E-6	4E-5
99	Einsteinium-254	W, all compounds	8E+0	7E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
100	Fermium-252	W, all compounds	5E+2	1E+1	5E-9	2E-11	6E-6	6E-5
100	Fermium-253	W, all compounds	1E+3	1E+1	4E-9	1E-11	1E-5	1E-4
100	Fermium-254	W, all compounds	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
100	Fermium-255	W, all compounds	5E+2	2E+1	9E-9	3E-11	7E-6	7E-5
100	Fermium-257	W, all compounds	2E+1	2E-1	7E-11	-	-	-
			Bone surf (4E+1)	Bone surf (2E-1)	-	3E-13	5E-7	5E-6
101	Mendelevium-257	W, all compounds	7E+3	8E+1	4E-8	-	1E-4	1E-3
			-	Bone surf (9E+1)	-	1E-10	-	-
101	Mendelevium-258	W, all compounds	3E+1	2E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	5E-13	6E-7	6E-6

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1 Oral Ingestion	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half- life less than 2 hours	Submersion[1]	-	2E+2	1E-7	1E-9	-	-
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half- life greater than 2 hours		-	2E-1	1E-10	1E-12	1E-8	1E-7
	Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known		-	4E-4	2E-13	1E-15	2E-9	2E-8

FOOTNOTES:

[1]"Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

[2]These radionuclides have radiological half-lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E-7 μCi/ml for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits (see 1.4.8).

[3]For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see 1.4.6(5)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour workweek is 0.2 milligrams uranium per cubic

meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8E-3 (SA) μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

$$SA = 3.6E\text{-}7 \text{ curies/gram U} \quad \text{U-depleted}$$

$$SA = [0.4 + 0.38\,(\text{enrichment}) + 0.0034\,(\text{enrichment})^2]\ E\text{-}6, \text{ enrichment} \geq 0.72$$

where enrichment is the percentage by weight of U-235, expressed as percent.

NOTE:

1. If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture are not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.
2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this section are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this section for any radionuclide that is not known to be absent from the mixture; or

	Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
	Col. 1 Oral Ingestion ALI (μCi)	Col.2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Col.1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
If it is known that Ac-227-D and Cm-250-W are not present	-	7E-4	3E-13	-	-	-
If, in addition, it is known that Ac-227-W,Y, Th-229-W,Y, Th-230-W, Th-232-W,Y, Pa-231-W,Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present	-	7E-3	3E-12	-	-	-

	Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
	Col. 1 Oral Ingestion ALI (μCi)	Col.2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Col.1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
If, in addition, it is known that Sm-146-W, Sm-147-W, Gd-148-D,W, Gd-152-D,W, Th-228-W,Y, Th-230-Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W,Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W,Y, Cf-251-Y, Cf-252-W,Y, and Cf-254-W,Y are not present	-	7E-2	3E-11	-	-	-
If, in addition, it is known that Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present	-	7E-1	3E-10	-	-	-
If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D,W, La-138-D, Lu-176-W, Hf-178m-D,W, Hf-182-D,W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D,W,Y, Pa-230-W,Y, U-233-D,W, U-234-D,W, U-235-D,W, U-236-D,W, U-238-D,W, Pu-241-Y, Bk-249-W, Cf-253-W,Y, and Es-253-W are not present	-	7E+0	3E-9	-	-	-

	Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
	Col. 1 Oral Ingestion ALI (μCi)	Col.2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Col.1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
If it is known that Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present	-	-	-	1E-14	-	-
If, in addition, it is known that Sm-146-W, Gd-148-D,W, Gd-152-D, Th-228-W,Y, Th-230-W,Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-W,Y, Pu-240-W,Y, Pu-242-W,Y, Pu-244-W,Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W,Y, Cf-250-W,Y, Cf-251-W,Y, Cf-252-W,Y, and Cf-254-W,Y are not present	-	-	-	1E-13	-	-
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W,Y, Es-254-W, Fm-257-W, and Md-258-W are not present	-	-	-	1E-12	-	

	Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
	Col. 1 Oral Ingestion ALI (μCi)	Col.2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Col.1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present	-	-	-	-	1E-6	1E-5

3. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 μm AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11 μCi of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E-11 μCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix B of this section for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").

   Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable DACs are DAC_A, DAC_B, and DAC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} \leq 1$$

APPENDIX C

Quantities [1] Of Licensed Material Requiring Labeling

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Hydrogen-3	1,000	Chromium-48	1,000
Beryllium-7	1,000	Chromium-49	1,000
Beryllium-10	1	Chromium-51	1,000
Carbon-11	1,000	Manganese-51	1,000
Carbon-14	1,000	Manganese-52m	1,000
Fluorine-18	1,000	Manganese-52	100
Sodium-22	10	Manganese-53	1,000
Sodium-24	100	Manganese-54	100
Magnesium-28	100	Manganese-56	1,000
Aluminum-26	10	Iron-52	100
Silicon-31	1,000	Iron-55	100
Silicon-32	1	Iron-59	10
Phosphorus-32	10	Iron-60	1
Phosphorus-33	100	Cobalt-55	100
Sulfur-35	100	Cobalt-56	10
Chlorine-36	10	Cobalt-57	100
Chlorine-38	1,000	Cobalt-58m	1,000
Chlorine-39	1,000	Cobalt-58	100
Argon-39	1,000	Cobalt-60m	1,000
Argon-41	1,000	Cobalt-60	1
Potassium-40	100	Cobalt-61	1,000
Potassium-42	1,000	Cobalt-62m	1,000
Potassium-43	1,000	Nickel-56	100
Potassium-44	1,000	Nickel-57	100
Potassium-45	1,000	Nickel-59	100
Calcium-41	100	Nickel-63	100
Calcium-45	100	Nickel-65	1,000
Calcium-47	100	Nickel-66	10
Scandium-43	1,000	Copper-60	1,000
Scandium-44m	100	Copper-61	1,000
Scandium-44	100	Copper-64	1,000
Scandium-46	10	Copper-67	1,000
Scandium-47	100	Zinc-62	100
Scandium-48	100	Zinc-63	1,000
Scandium-49	1,000	Zinc-65	10
Titanium-44	1	Zinc-69m	100
Titanium-45	1,000	Zinc-69	1,000
Vanadium-47	1,000	Zinc-71m	1,000
Vanadium-48	100	Zinc-72	100

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Vanadium-49	1,000	Gallium-65	1,000
Gallium-66	100	Krypton-81	1,000
Gallium-67	1,000	Krypton-83m	1,000
Gallium-68	1,000	Krypton-85m	1,000
Gallium-70	1,000	Krypton-85	1,000
Gallium-72	100	Krypton-87	1,000
Gallium-73	1,000	Krypton-88	1,000
Germanium-66	1,000	Rubidium-79	1,000
Germanium-67	1,000	Rubidium-81m	1,000
Germanium-68	10	Rubidium-81	1,000
Germanium-69	1,000	Rubidium-82m	1,000
Germanium-71	1,000	Rubidium-83	100
Germanium-75	1,000	Rubidium-84	100
Germanium-77	1,000	Rubidium-86	100
Germanium-78	1,000	Rubidium-87	100
Arsenic-69	1,000	Rubidium-88	1,000
Arsenic-70	1,000	Rubidium-89	1,000
Arsenic-71	100	Strontium-80	100
Arsenic-72	100	Strontium-81	1,000
Arsenic-73	100	Strontium-83	100
Arsenic-74	100	Strontium-85m	1,000
Arsenic-76	100	Strontium-85	100
Arsenic-77	100	Strontium-87m	1,000
Arsenic-78	1,000	Strontium-89	10
Selenium-70	1,000	Strontium-90	0.1
Selenium-73m	1,000	Strontium-91	100
Selenium-73	100	Strontium-92	100
Selenium-75	100	Yttrium-86m	1,000
Selenium-79	100	Yttrium-86	100
Selenium-81m	1,000	Yttrium-87	100
Selenium-81	1,000	Yttrium-88	10
Selenium-83	1,000	Yttrium-90m	1,000
Bromine-74m	1,000	Yttrium-90	10
Bromine-74	1,000	Yttrium-91m	1,000
Bromine-75	1,000	Yttrium-91	10
Bromine-76	100	Yttrium-92	100
Bromine-77	1,000	Yttrium-93	100
Bromine-80m	1,000	Yttrium-94	1,000
Bromine-80	1,000	Yttrium-95	1,000
Bromine-82	100	Zirconium-86	100
Bromine-83	1,000	Zirconium-88	10
Bromine-84	1,000	Zirconium-89	100
Krypton-74	1,000	Zirconium-93	1

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Krypton-76	1,000	Zirconium-95	10
Krypton-77	1,000	Zirconium-97	100
Krypton-79	1,000		
Niobium-88	1,000	Palladium-101	1,000
Niobium-89m		Palladium-103	100
(66 min)	1,000	Palladium-107	10
Niobium-89		Palladium-109	100
(122 min)	1,000	Silver-102	1,000
Niobium-90	100	Silver-103	1,000
Niobium-93m	10	Silver-104m	1,000
Niobium-94	1	Silver-104	1,000
Niobium-95m	100	Silver-105	100
Niobium-95	100	Silver-106m	100
Niobium-96	100	Silver-106	1,000
Niobium-97	1,000	Silver-108m	1
Niobium-98	1,000	Silver-110m	10
Molybdenum-90	100	Silver-111	100
Molybdenum-93m	100	Silver-112	100
Molybdenum-93	10	Silver-115	1,000
Molybdenum-99	100	Cadmium-104	1,000
Molybdenum-101	1,000	Cadmium-107	1,000
Technetium-93m	1,000	Cadmium-109	1
Technetium-93	1,000	Cadmium-113m	0.1
Technetium-94m	1,000	Cadmium-113	100
Technetium-94	1,000	Cadmium-115m	10
Technetium-96m	1,000	Cadmium-115	100
Technetium-96	100	Cadmium-117m	1,000
Technetium-97m	100	Cadmium-117	1,000
Technetium-97	1,000	Indium-109	1,000
Technetium-98	10	Indium-110m	
Technetium-99m	1,000	(69.1m)	1,000
Technetium-99	100	Indium-110	
Technetium-101	1,000	(4.9h)	1,000
Technetium-104	1,000	Indium-111	100
Ruthenium-94	1,000	Indium-112	1,000
Ruthenium-97	1,000	Indium-113m	1,000
Ruthenium-103	100	Indium-114m	10
Ruthenium-105	1,000	Indium-115m	1,000
Ruthenium-106	1	Indium-115	100
Rhodium-99m	1,000	Indium-116m	1,000
Rhodium-99	100	Indium-117m	1,000
Rhodium-100	100	Indium-117	1,000
Rhodium-101m	1,000	Indium-119m	1,000

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Rhodium-101	10	Tin-110	100
Rhodium-102m	10	Tin-111	1,000
Rhodium-102	10	Tin-113	100
Rhodium-103m	1,000	Tin-117m	100
Rhodium-105	100	Tin-119m	100
Rhodium-106m	1,000	Tin-121m	100
Rhodium-107	1,000	Tin-121	1,000
Palladium-100	100		
Tin-123m	1,000	Tellurium-133	1,000
Tin-123	10	Tellurium-134	1,000
Tin-125	10	Iodine-120m	1,000
Tin-126	10	Iodine-120	100
Tin-127	1,000	Iodine-121	1,000
Tin-128	1,000	Iodine-123	100
Antimony-115	1,000	Iodine-124	10
Antimony-116m	1,000	Iodine-125	1
Antimony-116	1,000	Iodine-126	1
Antimony-117	1,000	Iodine-128	1,000
Antimony-118m	1,000	Iodine-129	1
Antimony-119	1,000	Iodine-130	10
Antimony-120		Iodine-131	1
(16m)	1,000	Iodine-132m	100
Antimony-120		Iodine-132	100
(5.76d)	100	Iodine-133	10
Antimony-122	100	Iodine-134	1,000
Antimony-124m	1,000	Iodine-135	100
Antimony-124	10	Xenon-120	1,000
Antimony-125	100	Xenon-121	1,000
Antimony-126m	1,000	Xenon-122	1,000
Antimony-126	100	Xenon-123	1,000
Antimony-127	100	Xenon-125	1,000
Antimony-128		Xenon-127	1,000
(10.4m)	1,000	Xenon-129m	1,000
Antimony-128		Xenon-131m	1,000
(9.O1h)	100	Xenon-133m	1,000
Antimony-129	100	Xenon-133	1,000
Antimony-130	1,000	Xenon-135m	1,000
Antimony-131	1,000	Xenon-135	1,000
Tellurium-116	1,000	Xenon-138	1,000
Tellurium-121m	10	Cesium-125	1,000
Tellurium-121	100	Cesium-127	1,000
Tellurium-123m	10	Cesium-129	1,000
Tellurium-123	100	Cesium-130	1,000

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Tellurium-125m	10	Cesium-131	1,000
Tellurium-127m	10	Cesium-132	100
Tellurium-127	1,000	Cesium-134m	1,000
Tellurium-129m	10	Cesium-134	10
Tellurium-129	1,000	Cesium-135m	1,000
Tellurium-131m	10	Cesium-135	100
Tellurium-131	100	Cesium-136	10
Tellurium-132	10	Cesium-137	10
Tellurium-133m	100	Cesium-138	1,000
Barium-126	1,000	Promethium-141	1,000
Barium-128	100	Promethium-143	100
Barium-131m	1,000	Promethium-144	10
Barium-131	100	Promethium-145	10
Barium-133m	100	Promethium-146	1
Barium-133	100	Promethium-147	10
Barium-135m	100	Promethium-148m	10
Barium-139	1,000	Promethium-148	10
Barium-140	100	Promethium-149	100
Barium-141	1,000	Promethium-150	1,000
Barium-142	1,000	Promethium-151	100
Lanthanum-131	1,000	Samarium-141m	1,000
Lanthanum-132	100	Samarium-141	1,000
Lanthanum-135	1,000	Samarium-142	1,000
Lanthanum-137	10	Samarium-145	100
Lanthanum-138	100	Samarium-146	1
Lanthanum-140	100	Samarium-147	100
Lanthanum-141	100	Samarium-151	10
Lanthanum-142	1,000	Samarium-153	100
Lanthanum-143	1,000	Samarium-155	1,000
Cerium-134	100	Samarium-156	1,000
Cerium-135	100	Europium-145	100
Cerium-137m	100	Europium-146	100
Cerium-137	1,000	Europium-147	100
Cerium-139	100	Europium-148	10
Cerium-141	100	Europium-149	100
Cerium-143	100	Europium-150	
Cerium-144	1	(12.62h)	100
Praseodymium-136	1,000	Europium-150	
Praseodymium-137	1,000	(34.2y)	1
Praseodymium-138m	1,000	Europium-152m	100
Praseodymium-139	1,000	Europium-152	1
Praseodymium-142m	1,000	Europium-154	1
Praseodymium-142	100	Europium-155	10

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Praseodymium-143	100	Europium-156	100
Praseodymium-144	1,000	Europium-157	100
Praseodymium-145	100	Europium-158	1,000
Praseodymium-147	1,000	Gadolinium-145	1,000
Neodymium-136	1,000	Gadolinium-146	10
Neodymium-138	100	Gadolinium-147	100
Neodymium-139m	1,000	Gadolinium-148	0.001
Neodymium-139	1,000	Gadolinium-149	100
Neodymium-141	1,000	Gadolinium-151	10
Neodymium-147	100	Gadolinium-152	100
Neodymium-149	1,000	Gadolinium-153	10
Neodymium-151	1,000	Gadolinium-159	100
Terbium-147	1,000	Ytterbium-162	1,000
Terbium-149	100	Ytterbium-166	100
Terbium-150	1,000	Ytterbium-167	1,000
Terbium-151	100	Ytterbium-169	100
Terbium-153	1,000	Ytterbium-175	100
Terbium-154	100	Ytterbium-177	1,000
Terbium-155	1,000	Ytterbium-178	1,000
Terbium-156m		Lutetium-169	100
(5.0h)	1,000	Lutetium-170	100
Terbium-156m		Lutetium-171	100
(24.4h)	1,000	Lutetium-172	100
Terbium-156	100	Lutetium-173	10
Terbium-157	10	Lutetium-174m	10
Terbium-158	1	Lutetium-174	10
Terbium-160	10	Lutetium-176m	1,000
Terbium-161	100	Lutetium-176	100
Dysprosium-155	1,000	Lutetium-177m	10
Dysprosium-157	1,000	Lutetium-177	100
Dysprosium-159	100	Lutetium-178m	1,000
Dysprosium-165	1,000	Lutetium-178	1,000
Dysprosium-166	100	Lutetium-179	1,000
Holmium-155	1,000	Hafnium-170	100
Holmium-157	1,000	Hafnium-172	1
Holmium-159	1,000	Hafnium-173	1,000
Holmium-161	1,000	Hafnium-175	100
Holmium-162m	1,000	Hafnium-177m	1,000
Holmium-162	1,000	Hafnium-178m	0.1
Holmium-164m	1,000	Hafnium-179m	10
Holmium-164	1,000	Hafnium-180m	1,000
Holmium-166m	1	Hafnium-181	10
Holmium-166	100	Hafnium-182m	1,000

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Holmium-167	1,000	Hafnium-182	0.1
Erbium-161	1,000	Hafnium-183	1,000
Erbium-165	1,000	Hafnium-184	100
Erbium-169	100	Tantalum-172	1,000
Erbium-171	100	Tantalum-173	1,000
Erbium-172	100	Tantalum-174	1,000
Thulium-162	1,000	Tantalum-175	1,000
Thulium-166	100	Tantalum-176	100
Thulium-167	100	Tantalum-177	1,000
Thulium-170	10	Tantalum-178	1,000
Thulium-171	10	Tantalum-179	100
Thulium-172	100	Tantalum-180m	1,000
Thulium-173	100	Tantalum-180	100
Thulium-175	1,000	Tantalum-182m	1,000
Tantalum-182	10	Iridium-188	100
Tantalum-183	100	Iridium-189	100
Tantalum-184	100	Iridium-190m	1,000
Tantalum-185	1,000	Iridium-190	100
Tantalum-186	1,000	Iridium-192m	
Tungsten-176	1,000	(1.4m)	10
Tungsten-177	1,000	Iridium-192	
Tungsten-178	1,000	(73.8d)	1
Tungsten-179	1,000	Iridium-194m	10
Tungsten-181	1,000	Iridium-194	100
Tungsten-185	100	Iridium-195m	1,000
Tungsten-187	100	Iridium-195	1,000
Tungsten-188	10	Platinum-186	1,000
Rhenium-177	1,000	Platinum-188	100
Rhenium-178	1,000	Platinum-189	1,000
Rhenium-181	1,000	Platinum-191	100
Rhenium-182		Platinum-193m	100
(12.7h)	1,000	Platinum-193	1,000
Rhenium-182		Platinum-195m	100
(64.0h)	100	Platinum-197m	1,000
Rhenium-184m	10	Platinum-197	100
Rhenium-184	100	Platinum-199	1,000
Rhenium-186m	10	Platinum-200	100
Rhenium-186	100	Gold-193	1,000
Rhenium-187	1,000	Gold-194	100
Rhenium-188m	1,000	Gold-195	10
Rhenium-188	100	Gold-198m	100
Rhenium-189	100	Gold-198	100
Osmium-180	1,000	Gold-199	100

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Osmium-181	1,000	Gold-200m	100
Osmium-182	100	Gold-200	1,000
Osmium-185	100	Gold-201	1,000
Osmium-189m	1,000	Mercury-193m	100
Osmium-191m	1,000	Mercury-193	1,000
Osmium-191	100	Mercury-194	1
Osmium-193	100	Mercury-195m	100
Osmium-194	1	Mercury-195	1,000
Iridium-182	1,000	Mercury-197m	100
Iridium-184	1,000	Mercury-197	1,000
Iridium-185	1,000	Mercury-199m	1,000
Iridium-186	100	Mercury-203	100
Iridium-187	1,000		
Thallium-194m	1,000	Francium-223	100
Thallium-194	1,000	Radium-223	0.1
Thallium-195	1,000	Radium-224	0.1
Thallium-197	1,000	Radium-225	0.1
Thallium-198m	1,000	Radium-226	0.1
Thallium-198	1,000	Radium-227	1,000
Thallium-199	1,000	Radium-228	0.1
Thallium-201	1,000	Actinium-224	1
Thallium-200	1,000	Actinium-225	0.01
Thallium-202	100	Actinium-226	0.1
Thallium-204	100	Actinium-227	0.001
Lead-195m	1,000	Actinium-228	1
Lead-198	1,000	Thorium-226	10
Lead-199	1,000	Thorium-227	0.01
Lead-200	100	Thorium-228	0.001
Lead-201	1,000	Thorium-229	0.001
Lead-202m	1,000	Thorium-230	0.001
Lead-202	10	Thorium-231	100
Lead-203	1,000	Thorium-232	100
Lead-205	100	Thorium-234	10
Lead-209	1,000	Thorium-natural	100
Lead-210	0.01	Protactinium-227	10
Lead-211	100	Protactinium-228	1
Lead-212	1	Protactinium-230	0.1
Lead-214	100	Protactinium-231	0.001
Bismuth-200	1,000	Protactinium-232	1
Bismuth-201	1,000	Protactinium-233	100
Bismuth-202	1,000	Protactinium-234	100
Bismuth-203	100	Uranium-230	0.01
Bismuth-205	100	Uranium-231	100

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Bismuth-206	100	Uranium-232	0.001
Bismuth-207	10	Uranium-233	0.001
Bismuth-210m	0.1	Uranium-234	0.001
Bismuth-210	1	Uranium-235	0.001
Bismuth-212	10	Uranium-236	0.001
Bismuth-213	10	Uranium-237	100
Bismuth-214	100	Uranium-238	100
Polonium-203	1,000	Uranium-239	1,000
Polonium-205	1,000	Uranium-240	100
Polonium-207	1,000	Uranium-natural	100
Polonium-210	0.1	Neptunium-232	100
Astatine-207	100	Neptunium-233	1,000
Astatine-211	10	Neptunium-234	100
Radon-220	1	Neptunium-235	100
Radon-222	1	Neptunium-236	
Francium-222	100	(1.15E+5)	0.001
Neptunium-236		Curium-242	0.01
(22.5h)	1	Curium-243	0.001
Neptunium-237	0.001	Curium-244	0.001
Neptunium-238	10	Curium-245	0.001
Neptunium-239	100	Curium-246	0.001
Neptunium-240	1,000	Curium-247	0.001
Plutonium-234	10	Curium-248	0.001
Plutonium-235	1,000	Curium-249	1,000
Plutonium-236	0.001	Berkelium-245	100
Plutonium-237	100	Berkelium-246	100
Plutonium-238	0.001	Berkelium-247	0.001
Plutonium-239	0.001	Berkelium-249	0.1
Plutonium-240	0.001	Berkelium-250	10
Plutonium-241	0.01	Californium-244	100
Plutonium-242	0.001	Californium-246	1
Plutonium-243	1,000	Californium-248	0.01
Plutonium-244	0.001	Californium-249	0.001
Plutonium-245	100	Californium-250	0.001
Americium-237	1,000	Californium-251	0.001
Americium-238	100	Californium-252	0.001
Americium-239	1,000	Californium-253	0.1
Americium-240	100	Californium-254	0.001
Americium-241	0.001	Einsteinium-250	100
Americium-242m	0.001	Einsteinium-251	100
Americium-242	10	Einsteinium-253	0.1
Americium-243	0.001	Einsteinium-254m	1
Americium-244m	100	Einsteinium-254	0.01

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Americium-244	10	Fermium-252	1
Americium-245	1,000	Fermium-253	1
Americium-246m	1,000	Fermium-254	10
Americium-246	1,000	Fermium-255	1
Curium-238	100	Fermium-257	0.01
Curium-240	0.1	Mendelevium-257	10
Curium-241	1	Mendelevium-258	0.01
Any alpha-emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.001	Any radionuclide other than alpha-emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	0.01

NOTE: For purposes of 1.4.30(5), 1.4.33(1), and 1.4.54(1) where there is involved a combination of radionuclides in known amounts, the limit for the combination shall be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" – that is, unity.

[1]The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in Table I, Columns 1 and 2, of Appendix B of this section, rounding to the nearest factor of 10, and constraining the values listed between 0.001 and 1,000 microcuries (37 becquerels and 37 megabecquerels). Values of 100 microcuries (3.7 megabecquerels) have been assigned for radionuclides having a radioactive half-life in excess of E+9 years, except rhenium, 1000 microcuries (37 megabecquerels), to take into account their low specific activity.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX D

Requirements For Transfer Of Low-Level Radioactive Waste Intended For Disposal At Licensed Land Disposal Facilities And Manifests

I. Manifest.

A waste generator, collector, or processor who transports, or offers for transportation, low-level radioactive waste intended for ultimate disposal at a licensed low-level radioactive waste land disposal facility must prepare a Manifest reflecting information

requested on applicable NRC Forms 540 (Uniform Low-Level Radioactive Waste Manifest (Shipping Paper)) and 541 (Uniform Low-Level Radioactive Waste Manifest (Container and Waste Description)) and, if necessary, on an applicable NRC Form 542 (Uniform Low-Level Radioactive Waste Manifest (Manifest Index and Regional Compact Tabulation)). NRC Forms 540 and 540A must be completed and must physically accompany the pertinent low-level waste shipment. Upon agreement between shipper and consignee, NRC Forms 541 and 541A and 542 and 542A may be completed, transmitted, and stored in electronic media with the capability for producing legible, accurate, and complete records on the respective forms. Licensees are not required by the Agency to comply with the manifesting requirements of this section when they ship:

(a) LLW for processing and expect its return (i.e., for storage under their license) prior to disposal at a licensed land disposal facility:

(b) LLW is being returned to the licensee who is the "waste generator" or "generator," as defined in this section, or

(c) Radioactively contaminated material to a "waste processor" that becomes the processor's "residual waste."

For guidance in completing these forms, refer to the instructions that accompany the forms. Copies of manifests required by this appendix may be legible carbon copies, photocopies, or computer printouts that reproduce the data in the format of the uniform manifest.

NRC Forms 540, 540A, 541, 541A, 542 and 542A, and the accompanying instructions, in hard copy, may be obtained from the Information and Records Management Branch, Office of Information Resources Management, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-7232.

This appendix includes information requirements of the Department of Transportation, as codified in 49 CFR part 172. Information on hazardous, medical, or other waste, required to meet Environmental Protection Agency regulations, as codified in 40 CFR parts 259, 261 or elsewhere, is not addressed in this section, and must be provided on the required EPA forms. However, the required EPA forms must accompany the Uniform Low-Level Radioactive Waste Manifest required by this chapter.

As used in this appendix, the following definitions apply:

"Chelating agent" has the same meaning as that given in 1.1.2 of these regulations.

"Chemical description" means a description of the principal chemical characteristics of a low-level radioactive waste.

"Computer-readable medium" means that the regulatory agency's computer can transfer the information from the medium into its memory.

“Consignee” means the designated receiver of the shipment of low-level radioactive waste.

“Decontamination facility” means a facility operating under an Agency, U.S. Nuclear Regulatory Commission, Agreement State or Licensing State whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse, or other waste management objectives, and, for purposes of this section, is not considered to be a consignee for LLW shipments.

“Disposal container” means a container principally used to confine low-level radioactive waste during disposal operations at a land disposal facility (also see “high integrity container”). Note that for some shipments, the disposal container may be the transport package.

“EPA identification number” means the number received by a transporter following application to the Administrator of EPA as required by 40 CFR part 263.

“Generator” means a licensee operating under an Agency, U.S. Nuclear Regulatory Commission, Agreement State or Licensing State license who (1) is a waste generator as defined in this section, or (2) is the licensee to whom waste can be attributed within the context of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (e.g., waste generated as a result of decontamination or recycle activities).

“High integrity container (HIC)” means a container commonly designed to meet the structural stability requirements of Appendix E, Section II, and to meet Department of Transportation requirements for a Type A package.

“Land disposal facility” means the land, buildings and structures, and equipment which are intended to be used for the disposal of radioactive wastes.

“NRC Forms 540, 540A, 541, 541A, 542, and 542A” are official U.S. Nuclear Regulatory Commission Forms referenced in this appendix. Licensees need not use originals of these NRC Forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size, and location of information.

“Package” means the assembly of components necessary to ensure compliance with the packaging requirements of DOT regulations, together with its radioactive contents, as presented for transport.

“Physical description” means the items called for on NRC Form 541 to describe a low-level radioactive waste.

“Residual waste” means low-level radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor or decontamination facility, as applicable.

"Shipper" means the licensed entity (i.e., the waste generator, waste collector, or waste processor) who offers low-level radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

"Shipping paper" means NRC Form 540 and if required, NRC Form 540A which includes the information required by DOT in 49 CFR part 172.

"Source material" has the same meaning as defined in 1.1.2 of these regulations.

"Special nuclear material" has the same meaning as defined in 1.1.2 of these regulations.

"Uniform Low-Level Radioactive Waste Manifest or uniform manifest" means the combination of NRC Forms 540, 541, and, if necessary, 542, and their respective continuation sheets as needed, or equivalent.

"Waste collector" means an entity, operating under an Agency, U.S. Nuclear Regulatory Commission, Agreement State, or Licensing State license whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without processing or repackaging the collected waste, to another licensed waste collector, licensed waste processor, or licensed land disposal facility.

"Waste description" means the physical, chemical and radiological description of a low-level radioactive waste as called for on NRC Form 541.

"Waste generator" means an entity, operating under an Agency, U.S. Nuclear Regulatory Commission, Agreement State, or Licensing State license, who (1) possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and (2) transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment prior to disposal. A licensee performing processing or decontamination services may be a "waste generator" if the transfer of low-level radioactive waste from its facility is defined as "residual waste."

"Waste processor" means an entity, operating under an Agency, U.S. Nuclear Regulatory Commission , Agreement State, or Licensing State license, whose principal purpose is to process, repackage, or otherwise treat low-level radioactive material or waste generated by others prior to eventual transfer of waste to a licensed low-level radioactive waste land disposal facility.

"Waste type" means a waste within a disposal container having a unique physical description (i.e., a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

Information Requirements

A. General Information

The shipper of the radioactive waste, shall provide the following information on the uniform manifest:

1. The name, facility address, and telephone number of the licensee shipping the waste;

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for purposes of the manifested shipment; and

3. The name, address, and telephone number, or the name and EPA identification number for the carrier transporting the waste.

B. Shipment Information

The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the uniform manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3. The total disposal volume and disposal weight in the shipment;

4. The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C. Disposal Container and Waste Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of any high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types, (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained on these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste pursuant to Section I of Appendix E of this section. Waste not meeting the structural stability requirements of Section II B of Appendix E of this section must be identified.

D. Uncontainerized Waste Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding a waste shipment delivered without a disposal container;

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

4. For waste consigned to a disposal facility, the classification of the waste pursuant to Section I of Appendix E of this section. Waste not meeting the structural stability requirements of Section II.B of Appendix E of this section must be identified.

5. The identities and activities of individual radionuclides contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste.

E. Multi-Generator Disposal Container Information

This section applies to disposal containers enclosing mixtures of waste originating from different generators. (Note: The origin of the LLW resulting from a processor's activities may be attributable to one or more "generators" (including "waste generators") as defined in this section). It also applies to mixtures of wastes shipped in an Uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container, and, for discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained on these waste types within the disposal container. For each generator, provide the following:

   (a) The volume of waste within the disposal container;

   (b) A physical and chemical description of the waste, including the solidification agent, if any;

   (c) The total weight percentage of chelating agents for any disposal container containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

   (d) The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in Section II.B of Appendix E of this section; and

   (e) Radionuclide identities and activities contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

II. Certification

An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Agency. A collector in signing the certification is certifying that

nothing has been done to the collected waste which would invalidate the waste generator's certification.

III. Control and Tracking

A. Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements of Section III.A(1) through (9). Any licensee who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of Section III.A(1) through (9). A licensee shall:

(1) Prepare all wastes so that the waste is classified according to Section I of Appendix E of this section and meets the waste characteristics requirements in Section II of Appendix E of this section;

(2) Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, or Class C waste, or greater than Class C waste in accordance with Section I of Appendix E of this section;

(3) Conduct a quality assurance program to ensure compliance with Sections I and II of Appendix E of this section; (the program shall include management evaluation of audits);

(4) Prepare the NRC Uniform Low-Level Radioactive Waste Manifest as required by this appendix;

(5) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either (i) receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

(6) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option in Section III.A.5 of this section;

(7) Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(8) Retain a copy or electronically store the Uniform Low-Level Radioactive Waste Manifest, and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Subchapter 3;

(9) For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with Section III.E.

B. Any waste collector licensee who handles only prepackaged waste shall:

(1) Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

(2) Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

(3) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either: (i) Receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

(4) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in Section III.B.(3);

(5) Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(6) Retain a copy or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt;

(7) For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with Section III.E; and

(8) Notify the shipper and the Agency when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

C. Any licensed waste processor who treats or repackages wastes shall:

(1) Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of the NRC Form 540;

(2) Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume, and the other information as required in Section I.E. of this appendix;

(3) Prepare all wastes so that the waste is classified according to Section I of Appendix E and meets the waste characteristics requirements in Section II of Appendix E of this section;

(4) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with Sections I and III of Appendix E of this section;

(5) Conduct a quality assurance program to ensure compliance with Sections I and II of Appendix E of this section. (The program shall include management evaluation of audits);

(6) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either; (i) Receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

(7) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in Section III.C.(6) of Appendix D;

(8) Receive acknowledgement of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(9) Retain a copy or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Subchapter 3 of these regulations;

(10) For any shipment or any part of a shipment for which acknowledgement has not been received within the times set forth in this appendix, conduct an investigation in accordance with Section III.E of Appendix D; and

(11) Notify the shipper and the Agency when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

D. The land disposal facility operator shall:

(1) Acknowledge receipt of the waste within one week of receipt by returning, as a minimum, a signed copy of NRC Form 540 to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Uniform Low-Level Radioactive Waste Manifest and materials received, copies or electronic transfer of the affected forms must be returned indicating the discrepancy;

(2) Maintain copies of all completed manifests and electronically store the information until the Agency terminates the license; and

(3) Notify the shipper and the Agency when any shipment or part of a shipment has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

E. Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section must:

(1) Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

(2) Be traced and reported. The investigation shall include tracing the shipment and filing a report with the Agency. Each licensee who conducts a trace investigation shall file a written report with the Agency within 2 weeks of completion of the investigation.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX E

Classification and Characteristics of Low-Level Radioactive Waste

I. Classification of Radioactive Waste for Land Disposal

A. Considerations. Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

B. Classes of waste.

(1) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in Section II.A. If Class A waste also meets the stability requirements set forth in Section II.B, it is not necessary to segregate the waste for disposal.

(2) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in Section II.

(3) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in Section II.

C. Classification determined by long-lived radionuclides. If the radioactive waste contains only radionuclides listed in Table I, classification shall be determined as follows:

(1) If the concentration does not exceed 0.1 times the value in Table I, the waste is Class A.

(2) If the concentration exceeds 0.1 times the value in Table I, but does not exceed the value in Table I, the waste is Class C.

(3) If the concentration exceeds the value in Table I, the waste is not generally acceptable for land disposal.

(4) For wastes containing mixtures of radionuclides listed in Table I, the total concentration shall be determined by the sum of fractions rule described in Section I.G.

TABLE I

Radionuclide	Concentration curie/cubic meter[a]	Concentration nanocurie/gram[b]
C-14	8	
C-14 in activated metal	80	
Ni-59 in activated metal	220	
Nb-94 in activated metal	0.2	
Tc-99	3	
I-129	0.08	
Alpha emitting transuranic radionuclides with half-life greater than five years		100
Pu-241		3,500
Cm-242		20,000
Ra-226		100

[a]To convert the Ci/m^3 values to gigabecquerels (GBq) per cubic meter, multiply the Ci/m^3 value by 37.

[b]To convert the nCi/g values to becquerel (Bq) per gram, multiply the nCi/g value by 37.

D. Classification determined by short-lived radionuclides. If the waste does not contain any of the radionuclides listed in Table I, classification shall be determined based on the concentrations shown in Table II. However, as specified in Section I.F, if radioactive waste does not contain any nuclides listed in either Table I or II, it is Class A.

(1) If the concentration does not exceed the value in Column 1, the waste is Class A.

(2) If the concentration exceeds the value in Column 1 but does not exceed the value in Column 2, the waste is Class B.

(3) If the concentration exceeds the value in Column 2 but does not exceed the value in Column 3, the waste is Class C.

(4) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(5) For wastes containing mixtures of the radionuclides listed in Table II, the total concentration shall be determined by the sum of fractions rule described in Section I.G.

TABLE II

Radionuclide	Concentration, curie/cubic meter*		
	Column 1	Column 2	Column 3
Total of all radionuclides with less than 5-year	700	*	*
H-3	40	*	*
Co-60	700	*	*
Ni-63	3.5	70	700
Ni-63 in activated	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

* To convert the Ci/m^3 value to gigabecquerels (GBq) per cubic meter, multiply the Ci/m^3 value by 37. There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other radionuclides in Table II determine the waste to be Class C independent of these radionuclides.

E. Classification determined by both long- and short-lived radionuclides. If the radioactive waste contains a mixture of radionuclides, some of which are listed in Table I and some of which are listed in Table II, classification shall be determined as follows:

(1) If the concentration of a radionuclide listed in Table I is less than 0.1 times the value listed in Table I, the class shall be that determined by the concentration of radionuclides listed in Table II.

(2) If the concentration of a radionuclide listed in Table I exceeds 0.1 times the value listed in Table I, but does not exceed the value in Table I, the waste shall be Class C, provided the concentration of radionuclides listed in Table II does not exceed the value shown in Column 3 of Table II.

F. Classification of wastes with radionuclides other than those listed in Tables I and II. If the waste does not contain any radionuclides listed in either Table I or II, it is Class A.

G. The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m^3 (1.85 TBq/m^3) and Cs-137 in a concentration of 22 Ci/m^3 (814 GBq/m^3). Since the concentrations both exceed the values in Column 1, Table II, they must be

compared to Column 2 values. For Sr-90 fraction, 50/150 = 0.33., for Cs-137 fraction, 22/44 = 0.5; the sum of the fractions = 0.83. Since the sum is less than 1.0, the waste is Class B.

H. Determination of concentrations in wastes. The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste or weight of the waste if the units are expressed as becquerel (nanocurie) per gram.

II. Radioactive Waste Characteristics

A. The following are minimum requirements for all classes of waste and are intended to facilitate handling and provide protection of health and safety of personnel at the disposal site.

(1) Wastes shall be packaged in conformance with the conditions of the license issued to the site operator to which the waste will be shipped. Where the conditions of the site license are more restrictive than the provisions of Subchapter 4, the site license conditions shall govern.

(2) Wastes shall not be packaged for disposal in cardboard or fiberboard boxes.

(3) Liquid waste shall be packaged in sufficient absorbent material to absorb twice the volume of the liquid.

(4) Solid waste containing liquid shall contain as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

(5) Waste shall not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

(6) Waste shall not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with Section II.A(8).

(7) Waste must not be pyrophoric. Pyrophoric materials contained in wastes shall be treated, prepared, and packaged to be nonflammable.

(8) Wastes in a gaseous form shall be packaged at an absolute pressure that does not exceed 1.5 atmospheres at 20°C. Total activity shall not exceed 100 curies (3.7 terabecquerels) per container.

(9) Wastes containing hazardous, biological, pathogenic, or infectious material shall be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

B. The following requirements are intended to provide stability of the waste. Stability is intended to ensure that the waste does not degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

(1) Waste shall have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

(2) Notwithstanding the provisions in Section II.A(3) and (4), liquid wastes, or wastes containing liquid, shall be converted into a form that contains as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.

(3) Void spaces within the waste and between the waste and its package shall be reduced to the extent practicable.

III. Labeling

Each package of waste shall be clearly labeled to identify whether it is Class A, Class B, or Class C waste, in accordance with Section I.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX F

Quantities For Use With Decommissioning

Material	Microcurie*
Americium-241	0.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dysprosium-165	10
Dysprosium-166	100

* To convert microcurie (μCi) to kilobecquerel (kBq), multiply the μCi value by 37.

**Based on alpha disintegration rate of U-238, U-234, and U-235.

Material	Microcurie*
Erbium-169	100
Erbium-171	100
Europium-152 (9.2 h)	100
Europium-152 (13 yr)	1
Europium-154	1
Europium-155	10
Fluorine-18	1,000
Gadolinium-153	10
Gadolinium-159	100
Gallium-72	10
Germanium-71	100
Gold-198	100
Gold-199	100
Hafnium-181	10
Holmium-166	100
Hydrogen-3	1,000
Indium-113m	100
Indium-114m	10
Indium-115m	100
Indium-115	10
Iodine-125	1
Iodine-126	1
Iodine-129	0.1
Iodine-131	1
Iodine-132	10
Iodine-133	1
Iodine-134	10
Iodine-135	10
Iridium-192	10
Iridium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100

* To convert microcurie (μCi) to kilobecquerel (kBq), multiply the μCi value by 37.

**Based on alpha disintegration rate of U-238, U-234, and U-235.

Material	Microcurie*
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10
Osmium-191m	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-193	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	0.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	0.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10

* To convert microcurie (μCi) to kilobecquerel (kBq), multiply the μCi value by 37.

**Based on alpha disintegration rate of U-238, U-234, and U-235.

Material	Microcurie*
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-ll0m	1
Silver-111	100
Sodium-22	1
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulfur -35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
Thorium (natural)**	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
Uranium (natural)**	100
Uranium-233	0.01
Uranium-234	0.01
Uranium-235	0.01

* To convert microcurie (μCi) to kilobecquerel (kBq), multiply the μCi value by 37.

**Based on alpha disintegration rate of U-238, U-234, and U-235.

Material	Microcurie*
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	0.1

NOTE: Where there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" – that is, unity.

SOURCE: Miss. Code Ann. §45-14-11

* To convert microcurie (μCi) to kilobecquerel (kBq), multiply the μCi value by 37.

**Based on alpha disintegration rate of U-238, U-234, and U-235.

APPENDIX G

Nationally Tracked Source Thresholds

Radioactive material	Category 1 (TBq)	Category 1 (Ci)	Category 2 (TBq)	Category 2 (Ci)
Actinium-227	20	540	0.2	5.4
Americium-241	60	1,600	0.6	16
Americium-241/Be	60	1,600	0.6	16
Californium-252	20	540	0.2	5.4
Cobalt-60	30	810	0.3	8.1
Curium-244	50	1,400	0.5	14
Cesium-137	100	2,700	1	27
Gadolinium-153	1,000	27,000	10	270
Iridium-192	80	2,200	0.8	22
Plutonium-238	60	1,600	0.6	16
Plutonium-239/Be	60	1,600	0.6	16
Polonium-210	60	1,600	0.6	16
Promethium-147	40,000	1,100,000	400	11,000
Radium-226	40	1,100	0.4	11
Selenium-75	200	5,400	2	54
Strontium-90	1,000	27,000	10	270
Thorium-228	20	540	0.2	5.4
Thorium-229	20	540	0.2	5.4
Thulium-170	20,000	540,000	200	5,400
Ytterbium-169	300	8,100	3	81

The Terabecquerel (TBq) values are the regulatory standard. The curie (Ci) values specified are obtained by converting from the TBq value. The curie values are provided for practical usefulness only and are rounded after conversion.

SOURCE: Miss. Code Ann. §45-14-11

Subchapter 5. Radiation Safety Requirements For Industrial Radiographic Operations

Rule 1.5.1 **Purpose**. This section prescribes requirements for the issuance of licenses or registrations for the industrial use of sources of radiation and radiation safety requirements for persons using these sources of radiation in industrial radiography.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.2 **Scope**. The provisions and requirements of this section are in addition to, and not in substitution for, other applicable requirements of these regulations. Except for those regulations of this section clearly applicable only to sealed radioactive sources, both radiation machines and sealed radioactive sources are covered by this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.3 **Definitions**. As used in this section, the following definitions apply:

1. "Annual refresher safety training" means a review conducted or provided by the licensee or registrant for its employees on radiation safety aspects of industrial radiography. The review shall include, as a minimum, any results of internal inspections, new procedures or equipment, new or revised regulations, and accidents or errors that have been observed. The review shall also provide opportunities for employees to ask safety questions.

2. "ANSI" means the American National Standards Institute.

3. "Associated equipment" means equipment that is used in conjunction with a radiographic exposure device to make radiographic exposures that drives, guides, or comes in contact with the source.[26]

4. "Cabinet radiography" means industrial radiography conducted in an enclosure or cabinet so shielded that radiation levels at every location on the exterior meet the dose limits for individual members of the public as specified in 1.4.14 of these regulations.

5. "Cabinet x-ray system" means an x-ray system with the x-ray tube installed in an enclosure independent of existing architectural structures except the floor on which it may be placed.

a. The cabinet x-ray system is intended to contain at least that portion of a material being irradiated, provide radiation attenuation, and exclude personnel from its interior during generation of radiation. Included are all x-

[26] e.g., guide tube, control tube, control (drive) cable, removable source stop, “J” tube and collimator when used as an exposure head.

ray systems designed primarily for the inspection of carry- on baggage at airline, railroad, and bus terminals, and in similar facilities. An x-ray tube used within a shielded part of a building, or x-ray equipment which may temporarily or occasionally incorporate portable shielding, is not considered a cabinet x-ray system.

6. "Camera" see "Radiographic exposure device".

7. "Certifiable cabinet x-ray system" means an existing uncertified x-ray system that has been modified to meet the certification requirements specified in 21 CFR 1020.40.

8. "Certified cabinet x-ray system" means an x-ray system which has been certified in accordance with 21 CFR 1010.2 as being manufactured and assembled pursuant to the provisions of 21 CFR 1020.40.

9. "Certifying entity" means an independent certifying organization meeting the requirements in Appendix A of this section or a state regulatory program meeting the requirements in Appendix A, Sections II and III of this section.

10. "Collimator" means a radiation shield that is placed on the end of the guide tube or directly onto a radiographic exposure device to restrict the size of the radiation beam when the sealed source is cranked into position to make a radiographic exposure.

11. "Control cable" means the cable that is connected to the source assembly and used to drive the source to and from the exposure location.

12. "Control drive mechanism" means a device that enables the source assembly to be moved into and out of the exposure device.

13. "Control tube" means a protective sheath for guiding the control cable. The control tube connects the control drive mechanism to the radiographic exposure device.

14. "Drive cable" see "Control cable".

15. "Exposure head" means a device that locates the gamma radiography sealed source in the selected working position.[27]

16. "Field station" means a facility from which sources of radiation may be stored or used and from which equipment is dispatched.

17. "Guide tube" means a flexible or rigid tube, or "J" tube, for guiding the source assembly and the attached control cable from the exposure device to the exposure head. The guide tube may also include the connections

[27] An exposure head is also known as a source stop.

necessary for attachment to the exposure device and to the exposure head.

18. "Hands-on experience" means experience in all of those areas considered to be directly involved in the radiography process.

19. "Independent certifying organization" means an independent organization that meets all of the criteria of Appendix A of this section.

20. "Industrial radiography" means an examination of the structure of materials by nondestructive methods utilizing ionizing radiation to make radiographic images.

21. "Lay-barge radiography" means industrial radiography performed on any water vessel used for laying pipe.

22. "Offshore platform radiography" means industrial radiography conducted from a platform over a body of water.

23. "Permanent radiographic installation" means an enclosed shielded room, cell, or vault, not located at a temporary jobsite, in which radiography is performed.

24. "Pigtail" see "Source ssembly".

25. “Pill" see "Sealed source".

26. "Practical examination" means a demonstration through application of the safety rules and principles in industrial radiography including use of all procedures and equipment to be used by radiographic personnel.

27. "Projection sheath" see "Guide tube".

28. "Projector" see "Radiographic exposure device".

29. "Radiation safety officer for industrial radiography" means an individual with the responsibility for the overall radiation safety program on behalf of the licensee or registrant and who meets the requirements of 1.5.16.

30. "Radiographer" means any individual who performs or who, in attendance at the site where the sources of radiation are being used, personally supervises industrial radiographic operations and who is responsible to the licensee or registrant for assuring compliance with the requirements of these regulations and the conditions of the license or registration.

31. "Radiographer certification" means written approval received from a certifying entity stating that an individual has satisfactorily met the radiation safety, testing, and experience criteria in 1.5.17.

32. "Radiographer's assistant" means any individual who, under the direct supervision of a radiographer, uses radiographic exposure devices, sources of radiation, related handling tools, or radiation survey instruments in industrial radiography.

33. "Radiographic exposure device" means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure.

34. "Radiographic operations" means all activities performed with a radiographic exposure device, or with a radiation machine. Activities include using, transporting except by common or contract carriers, or storing at a temporary job site, performing surveys to confirm the adequacy of boundaries, setting up equipment, and any activity inside restricted area boundaries. Transporting a radiation machine is not considered a radiographic operation.

35. "Radiography" see "Industrial radiography."

36. "S-tube" means a tube through which the radioactive source travels when inside a radiographic exposure device.

37. "Sealed source" means any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

38. "Shielded position" means the location within the radiographic exposure device, source changer, or storage container where the sealed source is secured and restricted from movement.

39. "Source assembly" means an assembly that consists of the sealed source and a connector that attaches the source to the control cable. The source assembly may include a ballstop to secure the source in the shielded position.

40. "Source changer" means a device designed and used for replacement of sealed sources in radiographic exposure devices, including those source changers also used for transporting and storage of sealed sources.

41. "Storage area" means any location, facility, or vehicle which is used to store, or to secure a radiographic exposure device, a radiation machine, a storage container, or a sealed source when it is not in use and which is locked or has a physical barrier to prevent accidental exposure, tampering with, or unauthorized removal of the device, container, or source.

42. "Storage container" means a container in which sealed sources are secured and stored.

43. "Temporary jobsite" means a location where radiographic operations are

performed and where sources of radiation may be stored other than the location(s) of use authorized on the license or registration.

44. "Underwater radiography" means industrial radiography performed when the radiographic exposure device or radiation machine and/or related equipment are beneath the surface of the water.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.4 **Exemptions**.

1. Uses of certified and certifiable cabinet x-ray systems are exempt from the requirements of this section except for the following:

   a. For certified and certifiable cabinet x-ray systems, including those designed to allow admittance of individuals:

      i. No registrant shall permit any individual to operate a cabinet x-ray system until the individual has received a copy of and instruction in the operating procedures for the unit. Records that demonstrate compliance with this subparagraph shall be maintained for Agency inspection until disposal is authorized by the Agency.

      ii. Tests for proper operation of interlocks must be conducted and recorded at intervals not to exceed six months. Records of these tests shall be maintained for Agency inspection until disposal is authorized by the Agency.

      iii. The registrant shall perform an evaluation of the radiation dose limits to determine compliance with 1.4.14(1), (2), and (3) of these regulations, and 21 CFR 1020.40, Cabinet X-Ray Systems (39 Federal Register 12986, April 10, 1974), at intervals not to exceed one year. Records of these evaluations shall be maintained for Agency inspection for two years after the evaluation.

   b. Certified cabinet x-ray systems shall be maintained in compliance with 21 CFR 1020.40, Cabinet X-Ray Systems (39 Federal Register12986, April 10, 1974), and no modification shall be made to the system unless prior Agency approval has been granted.

2. Industrial uses of hand-held light intensified imaging devices are exempt from the requirements of this section if the dose rate 18 inches from the source of radiation to any individual does not exceed 2 millirem per hour. Devices which exceed this limit shall meet the applicable requirements of this section and the licensing or registration requirements of Subchapter 2 or Subchapter 3 of these

regulations, as applicable.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.5 **Licensing and Registration Requirements for Industrial Radiography Operations.**

1. The Agency will approve an application for a specific license for the use of licensed material or a registration for use of radiation machines if the applicant meets the following requirements:

2. The applicant satisfies the general requirements specified in Subchapter 2 for radiation machine facilities or Subchapter 3 for radioactive material, as applicable, and any special requirements contained in this section;

3. The applicant submits an adequate program for training radiographers and radiographer's assistants that meets the requirements of 1.5.17:

   a. After 2 years after the effective date of these regulations, the applicant need not describe the initial training and examination program for radiographers in the subjects outlined in 1.5.17(7).

   b. From August 11, 2001 to 2 years after the effective date of the regulations is published, the applicant may affirm that all individuals acting as industrial radiographers will be certified in radiation safety by a certifying entity before commencing duty as radiographers. This affirmation substitutes for a description of its initial training and examination program for radiographers in the subjects outlined in 1.5.17(7).

   c. The applicant submits procedures for verifying and documenting the certification status of radiographers and for ensuring that the certification of individuals acting as radiographers remains valid;

   d. The applicant submits written operating and emergency procedures as described in 1.5.18;

   e. The applicant submits a description of a program for inspections of the job performance of each radiographer and radiographer's assistant at intervals not to exceed 6 months as described in 1.5.17(5);

   f. The applicant submits a description of the applicant's overall organizational structure as it applies to the radiation safety responsibilities in industrial radiography, including specified delegation of authority and responsibility;

   g. The applicant submits the qualifications of the individual(s) designated as the radiation safety officer as described in 1.5.16(1);

h. If an applicant intends to perform leak testing of sealed sources or exposure devices containing depleted uranium (DU) shielding, the applicant must describe the procedures for performing the test. The description must include the:

i. Methods of collecting the samples;

ii. Qualifications of the individual who analyzes the samples;

iii. Instruments to be used; and

iv. Methods of analyzing the samples.

i. If the applicant intends to perform calibrations of survey instruments and alarming ratemeters, the applicant must describe methods to be used and the experience of the person(s) who will perform the calibrations. All calibrations must be performed according to the procedures described and at the intervals prescribed in 1.5.9 and 1.5.20(7)(d);

j. The applicant identifies and describes the location(s) of all field stations and permanent radiographic installations;

k. The applicant identifies the location(s) where all records required by this and other sections of these regulations will be maintained;

l. If a license application includes underwater radiography, a description of:

i. Radiation safety procedures and radiographer responsibilities unique to the performance of underwater radiography;

ii. Radiographic equipment and radiation safety equipment unique to underwater radiography; and

iii. Methods for gas-tight encapsulation of equipment; and

m. If an application includes offshore platform and/or lay-barge radiography, a description of:

i. Transport procedures for radioactive material to be used in industrial radiographic operations;

ii. Storage facilities for radioactive material; and

iii. Methods for restricting access to radiation areas.

n. A license or registration will be issued if 1.5.5(1) through 1.5.5(13), as applicable, are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.6 **Performance Requirements for Industrial Radiography Equipment.** Equipment used in industrial radiographic operations must meet the following minimum criteria:

1. Each radiographic exposure device, source assembly or sealed source, and all associated equipment must meet the requirements specified in American National Standard Institute, N432-1980 "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography,"(published as NBS Handbook 136, issued January 1981);

2. In addition to the requirements specified in 1.5.6(1), the following requirements apply to radiographic exposure devices, source changers, source assemblies or sealed sources.

   a. The licensee shall ensure that each radiographic exposure device has attached to it a durable, legible, clearly visible label bearing the:

      i. Chemical symbol and mass number of the radionuclide in the device;

      ii. Activity and the date on which this activity was last measured;

      iii. Model number or product code and serial number of the sealed source;

      iv. Name of the manufacturer of the sealed source; and

      v. Licensee's name, address, and telephone number.

   b. Radiographic exposure devices intended for use as Type B packages must meet the applicable transportation requirements of Subchapter 13 of these regulations.

   c. Modification of any exposure devices, source changers, and source assemblies and associated equipment is prohibited, unless approved by the Agency or other approval body.

3. In addition to the requirements specified in 1.5.6(1) and (2), the following requirements apply to radiographic exposure devices, source assemblies, and associated equipment that allow the source to be moved out of the device for

radiographic operations or to source changers;

a. The coupling between the source assembly and the control cable must be designed in such a manner that the source assembly will not become disconnected if cranked outside the guide tube. The coupling must be such that it cannot be unintentionally disconnected under normal and reasonably foreseeable abnormal conditions.

b. The device must automatically secure the source assembly when it is cranked back into the fully shielded position within the device. This securing system may only be released by means of a deliberate operation on the exposure device.

c. The outlet fittings, lock box, and drive cable fittings on each radiographic exposure device must be equipped with safety plugs or covers which must be installed during storage and transportation to protect the source assembly from water, mud, sand or other foreign matter.

d. Each sealed source or source assembly must have attached to it or engraved on it, a durable, legible, visible label with the words: "DANGER - RADIOACTIVE." The label must not interfere with the safe operation of the exposure device or associated equipment.

e. The guide tube must be able to withstand a crushing test that closely approximates the crushing forces that are likely to be encountered during use, and be able to withstand a kinking resistance test that closely approximates the kinking forces that are likely to be encountered during use.

f. Guide tubes must be used when moving the source out of the device.

g. An exposure head or similar device designed to prevent the source assembly from passing out of the end of the guide tube must be attached to the outermost end of the guide tube during radiographic operations.

h. The guide tube exposure head connection must be able to withstand the tensile test for control units specified in ANSI N432-1980.

i. Source changers must provide a system for ensuring that the source will not be accidentally withdrawn from the changer when connecting or disconnecting the drive cable to or from a source assembly.

4. All radiographic exposure devices and associated equipment in use after January 10, 1996, must comply with the requirements of this section; and

5. As an exception to 1.5.6(1), equipment used in industrial radiographic operations

need not comply with § 8.9.2(c) of the Endurance Test in American National Standards Institute N432-1980, if the prototype equipment has been tested using a torque value representative of the torque that an individual using the radiography equipment can reasonably exert on the lever or crankshaft of the drive mechanism.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.7 **Limits on External Radiation Levels from Storage Containers and Source Changers.** The maximum exposure rate limits for storage containers and source changers are 2 millisieverts (200 mrem) per hour at any exterior surface, and 0.1 millisieverts (10 mrem) per hour at 1 meter from any exterior surface with the sealed source in the shielded position.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.8 **Locking of Sources of Radiation, Storage Containers and Source Changers.**

1. Each radiographic exposure device must have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The exposure device and/or its container must be kept locked[28] when not under the direct surveillance of a radiographer or a radiographer's assistant except at permanent radiographic installations as stated in 1.5.22. In addition, during radiographic operations the sealed source assembly must be secured in the shielded position each time the source is returned to that position.

2. Each sealed source storage container and source changer must have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. Storage containers and source changers must be kept locked[3] when containing sealed sources except when under the direct surveillance of a radiographer or a radiographer's assistant.

3. The control panel of each radiation machine shall be equipped with a lock that will prevent the unauthorized use of an x-ray system or the accidental production of radiation. The radiation machine shall be kept locked and the key removed at all times except when under the direct visual surveillance of a radiographer or a radiographer’s assistant.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.9 **Radiation Survey Instruments**.

1. The licensee or registrant shall maintain sufficient calibrated and operable radiation survey instruments at each location where sources of radiation are

[28] If a keyed lock, the key must be removed at all times.

present to make radiation surveys required by this section and 1.4.17 of these regulations. Instrumentation required by this section must be capable of measuring a range from 0.02 millisieverts (2 mrem) per hour through 0.01 sievert (1 rem) per hour.

2. The licensee or registrant shall have each radiation survey instrument required under 1.5.9(1) calibrated:

   a. at energies appropriate for use and at intervals not to exceed 6 months and after each instrument servicing, except for battery changes;

   b. for linear scale instruments at 2 points located approximately 1/3 and 2/3 of full-scale on each scale; for logarithmic scale instruments at mid-range of each decade, and at 2 points of at least 1 decade; and for digital instruments at 3 points between 0.02 and 10 millisieverts (2 and 1000 mrem) per hour; and

   c. so that an accuracy within plus or minus 20 percent of the true radiation dose rate can be demonstrated at each point checked.

3. The licensee or registrant shall maintain records of the results of the instrument calibrations in accordance with 1.5.26.

4. Each radiation survey instrument shall be checked with a radiation source at the beginning of each day of use and at the beginning of each work shift to ensure it is operating properly

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.10 **Leak Testing and Replacement of Sealed Sources**

1. The replacement of any sealed source fastened to or contained in a radiographic exposure device and leak testing, of any sealed source shall be performed only by persons specifically authorized to do so by the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State

2. The opening, repair, or modification of any sealed source must be performed by persons specifically authorized to do so by the Agency, the U.S. Nuclear Regulatory Commission, or another Agreement State

3. Testing and recordkeeping requirements.

   a. Each licensee who uses a sealed source shall have the source tested for leakage at intervals not to exceed 6 months. The leak testing of the source must be performed using a method approved by the Agency, the U.S. Nuclear Regulatory Commission, or by another Agreement State. The wipe sample should be taken from the nearest accessible

point to the sealed source where contamination might accumulate. The wipe sample must be analyzed for radioactive contamination. The analysis must be capable of detecting the presence of 185 becquerel (0.005 µCi) of radioactive material on the test sample and must be performed by a person specifically authorized by the Agency, the U.S. Nuclear Regulatory Commission, or another Agreement State to perform the analysis.

b. The licensee shall maintain records of the leak tests in accordance with 1.5.27.

c. Unless a sealed source is accompanied by a certificate from the transferor that shows that it has been leak tested within 6 months before the transfer, it may not be used by the licensee until tested for leakage. Sealed sources that are in storage and not in use do not require leak testing, but must be tested before use or transfer to another person if the interval of storage exceeds 6 months.

4. Any test conducted pursuant to 1.5.10(2) and (3) which reveals the presence of 185 becquerel (0.005 µCi) or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall have it decontaminated and repaired or disposed of in accordance with regulations of the Agency. A report must be filed with the Agency within 5 days of any test with results that exceed the threshold in this paragraph, describing the equipment involved, the test results, and the corrective action taken.

5. Each exposure device using depleted uranium (DU) shielding and an "S" tube configuration must be tested for DU contamination at intervals not to exceed 12 months. The analysis must be capable of detecting the presence of 185 becquerel (0.005 µCi) of radioactive material on the test sample and must be performed by a person specifically authorized by the Agency, the U.S. Nuclear Regulatory Commission, or another Agreement State to perform the analysis. Should such testing reveal the presence of DU contamination, the exposure device must be removed from use until an evaluation of the wear of the S-tube has been made. Should the evaluation reveal that the S-tube is worn through, the device may not be used again. DU shielded devices do not have to be tested for DU contamination while not in use and in storage. Before using or transferring such a device, however, the device must be tested for DU contamination, if the interval of storage exceeds 12 months. A record of the DU leak-test must be made in accordance with 1.5.27.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.11 **Quarterly Inventory.**

1. Each licensee or registrant shall conduct a quarterly physical inventory to

account for all sources of radiation, and for devices containing depleted uranium received and possessed under the license.

2. The licensee or registrant shall maintain records of the quarterly inventory in accordance with 1.5.28.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.12 **Inspection and Maintenance of Radiation Machines, Radiographic Exposure Devices, Transport and Storage Containers, Associated Equipment, Source Changers, and Survey Instruments.**

1. The licensee or registrant shall perform visual and operability checks on survey meters, radiation machines, radiographic exposure devices, transport and storage containers, associated equipment and source changers before each day's use, or work shift, to ensure that:

   a. The equipment is in good working condition;

   b. The sources are adequately shielded; and

   c. Required labeling is present.

2. Survey instrument operability must be performed using checks sources or other appropriate means.

3. If equipment problems are found, the equipment must be removed from service until repaired.

4. Each licensee or registrant shall have written procedures for and perform inspection and routine maintenance of radiation machines, radiographic exposure devices, source changers, associated equipment, transport and storage containers, and survey instruments at intervals not to exceed 3 months or before the first use thereafter to ensure the proper functioning of components important to safety. If equipment problems are found, the equipment must be removed from service until repaired.

5. The licensee's inspection and maintenance program must include procedures to assure that Type B packages are shipped and maintained in accordance with the certificate of compliance or other approval.

6. Records of equipment problems and of any maintenance performed under must be 1.5.12 made in accordance with 1.5.30.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.13 **Permanent Radiographic Installations.**

1. Each entrance that is used for personnel access to the high radiation area in a permanent radiographic installation must have either:

   a. An entrance control of the type described in 1.4.19 of these regulations that causes the radiation level upon entry into the area to be reduced; or

   b. Both conspicuous visible and audible warning signals to warn of the presence of radiation. The visible signal must be actuated by radiation whenever the source is exposed or the machine is energized. The audible signal must be actuated when an attempt is made to enter the installation while the source is exposed or the machine is energized.

2. The alarm system must be tested for proper operation with a radiation source each day before the installation is used for radiographic operations. The test must include a check of both the visible and audible signals. Entrance control devices that reduce the radiation level upon entry as designated in 1.5.13(1)(a) must be tested monthly. If an entrance control device or an alarm is operating improperly, it must be immediately labeled as defective and repaired within 7 calendar days. The facility may continue to be used during this 7-day period, provided the licensee or registrant implements the continuous surveillance requirements of 1.5.22 and uses an alarming ratemeter. Test records for entrance controls and audible and visual alarms must be maintained in accordance with 1.5.31.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.14 **Labeling, Storage, and Transportation.**

1. The licensee may not use a source changer or a container to store radioactive material unless the source changer or the storage container has securely attached to it a durable, legible, and clearly visible label bearing the standard trefoil radiation caution symbol conventional colors, i.e., magenta, purple or black on a yellow background, having a minimum diameter of 25 mm, and the wording:

CAUTION *

RADIOACTIVE MATERIAL

NOTIFY CIVIL AUTHORITIES [or " NAME OF COMPANY"]

*--- or "DANGER"

2. The licensee may not transport radioactive material unless the material is packaged, and the package is labeled, marked, and accompanied with appropriate

shipping papers in accordance with regulations set out in Subchapter 13.

3. Radiographic exposure devices, source changers, storage containers, and radiation machines, must be physically secured to prevent tampering or removal by unauthorized personnel. The licensee shall store radioactive material in a manner that will minimize danger from explosion or fire.

4. The licensee shall lock and physically secure the transport package containing radioactive material in the transporting vehicle to prevent accidental loss, tampering, or unauthorized removal.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.15 **Conducting Industrial Radiographic Operations.**

1. Whenever radiography is performed at a location other than a permanent radiographic installation, the radiographer must be accompanied by at least one other qualified radiographer or an individual who has at a minimum met the requirements of 1.5.17(3). The additional qualified individual shall observe the operations and be capable of providing immediate assistance to prevent unauthorized entry. Radiography may not be performed if only one qualified individual is present.

2. All radiographic operations must be conducted in a permanent radiographic installation unless otherwise specifically authorized by the Agency.

3. Except when physically impossible, collimators shall be used in industrial radiographic operations that use radiographic exposure devices that allow the source to be moved out of the device.

4. A licensee or registrant may conduct lay-barge, offshore platform, or underwater radiography only if procedures have been approved by the Agency, the U.S. Nuclear Regulatory Commission, or by another Agreement State

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.16 **Radiation Safety Officer**. The radiation safety officer shall ensure that radiation safety activities are being performed in accordance with approved procedures and regulatory requirements in the daily operation of the licensee's or registrant’s program.

1. The minimum qualifications, training, and experience for radiation safety officers for industrial radiography are as follows:

   a. Completion of the training and testing requirements of 1.5.17(1);

   b. 2000 hours of hands-on experience as a qualified radiographer in

industrial radiographic operations; and

c. Formal training in the establishment and maintenance of a radiation protection program.

2. The Agency will consider alternatives when the radiation safety officer has appropriate training and experience in the field of ionizing radiation, and in addition, has adequate formal training with respect to the establishment and maintenance of a radiation safety protection program.

3. The specific duties and authorities of the radiation safety officer include:

a. Establishing and overseeing all operating, emergency, and ALARA procedures as required by Subchapter 4 of these regulations and reviewing them regularly to ensure that they conform to Agency regulations and to the license or registration conditions;

b. Overseeing and approving the training program for radiographic personnel to ensure that appropriate and effective radiation protection practices are taught;

c. Ensuring that required radiation surveys and leak tests are performed and documented in accordance with the regulations, including any corrective measures when levels of radiation exceed established limits;

d. Ensuring that personnel monitoring devices are calibrated, if applicable, and used properly; that records are kept of the monitoring results; and that timely notifications are made as required by Subchapter 4 of these regulations; and

e. Ensuring that operations are conducted safely and for implementing corrective actions including terminating operations.

4. Licensees and registrants will have 2 years from the effective date of these regulations to meet the requirements of 1.5.16(1) and 1.5.16(2).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.17 **Training.**

1. The licensee or registrant may not permit any individual to act as a radiographer until the individual:

a. Has received at least 40 hours of training in the subjects outlined in 1.5.17(7), in addition to on-the-job training consisting of hands-on experience under the supervision of a radiographer and is certified through a radiographer certification program by a certifying entity in accordance with the criteria specified in Appendix A of this section. The on-the-job

training shall include a minimum of 2 months (320 hours) of active participation in the performance of industrial radiography utilizing radioactive material and/or 1 month (160 hours) of active participation in the performance of industrial radiography utilizing radiation machines. Individuals performing industrial radiography utilizing radioactive materials and radiation machines must complete both segments of the on-the-job training (3 months or 480 hours); or

b. The licensee or registrant may, until 2 years after the effective date of these regulations, allow an individual who has not met the requirements of 1.5.17(1)(a), to act as a radiographer after the individual has received at least 40 hours of training in the subjects outlined in 1.5.17(7) and demonstrated an understanding of these subjects by successful completion of a written examination that was previously submitted to and approved by the Agency, the U.S. Nuclear Regulatory Commission, or another Agreement State, in addition to on-the-job training consisting of hands-on experience under the supervision of a radiographer. The on-the-job training shall include a minimum of 2 months (320 hours) of active participation in the performance of industrial radiography utilizing radioactive material and/or 1 month (160 hours) of active participation in the performance of industrial radiography utilizing radiation machines. Individuals performing industrial radiography utilizing radioactive materials and radiation machines must complete both segments of the on-the-job training (3 months or 480 hours).

2. In addition, the licensee or registrant may not permit any individual to act as a radiographer until the individual:

a. Has received copies of and instruction in the requirements described in the regulations contained in this section, and applicable sections of Subchapters 4, 10, and 13 of these regulations, in the license or registration under which the radiographer will perform industrial radiography, and the licensee's or registrant’s operating and emergency procedures;

b. Has demonstrated an understanding of items in 1.5.17(2)(a) by successful completion of a written or oral examination;

c. Has received training in the use of the registrant's radiation machines, or the licensee's radiographic exposure devices, sealed sources, in the daily inspection of devices and associated equipment, and in the use of radiation survey instruments; and

d. Has demonstrated understanding of the use of the equipment described in 1.5.17(2)(c) by successful completion of a practical examination.

3. The licensee or registrant may not permit any individual to act as a adiographer's

assistant until the individual:

a. Has received copies of and instruction in the requirements described in the regulations contained in this section, and applicable Subchapters 4, 10, and 13 of these regulations, in the license or registration under which the radiographer's assistant will perform industrial radiography, and the licensee's or registrant's operating and emergency procedures;

b. Has demonstrated an understanding of items in 1.5.17(3)(a) by successful completion of a written or oral examination;

c. Under the personal supervision of a radiographer, has received training in the use of the registrant's radiation machines, or the licensee's radiographic exposure devices and sealed sources, in the daily inspection of devices and associated equipment, and in the use of radiation survey instruments; and

d. Has demonstrated understanding of the use of the equipment described in 1.5.17(3)(c) by successful completion of a practical examination.

4. The licensee or registrant shall provide annual refresher safety training for each radiographer and radiographer's assistant at intervals not to exceed 12 months.

5. Except as provided in 1.5.17.5(d), the radiation safety officer or designee shall conduct an inspection program of the job performance of each radiographer and radiographer's assistant to ensure that the Agency's regulations, license or registration requirements, and operating and emergency procedures are followed. The inspection program must:

a. Include observation of the performance of each radiographer and radiographer's assistant during an actual industrial radiographic operation, at intervals not to exceed 6 months; and

b. Provide that, if a radiographer or a radiographer's assistant has not participated in an industrial radiographic operation for more than 6 months since the last inspection, the radiographer must demonstrate knowledge of the training requirements of 1.5.17(2)(c) and the radiographer's assistant must demonstrate knowledge of the training requirements of 1.5.17(3)(c) by a practical examination before these individuals can next participate in a radiographic operation.

c. The Agency may consider alternatives in those situations where the individual serves as both radiographer and radiation safety officer.

d. In those operations where a single individual serves as both radiographer and radiation safety officer, and performs all radiography operations, an inspection program is not required.

6. The licensee or registrant shall maintain records of the above training to include certification documents, written, oral and practical examinations, refresher safety training and inspections of job performance in accordance with 1.5.32.

7. The licensee or registrant shall include the following subjects required in 1.5.17(1):

   a. Fundamentals of radiation safety including:

      i. Characteristics of gamma and x-radiation;

      ii. Units of radiation dose and quantity of radioactivity;

      iii. Hazards of exposure to radiation;

      iv. Levels of radiation from sources of radiation; and

      v. Methods of controlling radiation dose (time, distance, and shielding);

   b. Radiation detection instruments including:

      i. Use, operation, calibration, and limitations of radiation survey instruments;

      ii. Survey techniques; and

      iii. Use of personnel monitoring equipment;

   c. Equipment to be used including:

      i. Operation and control of radiographic exposure equipment, remote handling equipment, and storage containers, including pictures or models of source assemblies (pigtails);

      ii. Operation and control of radiation machines;

      iii. Storage, control, and disposal of sources of radiation;

      and

      iv. Inspection and maintenance of equipment.

   d. The requirements of pertinent state and federal regulations; and

   e. Case histories of accidents in radiography.

8. Licensees and registrants will have one year from the effective date of these regulations to comply with the additional training requirements specified in 1.5.17(2)(a) and 1.5.17(3)(a).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.18 **Operating and Emergency Procedures.**

1. Operating and emergency procedures must include, as a minimum, instructions in at least the following:

   a. Appropriate handling and use of sources of radiation so that no person is likely to be exposed to radiation doses in excess of the limits established in Subchapter 4 of these regulations;

   b. methods and occasions for conducting radiation surveys;

   c. methods for posting and controlling access to radiographic areas;

   d. methods and occasions for locking and securing sources of radiation;

   e. personnel monitoring and the use of personnel monitoring equipment;

   f. transporting equipment to field locations, including packing of radiographic exposure devices and storage containers in the vehicles, placarding of vehicles when required, and control of equipment during transportation as described in Subchapter 13 of these regulations;

   g. the inspection, maintenance, and operability checks of radiographic exposure devices, radiation machines, survey instruments, alarming ratemeters, transport containers, and storage containers;

   h. Steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale or an alarming ratemeter alarms unexpectedly;

   i. The procedure(s) for identifying and reporting defects and noncompliance, as required by 1.5.38;

   j. The procedure for notifying proper persons in the event of an accident or incident;

   k. Minimizing exposure of persons in the event of an accident or incident, including a source disconnect, a transport accident, or loss of a source of radiation;

   l. Source recovery procedure if licensee will perform source recoveries; and

m. Maintenance of records.

2. The licensee or registrant shall maintain copies of current operating and emergency procedures in accordance with 1.5.33 and 1.5.37.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.19 **Supervision of Radiographer's Assistants**. The radiographer's assistant shall be under the personal supervision of a radiographer when using radiation machines, radiographic exposure devices, associated equipment, or a sealed source, or while conducting radiation surveys required by 1.5.21(2) to determine that the sealed source has returned to the shielded position or the radiation machine is off after an exposure. The personal supervision must include:

1. The radiographer's physical presence at the site where the sources of radiation are being used;

2. The availability of the radiographer to give immediate assistance if required; and

3. The radiographer's direct observation of the assistant's performance of the operations referred to in this section.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.20 **Personnel Monitoring**.

1. The licensee or registrant shall not permit any individual to act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations, each individual wears, on the trunk of the body, a direct reading pocket dosimeter, an alarming ratemeter, and a personnel dosimeter that is processed and evaluated by an accredited National Voluntary Laboratory Accreditation Program (NVLAP) processor. At permanent radiographic installations where other appropriate alarming or warning devices are in routine use, the use of an alarming ratemeter is not required.

   a. Pocket dosimeters must have a range from zero to 2 millisieverts (200 mrem) and must be recharged at the start of each shift. Electronic personal dosimeters may only be used in place of ion-chamber pocket dosimeters.

   b. Each personnel dosimeter must be assigned to and worn by only one individual.

   c. Personnel dosimeters must be exchanged at periods not to exceed one month.

d. After replacement, each personnel dosimeter must be returned to the supplier for processing within 14 calendar days of the end of the monitoring period, or as soon as practicable. In circumstances that make it impossible to return each personnel dosimeter in 14 calendar days, such circumstances must be documented and available for review by the Agency.

2. Direct reading dosimeters such as pocket dosimeters or electronic personal dosimeters, must be read and the exposures recorded at the beginning and end of each shift, and records must be maintained in accordance with 1.5.34.

3. Pocket dosimeters or electronic personal dosimeters must be checked at periods not to exceed 12 months for correct response to radiation, and records must be maintained in accordance with 1.5.34. Acceptable dosimeters shall read within plus or minus 20 percent of the true radiation exposure.

4. If an individual's pocket dosimeter is found to be offscale beyond its range, or the electronic personal dosimeter reads greater than 2 millisieverts (200 mrem), the individual's personnel dosimeter must be sent for processing within 24 hours. In addition, the individual may not resume work associated with the use of sources of radiation until a determination of the individual's radiation exposure has been made. This determination must be made by the radiation safety officer or the radiation safety officer's designee. The results of this determination must be included in the records maintained in accordance with 1.5.34.

5. If a personnel dosimeter is lost or damaged, the worker shall cease work immediately until a replacement personnel dosimeter is provided and the exposure is calculated for the time period from issuance to loss or damage of the personnel dosimeter. The results of the calculated exposure and the time period for which the personnel dosimeter was lost or damaged must be included in the records maintained in accordance with 1.5.34.

6. Dosimetry Reports received from the accredited (NVLAP) personnel dosimeter processor must be retained in accordance with 1.5.34.

7. Each alarming ratemeter must:

   a. be checked to ensure that the alarm functions properly (sounds) before using at the start of each shift;

   b. be set to give an alarm signal at a preset dose rate of 5 millisieverts (500 mrem) per hour; with an accuracy of plus or minus 20 percent of the true radiation dose rate;

   c. require special means to change the preset alarm function; and

d. be calibrated at periods not to exceed 12 months for correct response to radiation. The licensee or registrant shall maintain records of alarming ratemeter calibrations in accordance with 1.5.34.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.21 **Radiation Surveys**. The licensee or registrant shall:

1. Conduct all surveys with a calibrated and operable radiation survey instrument that meets the requirements of 1.5.9;

2. Conduct a survey of the entire circumference of the radiographic exposure device and the entire length of the guide tube after each exposure when approaching the device or the guide tube. The survey must determine that the sealed source has returned to its shielded position before exchanging films, repositioning the exposure head, or dismantling equipment. Radiation machines shall be surveyed after each exposure to determine that the machine is off;

3. Conduct a survey of the radiographic exposure device whenever the source is exchanged and whenever a radiographic exposure device is placed in a storage area as defined in 1.5.3, to ensure that the sealed source is in its shielded position; and

4. An area survey of the perimeter of the restricted area with a calibrated and operable radiation survey instrument shall be made with the source exposed before or during each radiographic exposure. Except for the initial radiographic exposure on each shift, the survey may be omitted when the source-target configuration for an exposure is substantially the same as that of the preceding exposure or if the exposure is made in a permanent radiographic facility.

5. Maintain records in accordance with 1.5.35.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.22 **Surveillance.** During each radiographic operation, the radiographer or radiographer's assistant shall ensure continuous direct visual surveillance of the operation to protect against unauthorized entry into a radiation area or a high radiation area, as defined in Subchapter 1 of these regulations, except at permanent radiographic installations where all entryways are locked and the requirements of 1.5.13 are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.23 **Posting**. All areas in which industrial radiography is being performed shall be conspicuously posted as required by 1.4.30(1) and (2) of these regulations. The exceptions listed in 1.4.31 of these regulations do not apply to industrial

radiographic operations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.24 **Records for Industrial Radiography**. Each licensee or registrant shall maintain a copy of its license or registration, documents incorporated by reference, and amendments to each of these items until superseded by new documents approved by the Agency, or until the Agency terminates the license or registration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.25 **Records of Receipt and Transfer of Sources of Radiation.**

1. Each licensee or registrant shall maintain records showing the receipts and transfers of sealed sources, devices using DU for shielding, and radiation machines, and retain each record for 3 years after it is made.

2. These records must include the date, the name of the individual making the record, radionuclide, number of becquerels (curies) or mass (for DU), and manufacturer, model, and serial number of each source of radiation and/or device, as appropriate.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.26 **Records of Radiation Survey Instruments.** Each licensee or registrant shall maintain records of the calibrations of its radiation survey instruments that are required under 1.5.9 and retain each record for 3 years after it is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.27 **Records of Leak Testing of Sealed Sources and Devices Containing DU.** Each licensee shall maintain records of leak test results for sealed sources and for devices containing DU. The results must be stated in units of becquerels (µCi). The licensee shall retain each record for 3 years after it is made or until the source in storage is removed.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.28 **Records of Quarterly Inventory.**

1. Each licensee or registrant shall maintain records of the quarterly inventory of sources of radiation, including devices containing depleted uranium as required by 1.5.11, and retain each record for 3 years.

2. The record must include the date of the inventory, name of the individual conducting the inventory, radionuclide, number of becquerels (curies) or mass

(for DU) in each device, location of sources of radiation and/or devices, and manufacturer, model, and serial number of each source of radiation and/or device, as appropriate.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.29 **Utilization Logs.**

1. Each licensee or registrant shall maintain utilization logs showing for each source of radiation the following information:

   a. a description, including the make, model, and serial number of the radiation machine, or the radiographic exposure device, transport, or storage container in which a sealed source is located;

   b. the identity and signature of the radiographer to whom assigned;

   c. the locations and dates of use including the dates removed and returned to storage; and

   d. For permanent radiographic installations, the dates each radiation machine is energized.

2. The licensee or registrant shall retain the logs required by 1.5.29.1 for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.30 **Records of Inspection and Maintenance of Radiation Machines, Radiographic Exposure Devices, Transport and Storage Containers, Associated Equipment, Source Changers, and Survey Instruments.**

1. Each licensee or registrant shall maintain records specified in 1.5.12 of equipment problems found in daily checks and quarterly inspections of radiation machines, radiographic exposure devices, transport and storage containers, associated equipment, source changers and survey instruments; and retain each record for 3 years after it is made.

2. The record must include the date of check or inspection, name of inspector, equipment involved, any problems found, and what repair and/or maintenance, if any, was performed.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.31 **Records of Alarm System and Entrance Control Checks at Permanent Radiographic Installations**. Each licensee or registrant shall maintain records of alarm system and entrance control device tests required by 1.5.13 and retain each record for 3 years after it is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.32 **Records of Training and Certification**. Each licensee or registrant shall maintain the following records for 3 years:

1. Records of training of each radiographer and each radiographer's assistant the record must include radiographer certification documents and verification of certification status, copies of written tests, dates of oral and practical examinations, the names of individuals conducting and receiving the oral and practical examinations, and a list of items tested and the results of the oral and practical examinations; and

2. Records of annual refresher safety training and semi-annual inspections of job performance for each radiographer and each radiographer's assistant. The records must list the topics discussed during the refresher safety training, the dates the annual refresher safety training was conducted, and names of the instructors and attendees. For inspections of job performance, the records must also include a list showing the items checked and any non-compliance observed by the radiation safety officer or designee.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.33 **Copies of Operating and Emergency Procedures.** Each licensee or registrant shall maintain a copy of current operating and emergency procedures until the Agency terminates the license or registration. Superseded material must be retained for 3 years after the change is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.34 **Records of Personnel Monitoring**. Each licensee or registrant shall maintain the following exposure records specified in 1.5.20:

1. Direct reading dosimeter readings and yearly operability checks required by 1.5.20(1) and 1.5.20(3) for 3 years after the record is made.

2. Records of alarming ratemeter calibrations for 3 years after each record is made.

3. Reports received from the accredited (NVLAP) personnel dosimeter processor until the Agency terminates the license or registration; and

4. Records of estimates of exposures as a result of off-scale personal direct reading dosimeters, or lost or damaged personnel dosimeters, until the Agency terminates the license or registration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.35 **Records of Radiation Surveys**. Each licensee shall maintain a record of each

exposure device survey conducted before the device is placed in storage as specified in 1.5.21(3). Each record must be maintained for 3 years after it is made.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.36 **Form of Records**. Each record required by the section must be legible throughout the specified retention period. The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of reproducing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, must include all pertinent information, such as stamps, initials, and signatures. The licensee or registrant shall maintain adequate safeguards against tampering with and loss of records.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.37 **Location of Documents and Records.**

1. Each licensee or registrant shall maintain copies of records required by this section and other applicable sections of these regulations at the location specified in 1.5.5(11).

2. Each licensee or registrant shall also maintain current copies of the following documents and records sufficient to demonstrate compliance at each applicable field station and each temporary jobsite;

   a. The license or registration authorizing the use of sources of radiation;

   b. A copy of Subchapters 1, 4, 5 & 10 of these regulations;

   c. Utilization logs for each source of radiation dispatched from that location as required by 1.5.29;

   d. Records of equipment problems identified in daily checks of equipment as required by 1.5.30(1);

   e. Records of alarm system and entrance control checks required by 1.5.31, if applicable;

   f. Records of dosimeter readings as required by 1.5.34;

   g. Operating and emergency procedures as required by 1.5.33;

   h. Evidence of the latest calibration of the radiation survey instruments in use at the site, as required by 1.5.26;

i. Evidence of the latest calibrations of alarming ratemeters and operability checks of dosimeters as required by 1.5.34;

j. Survey records as required by 1.5.35 and 1.4.43 of these regulations as applicable, for the period of operation at the site;

k. The shipping papers for the transportation of radioactive materials required by Subchapter 3 of these regulations; and

l. When operating under reciprocity pursuant to Subchapter 3 of these regulations, a copy of the applicable State license or registration, or U.S. Nuclear Regulatory Commission license authorizing the use of sources of radiation.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.38 **Notifications.**

1. In addition to the reporting requirements specified in 1.1.7 and under other sections of these regulations, each licensee or registrant shall provide a written report to the Agency within 30 days of the occurrence of any of the following incidents involving radiographic equipment:

   a. Unintentional disconnection of the source assembly from the control cable.

   b. Inability to retract the source assembly to its fully shielded position and secure it in this position.

   c. Failure of any component (critical to safe operation of the device) to properly perform its intended function.

   d. An indicator on a radiation-producing machine fails to show that radiation is being produced, an exposure switch fails to terminate production of radiation when turned to the off position, or a safety interlock fails to terminate x-ray production.

2. The licensee or registrant shall include the following information in each report submitted in accordance with 1.5.38(1) and in each report of overexposure submitted under 1.4.54 of these regulations which involves failure of safety components of radiography equipment:

   a. A description of the equipment problem.

   b. Cause of each incident, if known.

c. Manufacturer and model number of equipment involved in the incident.

d. Place, time and date of the incident.

e. Actions taken to establish normal operations.

f. Corrective actions taken or planned to prevent recurrence.

g. Names and qualifications of personnel involved in the incident.

3. Any licensee or registrant conducting radiographic operations or storing sources of radiation at any location not listed on the license or registration for a period in excess of 180 days in a calendar year, shall notify the Agency prior to exceeding the 180 days.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.5.39 **Specific Requirements for Radiographic Personnel Performing Industrial Radiography.**

1. At a job site, the following shall be supplied by the licensee or registrant:

a. At least one operable, calibrated survey instrument for each exposure device or radiation machine in use;

b. A current personnel dosimeter that is processed and evaluated by an accredited (NVLAP) processor for each person performing radiographic operations;

c. An operable, calibrated pocket dosimeter with a range of zero to 200 milliroentgens for each person performing radiographic operations ;

d. An operable, calibrated, alarming ratemeter for each person performing radiographic operations; and

e. The appropriate barrier ropes and signs.

2. Each radiographer at a job site shall have on their person a valid certification ID card issued by a certifying entity.

3. Industrial radiographic operations shall not be performed if any of the items in 1.5.39(1) and 1.5.39(2) are not available at the job site or are inoperable.

4. During an inspection, the Agency may terminate an operation if any of the items in 1.5.39(1) and 1.5.39(2) are not available or operable, or if the required number of radiographic personnel are not present. Operations shall not be resumed until all required conditions are met.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX A

Radiographer Certification

I. Requirements for an Independent Certifying Organization.

An independent certifying organization shall:

A. Be an organization such as a society or association, whose members participate in, or have an interest in, the field of industrial radiography;

B. Make its membership available to the general public nationwide. Membership shall not be restricted because of race, color, religion, sex, age, national origin or disability;

C. Have a certification program open to nonmembers, as well as members;

D. Be an incorporated, nationally recognized organization, that is involved in setting national standards of practice within its fields of expertise;

E. Have an adequate staff, a viable system for financing its operations, and a policy and decision-making review board;

F. Have a set of written organizational by-laws and policies that provide adequate assurance of lack of conflict of interest and a system for monitoring and enforcing those by-laws and policies;

G. Have a committee, whose members can carry out their responsibilities impartially, to review and approve the certification guidelines and procedures, and to advise the organization's staff in implementing the certification program;

H. Have a committee, whose members can carry out their responsibilities impartially, to review complaints against certified individuals and to determine appropriate sanctions;

I. Have written procedures describing all aspects of its certification program, maintain records of the current status of each individual's certification and the administration of its certification program;

J. Have procedures to ensure that certified individuals are provided due process with respect to the administration of its certification program, including the process of becoming certified and any sanctions imposed against certified individuals;

K. Have procedures for proctoring examinations, including qualifications for proctors.These procedures must ensure that the individuals proctoring each examination are not employed by the same company or corporation (or a wholly-owned subsidiary of such company or corporation) as any of the examinees;

L. Exchange information about certified individuals with the U.S. Nuclear Regulatory

Commission and other independent certifying organizations and/or Agreement States and allow periodic review of its certification program and related records; and

M. Provide a description to the U.S. Nuclear Regulatory Commission of its procedures for choosing examination sites and for providing an appropriate examination environment.

II. **Requirements for Certification Programs.**

All certification programs must:

A. Requires applicants for certifications to receive training in the topics set forth in 1.5.17(7) or equivalent Agreement State or U.S. Nuclear Regulatory Commission regulations, and satisfactorily complete a written examination covering these topics;

B. Require applicants for certification to provide documentation that demonstrates that the applicant has:

A. Received training in the topics set forth in 1.5.17(7) or equivalent Agreement State or U.S. Nuclear Regulatory Commission regulations;

B. Satisfactorily completed a minimum period of on-the-job training as specified in 1.5.17(1); and

C. Received verification by a State licensee or registrant or a U.S. Nuclear Regulatory Commission licensee that the applicant has demonstrated the capability of independently working as a radiographer.

C. Include procedures to ensure that all examination questions are protected from disclosure;

D. Include procedures for denying an application and revoking, suspending, and reinstating a certification;

E. Provide a certification period of not less than 3 years nor more than 5 years;

F. Include procedures for renewing certifications and, if the procedures allow renewals without examination, require evidence of recent full-time employment and annual refresher training; and

G. Provide a timely response to inquiries, by telephone or letter, from members of the public, about an individual's certification status.

III. **Requirements for Written Examinations**

All examinations must be:

A. Designed to test an individual's knowledge and understanding of the topics listed in

1.5.17(7) or equivalent Agreement State or U.S. Nuclear Regulatory Commission requirements;

B. Written in a multiple-choice format; and

C. Have test items drawn from a question bank containing psychometrically valid questions based on the material in 1.5.17(7).

e.g., guide tube, control tube, control (drive) cable, removable source stop,

“J” tube and collimator when used as an exposure head.

An exposure head is also known as a source stop.

If a keyed lock, the key must be removed at all times.

SubChapter 6 X-Rays In The Healing Arts

Rule 1.6.1 **Scope.** This section establishes requirements, for which a registrant is responsible, for use of x-ray equipment by or under the supervision of an individual authorized by and licensed in accordance with Mississippi statutes to engage in the healing arts or veterinary medicine. The provisions of this section are in addition to, and not in substitution for, other applicable provisions of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.2 **Definitions.** As used in this section, the following definitions apply:

1. "Accessible surface" means the external surface of the enclosure or housing provided by the manufacturer.

2. "Added filtration" means any filtration which is in addition to the inherent filtration.

3. "Aluminum equivalent" means the thickness of type 1100 aluminum alloy[29] affording the same attenuation, under specified conditions, as the material in question.

4. "Assembler" means any person engaged in the business of assembling, replacing, or installing one or more components into an x-ray system or subsystem. The term includes the owner of an x-ray system or his or her employee or agent who assembles components into an x-ray system that is subsequently used to provide professional or commercial services.

5. "Attenuation block" means a block or stack, having dimensions 20 centimeters by 20 centimeters by 3.8 centimeters, of type 1100 aluminum alloy or other materials having equivalent attenuation.

6. "Automatic exposure control" means a device which automatically controls one or more technique factors in order to obtain at a preselected location(s) a required quantity of radiation (See also "Phototimer").

7. "Barrier" (See "Protective barrier").

8. "Beam axis" means a line from the source through the centers of the x-ray fie1ds.

9. "Beam-limiting device" means a device which provides a means to restrict the dimensions of the x-ray field.

10. "C-Arm x-ray system" means an x-ray system in which the image receptor and x-ray tube housing assembly are connected by a common mechanical support system in order to maintain a desired spatial relationship. This system is

[29] The nominal chemical composition of type 1100 aluminum alloy is 99.00 percent minimum aluminum, 0.12 percent copper.

designed to allow a change in the projection of the beam through the patient without a change in the position of the patient.

11. "Cephalometric device" means a device intended for the radiographic visualization and measurement of the dimensions of the human head.

12. "Certified components" means components of x-ray systems which are subject to regulations promulgated under Public Law 90-602, the Radiation Control for Health and Safety Act of 1968.

13. "Certified system" means any x-ray system comprised totally of certified components.

14. "Changeable filters" means any filter, exclusive of inherent filtration, which can be removed from the useful beam through any electronic, mechanical, or physical process.

15. "Coefficient of variation" or "C" means the ratio of the standard deviation to the mean value of a sample population of observations. It is estimated using the following equation:

$$C = \frac{s}{\overline{X}} = \frac{1}{\overline{X}} \left[\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{(n-1)} \right]^{1/2}$$

where

s	=	Estimated standard deviation of the population.
$\overline{X}$	=	Mean Value of observations in sample.
X_i	=	i^{th} observation in sample.
n	=	Number of observations in sample.

16. "Computed tomography" means the production of a tomogram by the acquisition and computer processing of x-ray transmission data.

17. "Control panel" means that part of the x-ray control upon which are mounted the switches, knobs, pushbuttons, and other hardware necessary for setting the technique factors.

18. "Cooling curve" means the graphical relationship between heat units stored and cooling time.

19. "CT" (See "Computed tomography").

20. "Dead-man switch" means a switch so constructed that a circuit closing contact can be maintained only by continuous pressure on the switch by the operator.

21. "Detector" (See "Radiation detector").

22. "Diagnostic source assembly" means the tube housing assembly with a beam-limiting device attached.

23. "Diagnostic x-ray imaging system" means an assemblage of components for the generation, emission and reception of x-rays and the transformation, storage and visual display of the resultant x-ray image.

24. "Diagnostic x-ray system" means an x-ray system designed for irradiation of any part of the human or animal body for the purpose of diagnosis or visualization.

25. "Direct scattered radiation" means that scattered radiation which has been deviated in direction only by materials irradiated by the useful beam (See "Scattered radiation").

26. "Entrance exposure rate" means the exposure free in air per unit time at the point where the center of the useful beam enters the patient.

27. "Equipment" (See "X-ray equipment").

28. "Field emission equipment" means equipment which uses an x-ray tube in which electron emission from the cathode is due solely to the action of an electric field."

29. "Filter" means material placed in the useful beam to absorb preferentially selected radiations.

30. "Fluoroscopic imaging assembly" means a subsystem in which x-ray photons produce a fluoroscopic image. It includes the image receptor(s) such as the image intensifier and spot-film device, electrical interlocks, if any, and structural material providing linkage between the image receptor and diagnostic source assembly.

31. "Focal spot" means the area projected on the anode of the x-ray tube by the electrons accelerated from the cathode and from which the useful beam originates.

32. "General purpose radiographic x-ray system" means any radiographic x-ray system which, by design, is not limited to radiographic examination of specific anatomical regions.

33. "Gonad shield" means a protective barrier for the testes or ovaries.

34. "Half-value layer" means the thickness of specified material which attenuates the beam of radiation to an extent such that the exposure rate is reduced to one-half of its original value. In this definition, the contribution of all scattered radiation, other than any which might be present initially in the beam concerned, is deemed to be excluded.

35. "Healing arts screening" means the testing of human beings using x-ray machines for the detection or evaluation of health indications when such tests are not specifically and individually ordered by a licensed practitioner of the healing arts legally authorized to prescribe such x-ray tests for the purpose of diagnosis or treatment.

36. "HVL" (See "Half-value layer").

37. "Image intensifier" means a device, installed in its housing, which instantaneously converts an x-ray pattern into a corresponding light image of higher energy density.

38. "Image receptor" means any device, such as a fluorescent screen or radiographic film, which transforms incident x-ray photons either into a visible image or into another form which can be made into a visible image by further transformations.

39. "Image receptor support" means, for mammographic systems, that part of the system designed to support the image receptor during mammography.

40. "Inherent filtration" means the filtration of the useful beam provided by the permanently installed components of the tube housing assembly.

41. "Irradiation" means the exposure of a living being or matter to ionizing radiation.

42. "Kilovolt (kV) [kilo electron volt (keV)]" means the energy equal to that acquired by a particle with one electron charge in passing through a potential difference of one thousand volts in a vacuum. [Note: current convention is to use kV for photons and keV for electrons].

43. "Kilovolts peak" (See "Peak tube potential").

44. "kVp" (See "Peak tube potential").

45. "kWs" means kilowatt second.

46. "Lead equivalent" means the thickness of the material in question affording the same attenuation, under specified conditions as lead.

47. "Leakage radiation" means radiation emanating from the diagnostic source assembly except for:

    a. the useful beam; and

    b. radiation produced when the exposure switch or timer is not activated.

48. "Leakage technique factors" means the technique factors associated with the diagnostic source assembly which are used in measuring leakage radiation. They are defined as follows:

    a. For diagnostic source assemblies intended for capacitor energy storage equipment, the maximum-rated peak tube potential and the maximum-rated number of exposures in an hour for operation at the maximum-rated peak tube potential with the quantity of charge per exposure being 10 millicoulombs, i.e., 10 milliampere seconds, or the minimum obtainable from the unit, whichever is larger.

    b. For diagnostic source assemblies intended for field emission equipment rated for pulsed operation, the maximum-rated peak tube potential and the

maximum-rated number of x-ray pulses in an hour for operation at the maximum-rated peak tube potential.

c. For all other diagnostic source assemblies, the maximum-rated peak tube potential and the maximum-rated continuous tube current for the maximum-rated peak tube potential.

49. "Light field" means the area illuminated by light, being the locus of points at which the illumination exceeds a specific or specified level, simulating the radiation field.

50. "Line-voltage regulation" means the difference between the no-load and the load line potentials expressed as a percent of the load line potential. It is calculated using the following equation:

Percent line-voltage regulation = 100 $(V_n - V_1)/V_1$

where

V_n = No-load line potential and
V_1 = Load line potential.

51. "mA" means milliampere.

52. "mAs" means milliampere second.

53. "Maximum line current" means the root-mean-square current in the supply line of an x-ray machine operating at its maximum rating.

54. "Mobile x-ray equipment" (See "X-ray equipment").

55. "Patient" means an individual or animal subjected to healing arts examination, diagnosis, or treatment.

56. "PBL" See "Positive beam limitation."

57. "Peak tube potential" means the maximum value of the potential difference across the x-ray tube during an exposure.

58. "Phantom" means a volume of material behaving in a manner similar to tissue with respect to the attenuation and scattering of radiation.

59. "Phototimer" means a method for controlling radiation exposures to image receptors by measuring the amount of radiation which reaches a radiation monitoring device(s). The radiation monitoring device(s) is part of an electronic circuit which controls the duration of time the tube is activated (See "Automatic exposure control").

60. "PID" (See "Position indicating device").

61. "Portable x-ray equipment" (See "X-ray equipment").

62. "Position indicating device" means a device on dental x-ray equipment used to indicate the beam position and to establish a definite source surface (skin) distance. It may or may not incorporate or serve as a beam-limiting device.

63. "Positive beam limitation" means the automatic or semiautomatic adjustment of an x-ray beam to the selected image receptor size, whereby exposures cannot be made without such adjustment.

64. "Primary protective barrier" (See "Protective barrier").

65. "Protective apron" means an apron made of radiation absorbing materials used to reduce radiation exposure.

66. "Protective barrier" means a barrier of radiation absorbing material(s) used to reduce radiation exposure. The types of protective barriers are as follows:

    a. "Primary protective barrier" means the material, excluding filters, placed in the useful beam, to protect anyone other than the patient from radiation exposure.

    b. "Secondary protective barrier" means a barrier sufficient to attenuate the stray radiation to the required degree.

    c. "Protective glove" means a glove made of radiation absorbing materials used to reduce radiation exposure.

67. "Qualified expert" means an individual who has demonstrated to the satisfaction of the Agency that such individual possesses the knowledge, training, and experience to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs.

68. "Radiation detector" means a device which in the presence of radiation provides a signal or other indication suitable for use in measuring one or more quantities of incident radiation.

69. "Radiation therapy simulation system" means a radiographic or fluoroscopic x-ray system intended for localizing the volume to be exposed during radiation therapy and confirming the position and size of the therapeutic irradiation field.

70. "Radiograph" means an image receptor on which the image is created directly or indirectly by an x-ray pattern and results in a permanent record.

71. "Radiographic imaging system" means any system whereby a permanent or temporary image is recorded on an image receptor by the action of ionizing radiation.

72. "Rating" means the operating limits as specified by the component manufacturer.

73. "Recording" means producing a permanent form of an image resulting from x-ray photons.

74. "Scattered radiation" means radiation that, during passage through matter, has been deviated in direction (See "Direct scattered radiation").

75. "Secondary protective barrier" (See "Protective barrier").

76. "Shutter" means a device attached to the tube housing assembly which can totally intercept the entire cross section area of the useful beam and which has a lead equivalency not less than that of the tube housing assembly.

77. "SID" (See "Source-image receptor distance").

78. "Source" means the focal spot of the x-ray tube.

79. "Source-image receptor distance" means the distance from the source to the center of the input surface of the image receptor.

80. "Spot film" means a radiograph which is made during a fluoroscopic examination to permanently record conditions which exist during that fluoroscopic procedure.

81. "Spot-film device" means a device intended to transport and/or position a radiographic image receptor between the x-ray source and fluoroscopic image receptor. It includes a device intended to hold a cassette over the input end of an image intensifier for the purpose of making a radiograph.

82. "SSD" means the distance between the source and the skin entrance plane of the patient.

83. "Stationary x-ray equipment" (See "X-ray equipment").

84. "Stray radiation" means the sum of leakage and scattered radiation.

85. "Technique factors" means the following conditions of operation:

    a. for capacitor energy storage equipment, peak tube potential in kV and quantity of charge in mAs;

    b. for field emission equipment rated for pulsed operation, peak tube potential in kV and number of x-ray pulses;

    c. for CT x-ray systems designed for pulsed operation, peak tube potential in kV, scan time in seconds, and either tube current in mA, x-ray pulse width in seconds, and the number of x-ray pulses per scan, or the product of tube current, x-ray pulse width, and the number of x-ray pulses in mAs;

    d. for CT x-ray systems not designed for pulsed operation, peak tube potential in kV, and either tube current in mA and scan time in seconds, or the product of tube current and exposure time in mAs and the scan time when the scan time and exposure time are equivalent; and

e. for all other equipment, peak tube potential in kV, and either tube current in mA and exposure time in seconds, or the product of tube current and exposure time in mAs.

86. "Termination of irradiation" means the stopping of irradiation in a fashion which will not permit continuance of irradiation without the resetting of operating conditions at the control panel.

87. "Tomogram" means the depiction of the x-ray attenuation properties of a section through a body.

88. "Tube" means an x-ray tube, unless otherwise specified.

89. "Tube housing assembly" means the tube housing with tube installed. It includes high-voltage and/or filament transformers and other appropriate elements when such are contained within the tube housing.

90. "Tube rating chart" means the set of curves which specify the rated limits of operation of the tube in terms of the technique factors.

91. "Useful beam" means the radiation emanating from the tube housing port or the radiation head and passing through the aperture of the beam-limiting device when the exposure controls are in a mode to cause the system to produce radiation.

92. "Variable-aperture beam-limiting device" means a beam-limiting device which has capacity for stepless adjustment of the x-ray field size at a given SID.

93. "Visible area" means that portion of the input surface of the image receptor over which incident x-ray photons are producing a visible image.

94. "X-ray exposure control" means a device, switch, button, or other similar means by which an operator initiates and/or terminates the radiation exposure.

95. "X-ray equipment" means an x-ray system, subsystem, or component thereof. Types of x-ray equipment are as follows:

a. "Mobile x-ray equipment" means x-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled.

b. "Portable x-ray equipment" means x-ray equipment designed to be hand carried.

c. "Stationary x-ray equipment" means x-ray equipment which is installed in a fixed location.

96. "X-ray field" means that area of the intersection of the useful beam and any one of the set of planes parallel to and including the plane of the image receptor, whose perimeter is the locus of points at which the exposure rate is one-fourth of the maximum in the intersection.

97. "X-ray high-voltage generator" means a device which transforms electrical energy from the potential supplied by the x-ray control to the tube operating potential. The device may also include means for transforming alternating current to direct current, filament transformers for the x-ray tube(s), high-voltage switches, electrical protective devices, and other appropriate elements.

98. "X-ray system" means an assemblage of components for the controlled production of x-rays. It includes minimally an x-ray high-voltage generator, an x-ray control, a tube housing assembly, a beam-limiting device, and the necessary supporting structures. Additional components which function with the system are considered integral parts of the system.

99. "X-ray subsystem" means any combination of two or more components of an x-ray system.

100. "X-ray tube" means any electron tube which is designed to be used primarily for the production of x-rays.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.3 **General and Administrative Requirements.**

1. **Radiation Safety Requirements.** The registrant shall be responsible for directing the operation of the x-ray system(s) under his administrative control. The registrant or the registrant's agent shall assure that the requirements of these regulations are met in the operation of the x-ray system(s).

   a. An x-ray system which does not meet the provisions of these regulations shall not be operated for diagnostic purposes (if so directed by the Agency).

   b. Individuals who will be operating the x-ray systems shall be adequately instructed in the safe operating procedures and be competent in the safe use of the equipment. See Appendix A for a list of subject matters pertinent to this requirement. The Agency may use interview, observation and/or testing to determine compliance.

   c. A chart shall be provided in the vicinity of the diagnostic x-ray system's control panel which specifies, for all examinations performed with that system, the following information:

      i. patient's body part and anatomical size, or body part thickness, or age (for pediatrics), versus technique factors to be utilized;

      ii. type and size of the film or screen-film combination to be used;

      iii. type and focal distance of the grid to be used, if any;

      iv. source to image receptor distance to be used (except for dental intraoral radiography); and

v. type and location of placement of patient shielding (i.e., gonad, etc.) to be used.

d. The registrant of a facility shall establish and make available to x-ray operators written safety procedures, including patient holding and any restrictions of the operating technique required for the safe operation of the particular x-ray system. The operator shall be able to demonstrate familiarity with these procedures.

e. Except for human patients who cannot be moved out of the room, only the staff and ancillary personnel, or other persons, required for the medical procedure or training shall be in the room during the radiographic exposure. Other than the patient being examined:

i. All individuals shall be positioned such that no part of the body will be struck by the useful beam unless protected by not less than 0.5 millimeter lead equivalent material.

ii. The x-ray operator, other staff, ancillary personnel, and other persons required for the medical procedure shall be protected from the direct scatter radiation by protective aprons or whole body protective barriers of not less than 0.25 millimeter lead equivalent material.

iii. Human patients who cannot be removed from the room shall be protected from the direct scatter radiation by whole body protective barriers of not less than 0.25 millimeter lead equivalent material, or shall be so positioned that the nearest portion of the body is at least 2 meters from both the tube head and the nearest edge of the image receptor.

f. Gonad shielding of not less than 0.5 millimeter lead equivalent material shall be used for human patients, who have not passed the reproductive age, during radiographic procedures in which the gonads are in the useful beam, except for cases in which this would interfere with the diagnostic procedure.

g. Individuals shall not be exposed to the useful beam except for healing arts purposes and unless such exposure has been authorized by a licensed practitioner of the healing arts. This provision specifically prohibits deliberate exposure for the following purposes:

i. exposure of an individual for training, demonstration, or other non-healing-arts purposes; and

ii. exposure of an individual for the purpose of healing arts screening except as authorized by 1.6.3(1)(k).

h. When a patient or film must be provided with auxiliary support during a radiation exposure:

i. mechanical holding devices shall be used when the technique permits. The written safety procedures, required by 1.6.3(1)(d), shall list individual projections where holding devices cannot be utilized;

ii. written safety procedures, as required by 1.6.3(1)(d), shall indicate the requirements for selecting a holder and the procedure the holder shall follow;

iii. the human holder shall be instructed in personal radiation safety and protected as required by 1.6.3(1)(e);

iv. no individual shall be used routinely to hold film or patients;

v. in those cases where the patient must hold the film, except during intraoral examinations, any portion of the body other than the area of clinical interest struck by the useful beam shall be protected by not less than 0.5 millimeter lead equivalent material;

vi. when an animal must be held by an individual during an exposure, that individual shall be protected with appropriate shielding devices, such as leaded aprons and gloves, and shall be positioned such that no part of his or her body shall be struck by the useful beam; and

vii. each facility must have leaded aprons and gloves available in sufficient numbers to provide protection to all personnel who are involved with x-ray operations and who are otherwise not shielded.

i. Procedures and auxiliary equipment designed to minimize patient and personnel exposure commensurate with the needed diagnostic information shall be utilized.

i. The speed of the screen and film combinations used shall be the fastest speed consistent with the diagnostic objective of the examinations. Film cassettes without intensifying screens shall not be used for any routine diagnostic radiological imaging, with the exception of standard film packets for intraoral use in dental radiography.

ii. The radiation exposure to the patient shall be the minimum exposure required to produce images of good diagnostic quality.

iii. Portable or mobile x-ray equipment shall be used only for examinations where it is impractical to transfer the patient(s) to a stationary x-ray installation.

iv. X-ray systems subject to 1.6.6 shall not be utilized in procedures where the source to patient distance is less than 30 centimeters except for veterinary systems.

v. If grids are used between the patient and the image receptor to decrease scatter to the film and improve contrast the grid shall:

vi. Be positioned properly, i.e., tube side facing the right direction, and grid centered to the central ray.

vii. If of the focused type, be of the proper focal distance for the SIDs being used.

j. All individuals who are associated with the operation of an x-ray system are subject to the requirements of 1.4.5 and 1.4.7 of these regulations. In addition:

i. When protective clothing or devices are worn on portions of the body and a personnel monitoring device(s) is required, at least one such monitoring device shall be utilized as follows:

i. When an apron is worn, the monitoring device shall be worn at the collar outside of the apron.

ii. The dose to the whole body based on the maximum dose attributed to the most critical organ shall be recorded in the reports required by 1.4.6 of these regulations. If more than one device is used and a record is made of the data, each dose shall be identified with the area where the device was worn on the body.

ii. Exposure of a personnel monitoring device to deceptively indicate a dose delivered to an individual is prohibited.

k. **Healing Arts Screening.** Any person proposing to conduct a healing arts screening program shall not initiate such a program without prior approval of the Agency. When requesting such approval, that person shall submit the information outlined in Appendix B of this Subchapter. If any information submitted to the Agency becomes invalid or outdated, the Agency shall be immediately notified.

l. **Information and Maintenance Record and Associated Information.** The registrant shall maintain the following information for each x-ray system for inspection by the Agency:

i. model and serial numbers of all major components, and user's manuals for those components;

ii. tube rating charts and cooling curves;

iii. records of surveys, calibrations, maintenance, and modifications performed on the x-ray system(s); and

iv. a copy of all correspondence with this Agency regarding that x-ray system.

m. **X-Ray Log.** Each facility shall maintain an x-ray log containing the patient's name, the type of examinations, and the dates the examinations were performed. When the patient or film must be provided with human auxiliary support, the name of the human holder shall be recorded.

n. A sign shall be posted in a conspicuous area so as to be easily seen by the patient to the effect that if there is a pregnancy or the possibility of a pregnancy, the physician should be notified. Prescription of x-ray examinations of pregnant or possibly pregnant patients shall assure that medical consideration has been given to possible fetal exposure and appropriate protective measures are taken.

2. **X-ray Film Processing Facilities and Practices.** Each installation using a radiographic x-ray system and using analog image receptors (radiographic film) shall have available suitable equipment for handling and processing radiographic film in accordance with the following provisions:

a. Manually developed film:

i. Processing tanks shall be constructed of mechanically rigid, corrosion resistant material; and

ii. The temperature of solutions in the tanks shall be maintained within the range of 60ºF to 80ºF (16ºC to 27ºC). Film shall be developed in accordance with the time-temperature relationships recommended by the film manufacturer, or, in the absence of such recommendations, with the time-temperature chart below:

Time-Temperature Chart

Thermometer Reading (Degrees)		Minimum Developing Time (Minutes)
ºC	ºF	
26.7	80	2
26.1	79	2
25.6	78	2 ½
25.0	77	2 ½
24.4	76	3
23.9	75	3
23.3	74	3 ½
22.8	73	3 ½
22.2	72	4
21.7	71	4
21.1	70	4 ½
20.6	69	4 ½
20.0	68	5
19.4	67	5 ½

18.9	66	5 ½
18.3	65	6
17.8	64	6 ½
17.2	63	7
16.7	62	8
16.1	61	8 ½
15.6	60	9 ½

iii. Devices shall be utilized which will:

i. Indicate the actual temperature of the developer; and

ii. Signal the passage of a preset time appropriate to the developing time required.

b. Automatic Processors and Other Closed Processing Systems:

i. Films shall be developed in accordance with the time-temperature relationships recommended by the film manufacturer; in the absence of such recommendations, the film shall be developed using the chart below:

Developer Temperature (Degrees)		Minimum Immersion Time:* (Seconds)
°C	°F	
35.5	96	19
35	95	20
34.5	94	21
34	93	22
33.5	92	23
33	91	24
32	90	25
31.5	89	26
31	88	27
30.5	87	28
30	86	29
29.5	85	30

*Immersion time only, no crossover time included.

ii. The specified developer temperature and immersion time shall be posted in the darkroom or on the automatic processor.

c. **Other Requirements**

i. Pass boxes, if provided, shall be so constructed as to exclude light from the darkroom when cassettes are placed in or removed from the boxes, and shall incorporate adequate shielding from stray radiation to prevent exposure of undeveloped film.

ii. The darkroom shall be light tight and use proper safelighting such that any film type in use exposed in a cassette to x-radiation sufficient to produce an optical density from 1 to 2 when processed shall not suffer an increase in density greater than 0.1 (0.02 for mammography) when exposed in the darkroom for 2 minutes with all safelights on. If used, daylight film handling boxes shall preclude fogging of the film.

iii. Darkrooms typically used by more than one individual shall be provided a positive method to prevent accidental entry while undeveloped films are being handled or processed.

iv. Film shall be stored in a cool, dry place and shall be protected from exposure to stray radiation. Film in open packages shall be stored in a light tight container.

i. Film cassettes and intensifying screens shall be inspected periodically and shall be cleaned and replaced as necessary to best assure radiographs of good diagnostic quality.

ii. Outdated x-ray film shall not be used for human diagnostic radiographs, unless the film has been stored in accordance with the manufacturer's recommendations and a sample of the film passes a sensitometric test for normal ranges of base plus fog and speed.

iii. Film developing solutions shall be prepared in accordance with the directions given by the manufacturer, and shall be maintained in strength by replenishment or renewal so that full development is accomplished within the time specified by the manufacturer.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.4 **General Requirements for all Diagnostic X-Ray Systems.** In addition to other requirements of this section, all diagnostic x-ray systems shall meet the following requirements:

1. **Warning Label.** The control panel containing the main power switch shall bear the warning statement, legible and accessible to view: "WARNING: This x-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed."

2. **Battery Charge Indicator.** On battery-powered x-ray generators, visual means shall be provided on the control panel to indicate whether the battery is in a state of charge adequate for proper operation.

3. **Leakage Radiation from the Diagnostic Source Assembly.** The leakage radiation from the diagnostic source assembly measured at a distance of 1 meter in any direction from the source shall not exceed 100 milliroentgens (25.8 µC/kg) in 1 hour when the x-ray tube is operated at its leakage technique factors. Compliance shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters. If leakage technique factors cannot be set on the control panel, then compliance shall be determined by measuring leakage at maximum kVp and an appropriate mAs.

4. **Radiation from Components Other Than the Diagnostic Source Assembly**. The radiation emitted by a component other than the diagnostic source assembly shall not exceed 2 milliroentgens (0.516 µC/kg) in 1 hour at 5 centimeters from any accessible surface of the component when it is operated in an assembled x-ray system under any conditions for which it was designed. Compliance shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

5. **Beam Quality.**

a. **Half-value Layer.**

i. The half-value layer of the useful beam for a given x-ray tube potential shall not be less than the values shown in Table I. If it is necessary to determine such half-value layer at an x-ray tube potential which is not listed in Table I, linear interpolation or extrapolation may be made.

TABLE I

X-ray tube voltage (kilovolt peak)		Minimum HVL (mm of Al)		
Designed Operating Range	Measured Operating Potential	Dental Systems	Medical X-ray Systems Manufactured before 06/10/2006	Medical X-ray Systems Manufactured after 06/10/2006
Below 50	30	1.5	0.3	0.3
	40	1.5	0.4	0.4
	50	1.5	0.5	0.5
50 to 70	51	1.5	1.3	1.3
	60	1.5	1.5	1.5
	70	1.5	2.1	1.8
Above 70	71	2.1	2.1	2.5
	80	2.3	2.3	2.9
	90	2.5	2.5	3.2
	100	2.7	2.7	3.6
	110	3.0	3.0	3.9
	120	3.2	3.2	4.3

130	3.5	3.5	4.7
140	3.8	3.8	5.0
150	4.1	4.1	5.4

ii. For capacitor energy storage equipment, compliance with the requirements of 1.6.4(5) shall be determined with the maximum quantity of charge per exposure. This will be deemed to have been met if a mAs of 5-10 has been used.

iii. The required minimal half-value-layer of the useful beam shall include the filtration contributed by all materials which are permanently between the source and the patient.

b. **Filtration Controls.** For x-ray systems which have variable kVp and variable filtration for the useful beam, a device shall link the kVp selector with the filter(s) and shall prevent an exposure unless the minimum amount of filtration necessary to produce the HVL required by 1.6.4(5)(a) is in the useful beam for the given kVp which has been selected.

6. **Multiple Tubes.** Where two or more radiographic tubes are controlled by one exposure switch, the tube or tubes which have been selected shall be clearly indicated prior to initiation of the exposure. This indication shall be both on the x-ray control panel and at or near the tube housing assembly which has been selected.

7. **Mechanical Support of Tube Head.** The tube housing assembly supports shall be adjusted such that the tube housing assembly will remain stable during an exposure unless tube housing movement is a designed function of the x-ray system.

8. **Technique Indicators.**

a. The technique factors to be used during an exposure shall be indicated before the exposure begins. If automatic exposure controls are used, the technique factors which are set prior to the exposure shall be indicated.

b. The requirements of 1.6.4(8)(a) may be met by permanent markings on equipment having fixed technique factors. Indication of technique factors shall be visible from the operator's position except in the case of spot films made by the fluoroscopist.

9. **Locks**. All position locking, holding, and centering devices on x-ray system components shall function as intended.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.5 **Fluoroscopic X-Ray Systems.** All fluoroscopic x-ray systems shall be image intensified and meet the following requirements:

1. **Limitation of Useful Beam.**

a. **Primary Barrier.**

i. The fluoroscopic imaging assembly used shall be provided with a primary protective barrier which intercepts the entire cross section of the useful beam at any SID.

ii. The x-ray tube used for fluoroscopy shall not produce x-rays unless the barrier is in position to intercept the entire useful beam.

b. **Fluoroscopic Beam Limitation.**

i. For certified fluoroscopic systems, neither the length nor the width of the x-ray field in the plane of the image receptor shall exceed that of the visible area of the image receptor by more than 3 percent of the SID. The sum of the excess length and the excess width shall be no greater than 4 percent of the SID.

ii. For uncertified fluoroscopic systems with a spot film device, the x-ray beam with the shutters fully opened (during fluoroscopy or spot filming) shall be no larger than the largest spot film size for which the device is designed. Measurements shall be made at the minimum SID available but at no less than 20 centimeters table top to the film plane distance.

iii. For uncertified fluoroscopic systems without a spot film device, the requirements of 1.6.5(1)(b)(i) apply.

iv. Other requirements for fluoroscopic beam limitation:

i. Means shall be provided to permit further limitation of the field. Beam-limiting devices manufactured after May 22, 1979, and incorporated in equipment with a variable SID and/or a visible area of greater than 300 square centimeters shall be provided with means for stepless adjustments of the x-ray field.

ii. All equipment with a fixed SID and a visible area of 300 square centimeters or less shall be provided with either stepless adjustment of the x-ray field or with means to further limit the x-ray field size at the plane of the image receptor to 125 square centimeters or less.

iii. If provided, stepless adjustment shall provide continuous field sizes from the maximum obtainable to a field size of 5 centimeters by 5 centimeters or less.

iv. For equipment manufactured after February 25, 1978, when the angle between the image receptor and beam axis is variable, means shall be provided to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor; compliance shall be determined with the

beam axis indicated to be perpendicular to the plane of the image receptor.

v. For rectangular x-ray fields used with circular image reception, the error in alignment shall be determined along the length and width dimensions of the x-ray field which pass through the center of the visible area of the image receptor.

c. **Spot Film Beam Limitation.** Spot-film devices which are certified components shall meet the following additional requirements:

i. Means shall be provided between the source and the patient for adjustment of the x-ray field size in the plane of the film to the size of that portion of the film which has been selected on the spot film selector. Such adjustment shall be automatically accomplished except when the x-ray field size in the plane of the film is smaller than that of the selected portion of the film. For spot film devices manufactured after June 21, 1979, if the x-ray field size is less than the size of the selected portion of the film, the means for adjustment of the field size shall be only at the operator's option.

d. It shall be possible to adjust the x-ray field size in the plane of the film to a size smaller than the selected portion of the film. The minimum field size at the greatest SID shall be equal to, or less than, 5 centimeters by 5 centimeters.

e. The center of the x-ray field in the plane of the film shall be aligned with the center of the selected portion of the film to within 2 percent of the SID.

f. On spot-film devices manufactured after February 25, 1978, if the angle between the plane of the image receptor and beam axis is variable, means shall be provided to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor, and compliance shall be determined with the beam axis indicated to be perpendicular to the plane of the image receptor.

g. **Override.** If a means exists to override any of the automatic x-ray field size adjustments required in 1.6.5(1)(b), and (c) that means:

i. shall be designed for use only in the event of system failure;

ii. shall incorporate a signal visible at the fluoroscopist's position which will indicate whenever the automatic field size adjustment is overridden; and

iii. shall be clearly and durably labeled as follows:

FOR X-RAY FIELD

2. **Activation of the Fluoroscopic Tube**. X-ray production in the fluoroscopic mode shall be controlled by a device which requires continuous pressure by the fluoroscopist for the entire time of any exposure. When recording serial fluoroscopic images, the fluoroscopist shall be able to terminate the x-ray exposure(s) at any time, but means may be provided to permit completion of any single exposure of the series in process.

3. **Exposure Rate Limits.**

a. **Entrance Exposure Rate Allowable Limits.**

i. Fluoroscopic equipment which is provided with automatic exposure rate control shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 10 roentgens (2.58 mC/kg) per minute at the point where the center of the useful beam enters the patient, except:

i. During recording of fluoroscopic images, or

ii. When an optional high level control is provided. When so provided, the equipment shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 5 roentgens (1.29 mC/kg) per minute at the point where the center of the useful beam enters the patient unless the high level control is activated. Special means of activation of high level controls shall be required. The high level control shall only be operable when continuous manual activation is provided by the operator. A continuous signal audible to the fluoroscopist shall indicate that the high level control is being employed.

ii. Fluoroscopic equipment which is not provided with automatic exposure rate control shall not be operable at any combination of tube potential and current which will result in an exposure rate in excess of 5 roentgens (1.29 mC/kg) per minute at the point where the center of the useful beam enters the patient, except:

i. During recording of fluoroscopic images, or

ii. When an optional high level control is activated. Special means of activation of high level controls shall be required. The high level control shall only be operable when continuous manual activation is provided by the operator. A continuous signal audible to the fluoroscopist shall indicate that the high level control is being employed.

iii. Compliance with the requirements of 1.6.5(3) shall be determined as follows:

i. If the source is below the x-ray table, the exposure rate shall be measured 1 centimeter above the tabletop or cradle.

ii. If the source is above the x-ray table, the exposure rate shall be measured at 30 centimeters above the tabletop with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement.

iii. For a C-arm type of fluoroscope, the exposure rate shall be measured 30 centimeters from the input surface of the fluoroscopic imaging assembly, with the source positioned at any available SID, provided that the end of the beam-limiting device or spacer is no closer than 30 centimeters from the input surface of the fluoroscopic imaging assembly.

iv. For a lateral type fluoroscope, the exposure rate shall be measured at a point 15 centimeters from the center line of the x-ray table and in the direction of the x-ray source with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement. If the tabletop is movable, it shall be positioned as closely as possible to the lateral x-ray source, with the end of the beam limiting device or spacer no closer than 15 centimeters to the center line of the x-ray table.

b. Periodic measurement of entrance exposure rate shall be performed by a qualified expert for both maximum and typical values, as follows.[30]

i. Such measurements shall be made annually or after any maintenance of the system which might affect the exposure rate.

ii. Results of these measurements shall be posted where any fluoroscopist may have ready access to such results while using the fluoroscope and in the record required in 1.6.3(1)(l)(iii) The measurement results shall be stated in roentgens per minute and include the technique factors used in determining such results. The name of the person performing the measurements and the date the measurements were performed shall be included in the results.

iii. Conditions of periodic measurement of maximum entrance exposure rate are as follows:

i. the measurement shall be made under the conditions that satisfy the requirements of 1.6.5(3)(a)(iii);

[30] Materials should be placed in the useful beam to protect the imaging system when conducting these periodic measurements.

ii. the kVp, mA, and/or other selectable parameters shall be adjusted to those settings which give the maximum entrance exposure rate; and

iii. the x-ray system that incorporates automatic exposure rate control shall have sufficient attenuative material placed in the useful beam to produce the maximum output of that system.

iv. Conditions of periodic measurement of typical entrance exposure rate are as follows:

i. the measurement shall be made under the conditions that satisfy the requirements of 1.6.5(3)(a)(iii);

ii. the kVp and mA shall be typical of clinical use of the x-ray system; and

iii. the x-ray system(s) that incorporates automatic exposure rate control shall have an appropriate phantom placed in the useful beam to produce a milliamperage and/or kilovoltage typical of the use of the x-ray system.

4. **Barrier Transmitted Radiation Rate Limits.**

a. The exposure rate due to transmission through the primary protective barrier with the attenuation block in the useful beam, combined with radiation from the image intensifier shall not exceed 2 milliroentgens (0.516 µC/kg) per hour at 10 centimeters from any accessible surface of the fluoroscopic imaging assembly beyond the plane of the image receptor for each roentgen per minute of entrance exposure rate.

b. **Measuring Compliance of Barrier Transmission.**

i. The exposure rate due to transmission through the primary protective barrier combined with radiation from the image intensifier shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

ii. If the source is below the tabletop, the measurement shall be made with the input surface of the fluoroscopic imaging assembly positioned 30 centimeters above the tabletop.

iii. If the source is above the tabletop and the SID is variable, the measurement shall be made with the end of the beam-limiting device or spacer as close to the tabletop as it can be placed, provided that it shall not be closer than 30 centimeters.

iv. Compression devices and movable grids shall be removed from the useful beam during the measurement.

5. **Indication of Potential and Current.** During fluoroscopy and cinefluorography, the kV and the mA shall be continuously indicated.

6. **Source-to-Skin Distance**. The SSD shall not be less than:

   a. 38 centimeters on stationary fluoroscopic systems manufactured on or after August 1, 1974;

   b. 35.5 centimeters on stationary fluoroscopic systems manufactured prior to August 1, 1974;

   c. 30 centimeters on all mobile fluoroscopes; and

   d. 20 centimeters for all mobile fluoroscopes used for specific surgical procedures.

7. **Fluoroscopic Timer.**

   a. Means shall be provided to preset the cumulative on-time of the fluoroscopic x-ray tube. The maximum cumulative time of the timing device shall not exceed 5 minutes without resetting.

   b. A signal audible to the fluoroscopist shall indicate the completion of any preset cumulative on-time. Such signal shall continue to sound while x-rays are produced until the timing device is reset.

8. **Control of Scattered Radiation.**

   a. Fluoroscopic table designs when combined with procedures utilized shall be such that no unprotected part of any staff or ancillary individual's body shall be exposed to unattenuated scattered radiation which originates from under the table. The attenuation required shall be not less than 0.25 millimeter lead equivalent.

   b. Equipment configuration when combined with procedures shall be such that no portion of any staff or ancillary individual's body, except the extremities, shall be exposed to the unattenuated scattered radiation emanating from above the table top unless that individual:

      i. is at least 120 centimeters from the center of the useful beam; or

      ii. the radiation has passed through not less than 0.25 millimeter lead equivalent material including, but not limited to, drapes, Bucky-slot cover panel, or self-supporting curtains, in addition to any lead equivalency provided by the protective apron referred to in 1.6.3(1)(h)(vii).

   c. The Agency may grant exemptions to 1.6.5(8)(b) where a sterile field will not permit the use of the normal protective barriers. Where the use of prefitted sterilized covers for the barriers is practical, the Agency shall not permit such exemption. See Appendix C for a suggested list of

fluoroscopic procedures where such exemptions will be automatically granted.

9. **Spot Film Exposure Reproducibility.** Fluoroscopic systems equipped with spot film (radiographic) mode shall meet the exposure reproducibility requirements of 1.6.6(4) when operating in the spot film mode.

10. **Radiation Therapy Simulation Systems.** Radiation therapy simulation systems shall be exempt from all the requirements of 1.6.5(1), 1.6.5(3), 1.6.5(4), and 1.6.5(7) provided that:

    a. such systems are designed and used in such a manner that no individual other than the patient is in the x-ray room during periods of time when the system is producing x-rays; and

    b. systems which do not meet the requirements of 1.6.5(7) are provided with a means of indicating the cumulative time that an individual patient has been exposed to x-rays. Procedures shall require in such cases that the timer be reset between examinations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.6 **Radiographic Systems Other Than Fluoroscopic, Dental Intraoral, Veterinarian, Computed Tomography, or Mammography Systems.**

1. **Beam Limitation**. The useful beam shall be limited to the area of clinical interest. This shall be deemed to have been met if a positive beam-limiting device has been properly used or if evidence of collimation is shown on at least three sides or three corners of the film, (for example, projections from the shutters of the collimator, cone cutting at the corners, or borders at the film's edge).

    a. **General Purpose Stationary and Mobile X-Ray Systems.**

        i. The use of a variable-field beam limiting device providing stepless, independent adjustment of at least two dimensions of the x-ray field is required.

        ii. A method shall be provided for visually defining the perimeter of the x-ray field. The total misalignment of the edges of the visually defined field with the respective edges of the x-ray field along either the length or width of the visually defined field shall not exceed 2 percent of the distance from the source to the center of the visually defined field when the surface upon which it appears is perpendicular to the axis of the x-ray beam.

        iii. The Agency may grant an exemption on noncertified x-ray systems to 1.6.6(1)(a)(i) and (ii) provided the registrant makes a written application for such exemption and in that application:

i. demonstrates it is impractical to comply with 1.6.6(1)(a)(i) and (ii); and

ii. the purpose of 1.6.6(1)(a)(i) and (ii) will be met by other methods.

b. **Additional Requirements for Stationary General Purpose X-Ray Systems.** In addition to the requirements of 1.6.6(1)(a), all stationary general purpose x-ray systems shall meet the following requirements:

i. A method shall be provided to indicate when the axis of the x-ray beam is perpendicular to the plane of the image receptor, to align the center of the x-ray field with respect to the center of the image receptor to within 2 percent of the SID, and to indicate the SID to within 2 percent.

ii. The beam-limiting device shall indicate numerically the field size in the plane of the image receptor to which it is adjusted.

iii. Indication of field size dimension and SID's shall be specified in inches and/or centimeters, and shall be such that aperture adjustments result in x-ray field dimensions in the plane of the image receptor which correspond to those indicated by the beam-limiting device to within 2 percent of the SID when the beam axis is indicated to be perpendicular to the plane of the image receptor.

c. **X-Ray Systems Designed for One Image Receptor Size.** Radiographic equipment designed for only one image receptor size at a fixed SID shall be provided with means to limit the field at the plane of the image receptor to dimensions no greater than those of the image receptor, and to align the center of the x-ray field with the center of the image receptor to within 2 percent of the SID, or shall be provided with means to both size and align the x-ray field such that the x-ray field at the plane of the image receptor does not extend beyond any edge of the image receptor.

d. **Radiographic Systems Other Than Those Designated in 1.6.6(1)(a),(b), and (c).**

i. Means shall be provided to limit the x-ray field in the plane of the image receptor so that such field does not exceed each dimension of the image receptor by more than 2 percent of the SID when the axis of the x-ray beam is perpendicular to the plane of the image receptor.

ii. Means shall be provided to align the center of the x-ray field with the center of the image receptor to within 2 percent of the SID, or means shall be provided to both size and align the x-ray field such that the x-ray field at the plane of the image receptor does not extend beyond any edge of the image receptor. Compliance shall

be determined with the axis of the x-ray beam perpendicular to the plane of the image receptor.

iii. 1.6.6(1)(d)(i) and (ii) may be met with a system that meets the requirements for a general purpose x-ray system as specified in 1.6.6(1)(a) or, when alignment means are also provided, may be met with either:

i. an assortment of removable, fixed-aperture, beam-limiting devices sufficient to meet the requirement for each combination of image receptor size and SID for which the unit is designed with each such device having clear and permanent markings to indicate the image receptor size and SID for which it is designed; or

ii. a beam-limiting device having multiple fixed apertures sufficient to meet the requirement for each combination of image receptor size and SID for which the unit is designed. Permanent, clearly legible markings shall indicate the image receptor size and SID for which each aperture is designed and shall indicate which aperture is in position for use.

2. **Radiation Exposure Control**

a. **Exposure Initiation.** Means shall be provided to initiate the radiation exposure by a positive action on the part of the operator, such as the depression of a switch. Radiation exposure shall not be initiated without such a positive action. In addition, it shall not be possible to initiate an exposure when the timer is set to a "zero" or "off" position if either position is provided.

b. **Exposure Termination.** Means shall be provided to terminate the exposure at a preset time interval, preset product of current and time, a preset number of pulses, or a preset radiation exposure to the image receptor. Termination of an exposure shall cause automatic resetting of the timer to its initial setting or to "zero."

i. **Manual exposure control.** An x-ray exposure control shall be incorporated into each x-ray system such that an exposure can be terminated by the operator at any time ("dead-man" switch) except for:

i. exposure of 1/2 second or less; or

ii. during serial radiography when means shall be provided to permit completion of any single exposure of the series in process.

ii. **Automatic exposure control.** When an automatic exposure control is provided:

i. indication shall be made on the control panel when this mode of operation is selected;

ii. if the x-ray tube potential is equal to or greater than 50 kVp, the minimum exposure time for field emission equipment rated for pulsed operation shall be equal to or less than a time interval equivalent to two pulses;

iii. the minimum exposure time for all equipment other than that specified in 1.6.6(2)(b)(ii)(ii) shall be equal to or less than 1/60 second or a time interval required to deliver 5 mAs, whichever is greater;

iv. either the product of peak x-ray tube potential, current, and exposure time shall be limited to not more than 60 kWs per exposure, or the product of x-ray tube current and exposure time shall be limited to not more than 600 mAs per exposure, except that when the x-ray tube potential is less than 50 kVp, the product of x-ray tube current and exposure time shall be limited to not more than 2000 mAs per exposure; and

v. a visible signal shall indicate when an exposure has been terminated at the limits required by 1.6.6(2)(ii)(iv), and manual resetting shall be required before further automatically timed exposures can be made.

c. **Exposure Indication.** Means shall be provided for visual indication of x-ray production observable at or from the operator's protected position whenever x-rays are produced. In addition, a signal audible to the operator shall indicate that the exposure has terminated.

d. **Exposure Duration (Timer) Reproducibility.** With a timer setting of 0.5 seconds or less, the difference between the maximum exposure time (T_{max}) and the minimum exposure time (T_{min}) shall be less than or equal to 10% of the average exposure time $\overline{T}$), when four timer tests are performed:

$$(T_{max} - T_{min}) \leq 0.10\overline{T}$$

e. **Exposure Control Location**. The x-ray exposure control shall be so placed that the operator can view the patient while making any exposure.

f. **Operator Protection, Except Veterinary Systems.**

i. **Stationary systems.** Stationary x-ray systems shall be required to have the x-ray exposure control permanently mounted in a protected area so that the operator is required to remain in that protected area during the entire exposure.

ii. **Mobile and portable systems.** Mobile and portable x-ray systems which are:

i. used continuously for greater than one week in the same location, i.e., a room or suite shall be considered as stationary systems under 1.6.6(2)(f)(i); and

ii. used for less than one week in the same location shall be provided with either a protective barrier at least 6.5 feet (2 m) high for operator protection during exposures, or means shall be provided to allow the operator to be at least 12 feet (3.7 m) from the tube housing assembly during the exposure.

iii. **Operation Protection for Veterinary Systems.** All stationary, mobile or portable x-ray systems used for veterinary work shall be provided with either a 6.5 foot (2 m) high protective barrier for operator protection during exposures, or shall be provided with means to allow the operator to be at least 12 feet (3.7 m) from the tube housing assembly during exposures.

3. **Source-to-Skin Distance**. All mobile or portable radiographic systems shall be provided with means to limit the source-to-skin distance to equal to or greater than 30 centimeters, except for veterinary systems.

4. **Exposure Reproducibility.** When all technique factors are held constant, including control panel selections associated with automatic exposure control (phototiming) systems, the coefficient of variation of exposure for both manual and phototimed systems shall not exceed 0.05. This requirement shall be deemed to have been met, if, when four exposures are made at identical technique factors, the difference between the maximum exposure ($E_{\max}$) and the minimum exposure ($E_{\min}$) shall be less than or equal to 10% of the average exposure($\overline{E}$):

$$(E_{max} - E_{min}) \leq 0.10\overline{E}$$

5. **Radiation from Capacitor Energy Storage Equipment in Standby Status.** Radiation emitted from the x-ray tube when the exposure switch or timer is not activated shall not exceed a rate of 2 milliroentgens (0.516 µC/kg) per hour at 5 centimeters from any accessible surface of the diagnostic source assembly, with the beam-limiting device fully open.

6. **Accuracy**. Deviation of technique factors from indicated values shall not exceed the limits specified for that system by its manufacturer. In the absence of manufacturer's specifications, the deviation shall not exceed 10% of the indicated value.

7. **Linearity, Uncertified X-Ray Systems Only.** The following requirements apply when the equipment is operated on a power supply as specified by the

manufacturer for any fixed x-ray tube potential within the range of 40 percent to 100 percent of the maximum rated.

a. **Equipment having independent selection of x-ray tube current (mA).** The average ratios of exposure to the indicated milliampere-seconds product mR/mAs (C/kg/mAs) obtained at any two tube current settings shall not differ by more than 0.10 times their sum. This is:

$$|\bar{X}_1 - \bar{X}_2| \leq 0.10(\bar{X}_1 + \bar{X}_2)$$

where $\bar{X}_1$ and $\bar{X}_2$ are the average mR/mAs (C/kg/mAs) values obtained at any two tube current settings.

b. **Equipment having a combined x-ray tube current-exposure time product (mAs) selector, but not a separate tube current (mA) selector.** The average ratios of exposure to the indicated milliampere-seconds product mR/mAs (C/kg/mAs) obtained at any two mAs selector settings shall not differ by more than 0.10 times their sum. This is:

$$|\bar{X}_1 - \bar{X}_2| \leq 0.10(\bar{X}_1 + \bar{X}_2)$$

where $\bar{X}_1$ and $\bar{X}_2$ are the average mR/mAs (C/kg/mAs) values obtained at any two mAs selector settings.

c. **Measuring compliance**. Determination of compliance shall be based on 4 exposures, of no less than 0.05 seconds each, taken within a time period of one hour, at each of the two settings.

These two settings may include any two focal spot sizes provided that neither focal spot size is equal to or less than 0.45 millimeter, in which case the two settings shall be restricted to the same focal spot size. For purposes of this requirement, focal spot size is the nominal focal spot size specified by the x-ray tube manufacturer.

8. **Additional Requirements Applicable to Certified Systems Only**. Diagnostic x-ray systems incorporating one or more certified component(s) shall be required to comply with the following additional requirement(s) which relate to that certified component(s).

a. **Linearity.** When the equipment allows a choice of x-ray tube current settings and is operated on a power supply as specified by the manufacturer in accordance with the requirements of applicable Federal standards, for any fixed x-ray tube potential within the range of 40 to 100 percent of the maximum rating, the average ratios of exposure to the indicated milliampere-seconds product obtained at any 2 consecutive tube current settings shall not differ by more than 0.10 times their sum:

$$|\bar{X}_1 - \bar{X}_2| \leq 0.10(\bar{X}_1 + \bar{X}_2)$$

where $\overline{X}_1$ and $\overline{X}_2$ are the average mR/mAs (C/kg/mAs) values obtained at each of 2 consecutive tube current settings.

b. **Beam Limitation for Stationary and Mobile General Purpose X-Ray Systems.**

i. There shall be provided a means of stepless adjustment of the size of the x-ray field. The minimum field size at an SID of 100 cm shall be equal to or less than 5 centimeters by 5 centimeters.

ii. When a light localizer is used to define the x-ray field, it shall provide an average illumination of not less than 160 lux or 15 footcandles at 100 centimeters or at the maximum SID, whichever is less. The average illumination shall be based upon measurements made in the approximate center of each quadrant of the light field. Radiation therapy simulation systems manufactured on and after May 27, 1980, are exempt from this requirement.

c. **Beam Limitation for Portable X-Ray Systems**. Beam limitation for portable x-ray systems shall meet the beam limitation requirements of 1.6.6(1)(a) and 1.6.6(7)(b).

d. **Field Limitation and Alignment on Stationary General Purpose X-Ray Systems.** For stationary, general purpose x-ray systems which contain a tube housing assembly, an x-ray control, and, for those systems so equipped, a table, all certified in accordance with 21 CFR 1020.30(c):

i. Positive beam limitation (PBL) shall be provided whenever all the following conditions are met:

i. The image receptor is inserted into a permanently mounted cassette holder;

ii. The image receptor length and width are each less than 50 centimeters;

iii. The x-ray beam axis is within plus or minus 3 degrees of vertical and the SID is 90 centimeters to 130 centimeters inclusive; or the x-ray beam axis is within plus or minus 3 degrees of horizontal and the SID is 90 centimeters to 205 centimeters inclusive;

iv. The x-ray beam axis is perpendicular to the plane of the image receptor to within plus or minus 3 degrees;

v. Neither tomographic nor stereoscopic radiography is being performed; and

vi. The PBL system has not been intentionally overridden. This override provision is subject to 1.6.6(8)(d)(iii).

ii. Positive beam limitation (PBL) shall prevent the production of x-rays when:

i. Either the length or width of the x-ray field in the plane of the image receptor differs, except as permitted by 1.6.6(8)(d)(v), from the corresponding image receptor dimensions by more than 3 percent of the SID; or

ii. The sum of the length and width differences as stated in 1.6.6 (8)(d)(ii)(i) without regard to sign exceeds 4 percent of the SID.

iii. If a means of overriding the positive beam limitation (PBL) system exists, that means:

i. Shall be designed for use only in the event of PBL system failure or if the system is being serviced; and

ii. If in a position that the operator would consider it part of the operational controls or if it is referenced in the operator's manual or in other materials intended for the operator,

i. shall require that a key be utilized to defeat the PBL;

ii. shall require that the key remain in place during the entire time the PBL system is overridden; and

iii. shall require that the key or key switch be clearly and durably labeled as follows:

FOR X-RAY FIELD LIMITATION

SYSTEM FAILURE

iv. Compliance with 1.6.6(8)(d)(ii) shall be determined when the equipment indicates that the beam axis is perpendicular to the plane of the image receptor and the provisions of 1.6.6(8)(d)(i) are met. Compliance shall be determined no sooner than 5 seconds after insertion of the image receptor.

v. The positive beam limitation system shall be capable of operation, at the discretion of the operator, such that the size of the field may be made smaller than the size of the image receptor through stepless adjustment of the field size. The minimum field size at a SID of 100 centimeters shall be equal to or less than 5 centimeters by 5 centimeters.

vi. The positive beam limitation system shall be designed such that if a change in image receptor does not cause an automatic return to positive beam limitation function as described in 1.6.6(8)(d)(ii),

then any change of image receptor size or SID must cause the automatic return.

e. **Timers.** Except for dental panoramic systems, termination of exposure shall cause automatic resetting of the timer to its initial setting or to "zero."

9. **Tube Stands for Portable X-Ray Systems**. A tube stand or other mechanical support shall be used for portable x-ray systems so that the x-ray tube housing assembly need not be hand-held during exposures.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.7 **Intraoral Dental Radiographic Systems**. In addition to the provisions of 1.6.3and 1.6.4, the requirements of 1.6.7 apply to x-ray equipment and associated facilities used for dental radiography. Requirements for extraoral dental radiographic systems are covered in 1.6.6.

1. **Source-to-Skin Distance (SSD).** X-ray systems designed for use with an intraoral image receptor shall be provided with means to limit SSD, to not less than:

a. 18 centimeters if operable above 50 kVp; or

b. 10 centimeters if not operable above 50 kVp.

2. **Field Limitation.**

a. Radiographic systems designed for use with an intraoral image receptor shall be provided with means to limit the x-ray field such that the x-ray field at the minimum SSD shall be containable in a circle having a diameter of no more than 7 centimeters; and

b. An open ended PID (position indicating device) shall be used on new dental x-ray equipment purchased after the effective date of these regulations.

3. **Radiation Exposure Control for Certified and Noncertified Systems.**

a. **Exposure Initiation.**

i. Means shall be provided to initiate the radiation exposure by a deliberate action on the part of the operator, such as the depression of a switch. Radiation exposure shall not be initiated without such an action; and

ii. It shall not be possible to make an exposure when the timer is set to a "zero" or "off" position if either position is provided.

b. **Exposure Termination.**

i. Means shall be provided to terminate the exposure at a preset time interval, preset product of current and time, a preset number of pulses, or a preset radiation exposure to the image receptor.

ii. An x-ray exposure control shall be incorporated into each x-ray system such that an exposure can be terminated by the operator at any time, except for exposures of 1/2 second or less.

iii. Termination of an exposure shall cause automatic resetting of the timer to its initial setting or to "zero".

c. **Exposure Indication.** Means shall be provided for visual indication observable at or from the operator's protected position whenever x-rays are produced. In addition, a signal audible to the operator shall indicate that the exposure has terminated.

d. **Exposure Duration (Timer) Reproducibility.** With a timer setting of 0.5 seconds or less, the difference between the maximum exposure time (T_{max}) and the minimum exposure time (T_{min}) shall be less than or equal to 10% of the average exposure time $\overline{T}$), when four timer test are performed:

$$(T_{max} - T_{min}) \leq 0.10\overline{T}$$

e. **Exposure Control Location and Operation Protection.**

i. Stationary x-ray systems shall be required to have the x-ray exposure control permanently mounted in a protected area, so that the operator is required to remain in that protected area during the entire exposure; and

ii. Mobile and portable x-ray systems which are:

i. used for greater than one week in the same location, i.e., a room or suite, shall meet the requirements of 1.6.7(3)(e)(i); and

ii. used for less than one week in the same location, shall be provided with either a protective barrier at least 6.5 feet (2m) high for operator protection, or means to allow the operator to be at least 12 feet (3.7 m) from the tube housing assembly while making exposures.

4. **Exposure Reproducibility**. The coefficient of variation shall not exceed 0.05 when all technique factors are held constant. This requirement shall be deemed to have been met if, when 4 exposures are made within a period of one hour at identical technique factors, the difference between the maximum exposure value (E_{max}) and the minimum exposure value (E_{min}) shall be less than or equal to 10% of the average exposure ($\overline{E}$):

$$(E_{max} - E_{min}) \leq 0.10\overline{E}$$

5. **Linearity.** When the equipment allows a choice of x-ray tube current settings and is operated on a power supply as specified by the manufacturer in accordance with any fixed x-ray tube potential within the range of 40 to 100 percent of the maximum rating, the average ratios of exposure to the indicated millampere-seconds product obtained at any 2 consecutive tube current settings shall not differ by more than 0.10 times their sum:

$$|\overline{X}_1 - \overline{X}_2| \leq 0.10(\overline{X}_1 + \overline{X}_2)$$

where $\overline{X}_1$ and $\overline{X}_2$ are the average mR/mAs (C/kg/mAs) values obtained at each of 2 consecutive tube current settings.

6. **Accuracy.** Deviation of technique factors from indicated values shall not exceed the limits specified for that system by its manufacturer. In the absence of manufacturer's specifications, the deviation shall not exceed 10% of the indicated value.

7. **kVp Limitations**. Dental x-ray machines with a nominal fixed kVp of less than 50 kVp shall not be used to make diagnostic dental radiographs of humans.

8. **Administrative Controls.**

   a. Patient and film holding devices shall be used when the techniques permit.

   b. The tube housing and the PID shall not be hand held during an exposure.

   c. The x-ray system shall be operated in such a manner that the useful beam at the patient's skin does not exceed the requirements of 1.6.7(2).

   d. Dental fluoroscopy without image intensification shall not be used.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.8 **Veterinary Medicine Radiographic Installations.**

1. **Equipment.**

   a. The protective tube housing shall be equivalent to the requirements of 1.6.4(3).

   b. Diaphragms or cones shall be provided for collimating the useful beam to the area of clinical interest and shall provide the same degree of protection as is required of the housing.

   c. The total filtration permanently in the useful beam shall not be less than 0.5 millimeters aluminum equivalent for machines operating up to 50 kVp, 1.5 millimeters aluminum equivalent for machines operating

between 50 and 70 kVp, and 2.5 millimeters aluminum equivalent for machines operating above 70 kVp.

d. A device shall be provided to terminate the exposure after a preset time or exposure.

e. A dead-man type of exposure switch shall be provided, together with an electrical cord of sufficient length, so that the operator can stand out of the useful beam and at least 6 feet (1.83 m) from the animal during all x-ray exposures.

2. **Structural Shielding**. All wall, ceiling, and floor areas shall be equivalent to or provided with applicable protective barriers to assure compliance with 1.4.5 of these regulations.

3. **Operating Procedures.**

a. The operator shall stand well away from the useful beam and the animal during radiographic exposures.

b. No individual other than the operator shall be in the x-ray room while exposures are being made unless such individual's assistance is required.

c. When an animal must be held in position during radiography, mechanical supporting or restraining devices should be used. If the animal must be held by an individual, that individual shall be protected with appropriate shielding devices, such as protective gloves and apron, and he shall be so positioned that no part of his body will be struck by the useful beam. The exposure of any individual used for this purpose shall be monitored.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.9 **Computed Tomography X-Ray Systems.**

1. **Definitions.** In addition to the definitions provided in 1.1.2 and 1.6.2 of these regulations, the following definitions shall be applicable to 1.6.9:

a. "Computed tomography dose index" means the integral from -7*T* to +7*T* of the dose profile along a line perpendicular to the tomographic plane divided by the product of the nominal tomographic section thickness and the number of tomograms produced in a single scan, that is:

$$CTDI = \frac{1}{nT} \int_{-7T}^{+7T} D(z)\,dz$$

where:

z = Position along a line perpendicular to the tomographic plane.
D(z) = Dose at position z.

T = Nominal tomographic section thickness.
n = Number of tomograms produced in a single scan.

This definition assumes that the dose profile is centered around $z = 0$ and that, for a multiple tomogram system, the scan increment between adjacent scans is nT.

b. "Contrast scale" means the change in the linear attenuation coefficient per CTN relative to water, that is:

$$CS = \frac{(\mu_x - \mu_w)}{(CTN)_x - (CTN)_w}$$

where:

μ_x = Linear attenuation coefficient of the material of interest.
μ_w = Linear attenuation coefficient of water.
$(CTN)_x$ = *CTN* of the material of interest.
$(CTN)_w$ = *CTN* of water.

c. "CS" (See "Contrast scale").

d. "CT conditions of operation" means all selectable parameters governing the operation of a CT x-ray system including, but not limited to, nominal tomographic section thickness, filtration, and the technique factors as defined in 1.6.2.

e. "CTDI" (See "Computed tomography dose index").

f. "CT gantry" means the tube housing assemblies, beam-limiting devices, detectors, and the supporting structures and frames which hold these components.

g. "CTN" (See "CT number").

h. "CT number" means the number used to represent the x-ray attenuation associated with each elemental area of the CT image.

$$CTN = \frac{k(\mu_x - \mu_w)}{\mu_w}$$

where:

k = A constant[31]
μ_x = Linear attenuation coefficient of the material of interest.
μ_w = Linear attenuation coefficient of water.

[31] The constant has a normal value of 1,000 when the Houndsfield scale of CTN is used.

i. "Dose profile" means the dose as a function of position along a line.

j. "Elemental area" means the smallest area within a tomogram for which the x-ray attenuation properties of a body are depicted. (See also "Picture element").

k. "Multiple tomogram system" means a computed tomography x-ray system which obtains x-ray transmission data simultaneously during a single scan to produce more than one tomogram.

l. "Noise" means the standard deviation of the fluctuations in *CTN* expressed as a percentage of the attenuation coefficient of water. Its estimate (S_n) is calculated using the following expression:

$$S_n = \frac{(100 \times CS \times s)}{\mu_w}$$

where:

CS = Contract scale.
μ_w = Linear attenuation coefficient of water.
s = Estimated standard deviation of the *CTN* of picture elements in a specified area of the CT image.

m. "Nominal tomographic section thickness" means the full width at half-maximum of the sensitivity profile taken at the center of the cross-sectional volume over which x-ray transmission data are collected.

n. "Picture element" means an elemental area of a tomogram.

o. "Reference plane" means a plane which is displaced from and parallel to the tomographic plane.

p. "Scan" means the complete process of collecting x-ray transmission data for the production of a tomogram. Data can be collected simultaneously during a single scan for the production of one or more tomograms.

q. "Scan increment" means the amount of relative displacement of the patient with respect to the CT x-ray system between successive scans measured along the direction of such displacement.

r. "Scan sequence" means a preselected set of two or more scans performed consecutively under preselected CT conditions of operation.

s. "Scan time" means the period of time between the beginning and end of x-ray transmission data accumulation for a single scan.

t. "Single tomogram system" means a CT x-ray system which obtains x-ray transmission data during a scan to produce a single tomogram.

u. "Tomographic plane" means that geometric plane which is identified as corresponding to the output tomogram.

v. "Tomographic section" means the volume of an object whose x-ray attenuation properties are imaged in a tomogram.

2. **Requirement for Equipment.**

a. **Termination of Exposure.**

i. Means shall be provided to terminate the x-ray exposure automatically by either de-energizing the x-ray source or shuttering the x-ray beam in the event of equipment failure affecting data collection. Such termination shall occur within an interval that limits the total scan time to no more than 110 percent of its preset value through the use of either a backup timer or devices which monitor equipment function.

ii. A visible signal shall indicate when the x-ray exposure has been terminated through the means required by 1.6.9(2)(a)(i).

iii. The operator shall be able to terminate the x-ray exposure at any time during a scan, or series of scans under CT x-ray system control, of greater than one-half second duration.

b. **Tomographic Plane Indication and Alignment.**

i. For any single tomogram system, means shall be provided to permit visual determination of the tomographic plane or a reference plan offset from the tomographic plane.

ii. For any multiple tomogram system, means shall be provided to permit visual determination of the location of a reference plane. This reference plane can be offset from the location of the tomographic planes.

iii. If a device using a light source is used to satisfy 1.6.9(2)(b)(i) or (ii), the light source shall provide illumination levels sufficient to permit visual determination of the location of the tomographic plane or reference plane under ambient light conditions of up to 500 lux.

c. **Beam-On and Shutter Status Indicators and Control Switches.**

i. The CT x-ray control and gantry shall provide visual indication whenever x-rays are produced and, if applicable, whether the shutter is open or closed.

ii. Each emergency button or switch shall be clearly labeled as to its function.

d. **Indication of CT Conditions of Operation**. The CT x-ray system shall be designed such that the CT conditions of operation to be used during a scan or a scan sequence shall be indicated prior to the initiation of a scan or a scan sequence. On equipment having all or some of these conditions of operation at fixed values, this requirement may be met by permanent markings. Indication of CT conditions of operation shall be visible from any position from which scan initiation is possible.

e. **Extraneous Radiation.** When data are not being collected for image production, the radiation adjacent to the tube port shall not exceed that permitted by 1.6.4(3).

f. **Maximum Surface CTDI Identification**. The angular position where the maximum surface CTDI occurs shall be identified to allow for reproducible positioning of a CT dosimetry phantom.

g. **Additional Requirements Applicable to CT X-Ray Systems Containing a Gantry Manufactured After September 3, 1985.**

i. The total error in the indicated location of the tomographic plane or reference plane shall not exceed 5 millimeters.

ii. If the x-ray production period is less than one-half second, the indication of x-ray production shall be actuated for at least one-half second. Indicators at or near the gantry shall be discernible from any point external to the patient opening where insertion of any part of the human body into the primary beam is possible.

iii. The deviation of indicated scan increment versus actual increment shall not exceed plus or minus 1 millimeter with any mass from 0 to 100 kilograms resting on the support device. The patient support device shall be incremented from a typical starting position to the maximum incremented distance or 30 centimeters, whichever is less, and then returned to the starting position. Measurement of actual versus indicated scan increment may be taken anywhere along this travel.

iv. Premature termination of the x-ray exposure by the operator shall necessitate resetting of the CT conditions of operation prior to the initiation of another scan.

3. **Facility Design Requirements.**

a. **Aural Communication.** Provision shall be made for two-way aural communication between the patient and the operator at the control panel.

b. **Viewing Systems.**

i. Windows, mirrors, closed-circuit television, or an equivalent shall be provided to permit continuous observation of the patient during

irradiation and shall be so located that the operator can observe the patient from the control panel.

ii. When the primary viewing system is by electronic means, an alternate viewing system (which may be electronic) shall be available for use in the event of failure of the primary viewing system.

4. **Surveys, Measurements, Spot Checks and Operating Procedures.**

a. **Surveys.**

i. All CT x-ray systems installed after the effective date of these regulations and those systems not previously surveyed shall have a survey made by, or under the direction of, a qualified expert. In addition, such surveys shall be done after any change in the facility or equipment which might cause a significant increase in radiation hazard.

ii. The registrant shall obtain a written report of the survey from the qualified expert, and a copy of the report shall be made available to the Agency upon request.

b. **Radiation Measurements.**

i. The measurements of the radiation output of the CT x-ray system shall be performed by, or under the direction of, a qualified expert.

ii. The measurement of the radiation output of the CT x-ray system shall be performed annually and after any change or replacement of components which could cause a change in the radiation output.

iii. The measurement of the radiation output of the CT x-ray system shall be performed with a calibrated dosimetry system. The calibration of such system shall be traceable to a national standard. The dosimetry system shall have been calibrated within the preceding 2 years.

iv. CT dosimetry phantom(s) shall be used in determining the radiation output of a CT x-ray system. Such phantom(s) shall meet the following specifications and conditions of use:

i. CT dosimetry phantom(s) shall be right circular cylinders of polymethyl-methacrylate of density 1.19 plus or minus 0.01 grams per cubic centimeter. The phantom(s) shall be at least 14 centimeters in length and shall have diameters of 32.0 centimeters for testing CT x-ray systems designed to image any section of the body and 16.0 centimeters for systems designed to image the head or for whole body scanners operated in the head scanning mode.

ii. CT dosimetry phantom(s) shall provide means for the placement of a dosimeter(s) along the axis of rotation and along a line parallel to the axis of rotation 1.0 centimeter from the outer surface and within the phantom. Means for the placement of dosimeters or alignment devices at other locations may be provided.

iii. Any effects on the doses measured to the removal of phantom material to accommodate dosimeters shall be accounted for through appropriate corrections to the reported data or included in the statement of maximum deviation for the values obtained using the phantom.

iv. All dose measurements shall be performed with the CT dosimetry phantom placed on the patient couch or support device without additional attenuation materials present.

v. The measurement of the radiation output shall be required for each type of head, body, or whole-body scan performed at the facility.

vi. Measurement of the radiation output shall meet the following requirements:

i. The dose profile along the center axis of the CT dosimetry phantom for the minimum, maximum, and midrange values of the nominal tomographic section thickness used by the registrant shall be measurable. Where less than three nominal tomographic thicknesses can be selected, the dose profile determination shall be performed for each available nominal tomographic section thickness.

ii. The *CTDI*[32] along the two axes specified in 1.6.9(4)(b)(iv)(ii) shall be measured. The CT dosimetry phantom shall be oriented so that the measurement point 1.0 centimeter from the outer surface and within the phantom is in the same angular position within the gantry as the point of maximum surface *CTDI* identified. The CT conditions of operation shall correspond to typical values used by the registrant.

iii. The spot checks specified in 1.6.9(4)(c) shall be made.

[32]For the purpose of determining the CTDI, the manufacturer's statements as to the nominal tomographic section thickness for that particular system may be utilized.

vii. Procedures for the measurement of radiation output shall be in writing. Records of measurements performed shall be maintained for inspection by the Agency.

c. **Spot Checks.**

i. The spot-check procedures shall be in writing and shall have been developed by a qualified expert.

ii. The spot-check procedures shall incorporate the use of a CT dosimetry phantom which has a capability of providing an indication of contrast scale, noise, nominal tomographic section thickness, the resolution capability of the system for low and high contrast objects, and measuring the mean *CTN* for water or other reference material.

iii. All spot checks shall be included in the measurement required by 1.6.9(4)(b) and at time intervals and under system conditions specified by a qualified expert.

iv. Spot checks shall include acquisition of images obtained with the CT dosimetry phantom(s) using the same processing mode and CT conditions of operation as are used to perform measurements required by 1.6.9(4)(b). The images shall be retained, until a new measurement is performed, in two forms as follows:

i. photographic copies of the images obtained from the image display device; and

ii. images stored in digital form on a storage medium compatible with the CT x-ray system.

v. Written records of the spot checks performed shall be maintained for inspection by the Agency.

d. **Operating Procedures.**

i. The CT x-ray system shall not be operated except by an individual who has been specifically trained in its operation.

ii. Information shall be available at the control panel regarding the operation of the system and measurements of radiation output. Such information shall include the following:

i. dates of the latest measurements and spot checks and the location within the facility where the results of those tests may be obtained;

ii. instructions on the use of the CT dosimetry phantom(s) including a schedule of spot checks appropriate for the system, allowable variations for the indicated parameters,

and the results of at least the most recent spot checks conducted on the system;

iii. the distance in millimeters between the tomographic plane and the reference plane if a reference plane is utilized; and

iv. a current technique chart available at the control panel which specifies for each routine examination the CT conditions of operation and the number of scans per examination.

iii. If the measurement or spot check of the CT x-ray system identifies that a system operating parameter has exceeded a tolerance established by the qualified expert, use of the CT x-ray system on patients shall be limited to those permitted by established written instructions of the qualified expert.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.6.10 **Mammography X-Ray Systems.**

1. **Equipment Standards.**

a. **System Design.** The x-ray system shall be specifically designed for mammography.

b. **Image Receptor.** The image receptor systems and their individual components shall be specifically designed for or appropriate for mammography.

c. **Target/Filter.** The x-ray system must have the capability of providing kVp/target/filter combinations appropriate to image receptor systems meeting the requirements of 1.6.10(1)(b).

d. **Beam Quality.**

i. When used with screen-film image receptors, and the contribution to filtration made by the compression device is included, the useful beam shall have a half-value layer (HVL) between the values of: measured kVp/100 and measured kVp/100 + 0.1 millimeters aluminum equivalent.

ii. For Xeroradiography using a kVp in the range of 35-50, the HVL of the useful beam with the compression device in place shall be at least 1.2 mm aluminum equivalent.

iii. For all other imaging systems, the HVL shall not be less than that specified in 1.6.4(5)(a).

e. **Resolution.** The combination of focal spot size, source-to-image distance and magnification shall produce a radiograph with a resolution of at least

12.5 cycles per millimeter at an object-to-image receptor distance of five centimeters. This standard applies to the routine mammographic film being utilized at the facility. Compliance shall be deemed to have been met if AAPM Report No. 29, Table 3-3 (See Subchapter 6, Appendix D) is followed.

f. **Compression.**

i. The x-ray system shall be capable of compressing the breast with a force of at least 25 pounds and the maximum force shall be no greater than 40 pounds.

ii. To within 1% of the source-to-image distance, the chest wall edge of the compression paddle must be aligned with the chest wall edge of the image receptor when the image receptor is placed in normal imaging position.

g. **System Capabilities.** A mammographic x-ray system utilizing screen-film image receptors shall have:

i. the capability of using anti-scatter grids which are:

i. specifically designed for mammography;

ii. integral to the x-ray system; and

iii. available for all image receptor sizes.

ii. the capability of automatic exposure control for systems installed after the effective date of these regulations.

h. **Milliampere-second Read-out Accuracy**. All mammographic x-ray systems shall indicate, or provide the means of determining, the mAs resulting from each exposure made with automatic exposure control. The accuracy of the mAs read-out shall be within 10% of the actual mAs delivered.

i. **Transmission.** For x-ray systems manufactured after September 5, 1978, the transmission of the primary beam through any image receptor support provided with the system shall be limited such that the exposure 5 centimeters from any accessible surface beyond the plane of the image receptor supporting device does not exceed 0.1 milliroentgen (25.8 nC/kg) for each activation of the tube. Exposure shall be measured with the system operated at the minimum SID for which it is designed. Compliance shall be determined at the maximum rated peak tube potential for the system and at the maximum rated product of tube current and exposure time (mAs) for that peak tube potential. Compliance shall be determined by measurements averaged over an area of 100 square centimeters with no linear dimension greater than 20 centimeters.

j. **Collimation.**

i. The mammographic system shall be provided with means to limit the useful beam such that the x-ray field at the plane of the image receptor does not extend beyond any edge of the image receptor at any designated SID except the edge of the image receptor designed to be adjacent to the chest wall where the x-ray field may not extend beyond this edge by more than 2 percent of the SID. This requirement can be met with a system which performs as prescribed in 1.6.6(1)(d)(iii). When the beam-limiting device and image receptor support device are designed to be used to immobilize the breast during a mammographic procedure, and the SID may vary, the SID indication specified in 1.6.6(1)(d)(iii)(i) and (ii) shall be the maximum SID for which the beam-limiting device or aperture is designed. In addition, each image receptor support intended for use on a system designed only for mammography shall have clear and permanent markings to indicate the maximum image receptor size for which it is designed.

ii. The misalignment for the chest-wall edge of the collimator light field with the chest-wall edge of the x-ray beam shall not exceed 2% of the SID. The edge of the x-ray beam on the other three sides shall not exceed the edge of the light field on those sides.

k. **Accuracy of kVp.** The accuracy of the indicated kVp shall be no less than ± 2 kVp.

l. **Automatic Exposure Control Performance**. See 1.6.6(4). In addition, those mammographic systems operating with automatic exposure control shall be able to maintain film density to within ± 0.3 OD of the average OD over the range of clinically used kVps, for phantom thicknesses of 2 centimeters to 6 centimeters.

m. **Radiation Output Minimum.** At a kVp of 28, the mammographic system shall be capable of generating at least 8 mR/mAs and at least 800 mR/second, measured at a point 4.5 centimeters from the surface of the patient support device when the SID is at its maximum.

n. **Screen-film Contact.** Cassettes shall not be used for mammography if one or more large areas (>1 cm) of poor contact can be seen in a 30-40 mesh test.

o. **Image Quality.** The minimum image quality achieved at a mammographic facility shall be the ability to observe the image of a 0.75 mm fiber, 0.32 mm speck group, and a 0.75 mm mass from an ACR phantom or equivalent on the standard mammographic film in use in a facility. No mammograms shall be taken on patients if this minimum is not met.

p. **Dose**. The mean glandular dose for one craniocaudal view of a 4.5 cm (1.8 inch) compressed breast, composed of 50 percent adipose/50 percent glandular tissue, shall not exceed the following values:

i. 100 millirads (1 milligray) for non-grid screen - film systems.

ii. 300 millirads (3 milligray) for screen-film systems.

iii. 400 millirads (4 milligray) for Xerography systems.

2. **Quality Assurance.**

a. **Quality Assurance Program Required.** The registrant shall have a written, ongoing equipment quality assurance program specific to mammographic imaging, covering all components of the diagnostic x-ray imaging system, to ensure consistently high-quality images with minimum patient exposure. Responsibilities under this requirement include:

i. conducting or training others to conduct equipment performance monitoring functions;

ii. analyzing the monitoring results to determine if there are problems requiring correction;

iii. carrying out or arranging for the necessary corrective actions when results of quality control test results including those specified in 1.6.10(2)(c) indicate the need; and

iv. maintenance of records documenting 1.6.10(2)(a)(i) through (iii) above.

b. **Quality Assurance Program Review.** At intervals not to exceed 12 months, the registrant shall conduct a review of the effectiveness of the quality assurance program required in 1.6.10(2)(a) and maintain a written report of such review. The two most recent copies of such reports shall be available for inspection by the agency.

c. **Equipment Quality Control Tests.** The registrant shall ensure that the following quality control tests are performed when applicable equipment is initially installed and according to the frequency specified, and that applicable tests are performed after major changes or replacement of parts:[33]

i. Processor performance by sensitometric means daily, prior to the first patient exposure. For any mammography registrant using film processors at multiple locations, such as a mobile service, each processor shall be subject to this requirement. Corrective action shall be taken when:

[33] Operator/technologist generally performs tests i - vi, Physicist generally performs tests vii - xiv.

i. deviations of (0.15 or more in Optical Density (OD) from established operating levels occur for readings of mid-density (MD) and density difference (DD) on the sensitometric control charts.

ii. base plus fog (B+F) exceeds the established operating level by more than 0.03 OD.

ii. Screen-film contact and artifact detection - 6 months.

iii. Screen cleaning - monthly.

iv. Compression device performance (releases, level of force, etc.) - 6 months.

v. Image quality (using a test "phantom," which simulates the composition of the breast and includes normal and pathological breast structures) - monthly for stationary systems and prior to performing mammography at each new location for mobile systems.

vi. Dark dusting of Xerographic plates in positive mode - monthly.

vii. For receptor speed uniformity (screen-film cassette) - 12 months.

viii. Collimator alignment - 12 months.

ix. Primary/secondary barrier transmission - upon initial x-ray system installation only.

x. Resolution and/or focal spot size - upon tube installation or replacement only.

xi. Half-value-layer - 12 months.

xii. kVp accuracy - 12 months.

xiii. Output reproducibility, mA linearity, timer linearity, and mR/mAs - 12 months.

xiv. Automatic exposure control reproducibility, including kVp response and thickness response - 12 months.

d. **Additional Quality Control Requirements.** The registrant shall perform the following observations according to the frequency noted and record the results. Corrections of problems noted shall be made and recorded. Records shall be maintained over the most recent two year period.

i. Retake rate - 3 months or after 250 patients.

ii. Viewbox uniformity - 6 months.

iii. Darkroom integrity - 6 months.

iv. Adequacy of film storage (including storage after exposure if processing does not occur immediately) 12 months.

3. **Additional Facility Requirements.**

a. **Masks.** Masks may be provided on the viewboxes to block extraneous light from the viewer's eye when the illuminated surface of the viewbox is larger than the film size or area of clinical interest.

b. **Film Processing.** Film processors utilized for mammography shall be adjusted to and operated at the specifications recommended by the mammographic film manufacturer, or at other settings such that the sensitometric performance is at least equivalent.

c. **Instrument Calibration.** An image quality phantom and calibrated sensitometer, densitometer and thermometer must be available to each facility in order to comply with the quality control test frequencies specified in 1.6.10(2)(c) of this section. The calibration of the instruments must be checked every 12 months.

d. **Operator Qualifications**. The operator of the x-ray machine shall be certified by the American Registry of Radiologic Technologists or an equivalent state licensing body and shall have had special training in mammography.

e. **Physician Qualifications**. The physician interpreting the mammograms shall be certified by the American Board of Radiology, the American Osteopathic Board of Radiology, or Board eligible, or equivalent, and shall have had special training in mammography and image interpretation.

f. **Physicist Qualifications**. The person performing evaluation of mammographic system performance in accordance with these regulations shall be certified by the American Board of Radiology or equivalent or be recognized as competent by a state radiation control program.

g. **Image Retention**. Clinical images shall be retained for a minimum of 5 years.

h. **Retake Rate.** The minimum acceptable retake rate shall be no greater than 5%.

i. **Darkroom Fog**. Darkroom fog levels shall not exceed 0.05 OD when sensitized film is exposed to darkroom conditions with safelight on for 2 minutes.

4. **Personnel Responsibilities.**

a. **Operator/Technologist.**

Daily.

i. Processor performance in accordance with 1.6.10(2)(c)(i).

Monthly.

ii. Screen cleaning.

iii. Image quality in accordance with 1.6.10(2)(c)(v).

iv. Dark dusting.

Quarterly.

v. Retake rate.

Semiannually.

vi. Screen-film contact and artifact detection.

vii. Compression device performance.

viii. Viewbox uniformity.

ix. Darkroom integrity.

Annually.

x. Adequacy of film storage.

b. **Medical Physicist.**

Initially and as specified by the medical physicist.

i. Primary/secondary barrier transmission.

ii. Resolution and/or focal spot size.

Annually.

iii. Receptor speed uniformity.

iv. Collimator alignment.

v. Half-value-layer.

vi. kVp accuracy.

vii. Output reproducibility, mA linearity, timer linearity, and mR/mAs.

viii. Automatic exposure control reproducibility, including kVp response and thickness response.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX A

Determination Of Competence

The following are areas in which the agency considers it important that an individual have expertise for the competent operation of x-ray equipment.

I. Familiarization With Equipment.

a. Identification of controls.

b. Function of each control.

c. How to use a technique chart.

II. Radiation Protection.

a. Collimation.

b. Filtration.

c. Gonad shielding and other patient protection devices if used.

d. Restriction of x-ray tube radiation to the image receptor.

e. Personnel protection.

f. Grids.

III. Film Processing.

a. Film speed as related to patient exposure.

b. Film processing parameters.

c. Quality Assurance Program.

IV. Emergency Procedures.

a. Termination of exposure in event of automatic timing device failure.

V. Proper use of Personnel Dosimetry, if Required.

VI. Understanding Units of Radiation.

APPENDIX B

Information To Be Submitted By Persons Proposing To Conduct Healing Arts Screening

Persons requesting that the Agency approve a healing arts screening program shall submit the following information and evaluation:

I. Name and address of the applicant and, where applicable, the names and addresses of agents within this State.

II. Diseases or conditions for which the x-ray examinations are to be used in diagnoses.

III. A detailed description of the x-ray examinations proposed in the screening program.

IV. Description of the population to be examined in the screening program, i.e., age, sex, physical condition, and other appropriate information.

V. An evaluation of any known alternate methods not involving ionizing radiation which could achieve the goals of the screening program and why these methods are not used instead of the x-ray examinations.

VI. An evaluation by a qualified expert of the x-ray system(s) to be used in the screening program. The evaluation by the qualified expert shall show that such system(s) do satisfy all requirements of these regulations. The evaluation shall include a measurement of patient exposures for the x-ray examinations to be performed.

VII. A description of the diagnostic x-ray quality control program.

VIII. A copy of the technique chart for the x-ray examination procedures to be used.

IX. The qualifications of each individual who will be operating the x-ray system(s).

X. The qualifications of the individual who will be supervising the operators of the x-ray system(s). The extent of supervision and the method of work performance evaluation shall be specified.

XI. The name and address of the individual who will interpret the radiograph(s).

XII. A description of the procedures to be used in advising the individuals screened and their private practitioners of the healing arts of the results of the screening procedure and any further medical needs indicated.

XIII. A description of the procedures for the retention or disposition of the radiographs and other records pertaining to the x-ray examinations.

XIV. An indication of the frequency of screening and the duration of the entire screening program.

APPENDIX C

Exemptions From Shielding For Certain Fluoroscopic Procedures

I. Myelograms

II. Arthrograms

III. Angiograms

IV. Percutaneous nephrostomies

V. Biliary drainage procedures

VI. Percutaneous cholangiograms

VII. T-tube cholangiograms

VIII. Sinograms or fistulograms

IX. Fluoroscopic biopsy procedures

APPENDIX D

Actual (f_{eff}) and Nominal (f_{nom}) Focal Spot Sizes necessary to achieve an Object Plan Spatial Resolution of 12.5 cycles/mm at the Chest Wall

SID (cm)	Magnification	f_{eff} (mm)	f_{nom} (mm)
80	1.07	1.2	0.6
65	1.08	1.1	0.5
50	1.11	0.85	0.4
--	1.5	0.23	0.15
--	2.0	0.15	0.10

Subchapter 7 Use of Radionuclides In The Healing Arts

Rule 1.7.1 **Purpose and Scope.** Subchapter 7 establishes requirements and provisions for the production, preparation, compounding and use of radionuclides in the healing arts and for issuance of licenses authorizing the medical use of this material. These requirements and provisions provide for the radiation safety of workers, the general public, patients, and human research subjects. The requirements and provisions of Subchapter 7 are in addition to, and not in substitution for, other applicable provisions of these regulations. The requirements and provisions of these regulations apply to applicants and licensees subject to Subchapter 7 unless specifically exempted.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.2 **Definitions.** As used in Subchapter 7, the following definitions apply:

1. "Address of Use" means the building or buildings that are identified on the license and where radioactive material may be produced, prepared, received, used or stored.

2. "Area of use" means a portion of an address of use that has been set aside for the purpose of receiving, using or storing radioactive material.

3. "Authorized medical physicist" means an individual who:

   a. Meets the requirements in 1.7.20(1) or 1.7.23; or

   b. Is identified as an authorized medical physicist or teletherapy physicist on:

      i. a specific medical use license or equivalent permit issued by the Agency, Nuclear Regulatory Commission, Agreement State or Licensing State;

      ii. a permit issued by the Agency, Nuclear Regulatory Commission, Agreement State or Licensing State broad scope medical use licensee; or

      iii. a medical use permit issued by a Nuclear Regulatory Commission master material licensee; or

      iv. a permit issued by a Nuclear Regulatory Commission master material license broad scope medical use permittee.

4. "Authorized nuclear pharmacist" means a pharmacist who:

   a. Meets the requirements in 1.7.21(1) or 1.7.23; or

   b. Is identified as an authorized nuclear pharmacist on:

i. a specific license that authorizes medical use or, the practice of nuclear pharmacy, issued by the Agency, Nuclear Regulatory Commission, Agreement State or Licensing State;

ii. a permit issued by a Nuclear Regulatory Commission master material licensee that authorizes medical use or the practice of nuclear pharmacy;

iii. a permit issued by an Agency, Nuclear Regulatory Commission, Agreement State or Licensing State broad scope medical use licensee that authorizes medical use or the practice of nuclear pharmacy;

iv. a permit issued by a Nuclear Regulatory Commission master material license broad scope medical use permittee that authorizes medical use or the practice of nuclear pharmacy; or

v. by a commercial nuclear pharmacy that has been authorized to identify authorized nuclear pharmacists; or

vi. Is designated as an authorized nuclear pharmacist in accordance with 1.3.12(10)(b)(iv).

5. "Authorized user" means a physician, dentist, or podiatrist who:

a. Meets the requirements in 1.7.23 and 1.7.39(1), 1.7.43(1), 1.7.48(1), 1.7.49(1), 1.7.50(1), 1.7.60(1), 1.7.61, 1.7.63(1), or 1.7.81(1); or

b. Is identified as an authorized user on:

i. a license issued by the Agency, Nuclear Regulatory Commission, Agreement State or Licensing State;

ii. A permit issued by a Nuclear Regulatory Commission master material licensee that is authorized to permit the medical use of radioactive material;

iii. A permit issued by an Agency, Nuclear Regulatory Commission or Agreement State specific licensee of broad scope that is authorized to permit the medical use of radioactive material; or

iv. A permit issued by a Nuclear Regulatory Commission master material license broad scope permittee that is authorized to permit the medical use of radioactive material.

6. "Brachytherapy" means a method of radiation therapy in which plated, embedded, activated, or sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, intraluminal or interstitial application.

7. "Client's address" means the address of use or a temporary jobsite for the purpose of providing mobile medical service in accordance with 1.7.34.

8. "Dedicated check source" means a radioactive source that is used to assure the consistent response of a radiation detection or measurement device over several months or years.

9. "Dentist" means an individual licensed to practice dentistry by the state in which the Agency is located.

10. "Diagnostic clinical procedures manual" means a collection of written procedures that describes each method (and other instructions and precautions) by which the licensee performs diagnostic clinical procedures; where each diagnostic clinical procedure has been approved by the authorized user and includes the radiopharmaceutical, dosage, and route of administration, or in the case of sealed sources for diagnosis, the procedure.

11. "High dose-rate remote afterloader" (HDR) means a device that remotely delivers a dose rate in excess of 12 gray (1200 rads) per hour at the point or surface where the dose is prescribed.

12. "Low dose-rate remote afterloader"(LDR) means a device that remotely delivers a dose rate of less than or equal to 2 gray (200 rads) per hour at the point or surface where the dose is prescribed.

13. "Management" means the chief executive officer or other individual having the authority to manage, direct, or administer the licensee's activities, or those persons' delegate or delegates.

14. “Manual brachytherapy”, as used in this section, means a type of brachytherapy in which the brachytherapy sources (e.g., seeds, ribbons) are manually placed topically on or inserted either into the body cavities that are in close proximity to a treatment site or directly into the tissue volume.

15. "Medical institution" means an organization in which several medical disciplines are practiced.

16. "Medical use" means the intentional internal or external administration of radioactive material, or the radiation from radioactive material to patients or human research subjects under the supervision of an authorized user.

17. "Medium dose-rate remote afterloader" (MDR) means a device that remotely delivers a dose rate of greater than 2 gray (200 rads), but less than, or equal to, 12 gray (1200 rads) per hour at the treatment site.

18. "Misadministration" means an event that meets the criteria in 1.7.110(1).

19. "Mobile nuclear medicine service" means the transportation of radioactive material to and its medical use at the client’s address.

20. "Output" means the exposure rate, dose rate, or a quantity related in a known manner to these rates from a brachytherapy source, or a teletherapy, remote afterloader, or gamma stereotactic radiosurgery unit for a specified set of exposure conditions.

21. "Patient intervention" means actions by the patient or human research subject, whether intentional or unintentional, such as dislodging or removing treatment devices or prematurely terminating the administration.

22. "Pharmacist" means an individual licensed by the appropriate authority to practice pharmacy in the state in which the Agency is located.

23. "Physician" means a doctor of medicine or doctor of osteopathy licensed by the appropriate authority to prescribe drugs in the practice of medicine in the state in which the Agency is located.

24. "Podiatrist" means an individual licensed by the appropriate authority to practice podiatry in the state in which the Agency is located.

25. “Positron Emission Tomography (PET) radionuclide production facility” means a facility operating a cyclotron or accelerator for the purpose of producing PET radionuclides.

26. "Preceptor" means an individual who provides, directs, or verifies the training and experience required for an individual to become an authorized user, an authorized medical physicist, an authorized nuclear pharmacist, or a Radiation Safety Officer.

27. "Prescribed dosage" means the specified activity or range of activity of a radioactive drug as documented:

    a. In a written directive as specified in 1.7.16; or

    b. In accordance with the directions of the authorized user for procedures performed pursuant to 1.7.37 and 1.7.40.

28. "Prescribed dose" means:

    a. For gamma stereotactic radiosurgery, the total dose as documented in the written directive; or

    b. For teletherapy, the total dose and dose per fraction as documented in the written directive; or

    c. For manual brachytherapy, either the total source strength and exposure time or the total dose, as documented in the written directive; or

    d. For remote brachytherapy afterloaders, the total dose and dose per fraction as documented in the written directive.

29. "Pulsed dose-rate remote afterloader" (PDR) means a special type of remote afterloading device that uses a single source capable of delivering dose rates in the "high dose-rate" range, but:

    a. Is approximately one-tenth of the activity of typical high dose-rate remote afterloader sources; and

    b. Is used to simulate the radiobiology of a low dose rate treatment by inserting the source for a given fraction of each hour.

30. "Radiation Safety Officer" means an individual who:

    a. Meets the requirements in 1.7.19(1) or 1.7.19(3)(a) and 1.7.23;

    b. Is identified as a Radiation Safety Officer on:

        i. a specific medical use license issued by the Agency, Nuclear Regulatory Commission or Agreement State license; or

        ii. A medical use permit issued by a Nuclear Regulatory Commission master material licensee.

31. "Radioactive drug" means any chemical compound containing radioactive material that may be used on or administered to patients or human research subjects as an aid in the diagnosis, treatment, or prevention of disease or other abnormal condition.

32. "Sealed source" means any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

33. "Sealed Source and Device Registry" means the national registry that contains the registration certificates maintained by the Nuclear Regulatory Commission, that summarizes the radiation safety information for the sealed sources and devices and describe the licensing and use conditions approved for the product.

34. "Stereotactic radiosurgery" means the use of external radiation in conjunction with a stereotactic guidance device to very precisely deliver a dose to a treatment site.

35. "Structured educational program" means an educational program designed to impart particular knowledge and practical education through interrelated studies and supervised training.

36. "Teletherapy" means a method of radiation therapy in which collimated gamma rays are delivered at a distance from the patient or human research subject.

37. "Temporary jobsite" means a location where mobile medical services are conducted other than the location(s) of use authorized on the license.

38. "Therapeutic dosage" means a dosage of unsealed radioactive material that is intended to deliver a radiation dose to a patient or human research subject for palliative or curative treatment.

39. "Therapeutic dose" means a radiation dose delivered from a sealed source containing radioactive material to a patient or human research subject for palliative or curative treatment.

40. "Treatment site" means the anatomical description of the tissue intended to receive a radiation dose, as described in a written directive.

41. "Type of use" means use of radioactive material as specified under 1.7.37, 1.7.40, 1.7.44, 1.7.52, 1.7.62, 1.7.64 or 1.7.82.

42. "Unit dosage" means a dosage that:

    a. Is obtained or prepared in accordance with the regulations for uses described in 1.7.37, 1.7.40, or 1.7.44; and

    b. Is to be administered as a single dosage to a patient or human research subject without any further manipulation of the dosage after it is initially prepared

43. "Visiting authorized user" means an authorized user who is not identified on the license of the licensee being visited.

44. "Written directive" means an authorized user's written order for the administration of radioactive material or radiation from radioactive material to a specific patient or human research subject, as specified in 1.7.16.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.3 **Maintenance of Records.** Each record required by Subchapter 7 must be legible throughout the retention period specified by each Agency regulation. The record may be the original, a reproduced copy, or a microform provided that the copy or microform is authenticated by authorized personnel and the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, and specifications must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.4 **Provisions for Research Involving Human Subjects.** A licensee may conduct research involving human subjects using radioactive material provided:

1. That the research is conducted, funded, supported, or regulated by a Federal agency which has implemented the Federal Policy for the Protection of Human Subjects. Otherwise, a licensee shall apply for and receive approval of a specific

amendment to its Agency Nuclear Regulatory Commission license before conducting such research. Both types of licensees shall, at a minimum, obtain prior informed consent from the human subjects and obtain prior review and approval of the research activities by an "Institutional Review Board" in accordance with the meaning of these terms as defined and described in the Federal Policy for the Protection of Human Subjects;

2. The research involving human subjects authorized in 1.7.4(1) shall be conducted using radioactive material authorized for medical use in the license; and

3. Nothing in 1.7.4 relieves licensees from complying with the other requirements in Subchapter 7.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.5 **U.S. Food and Drug Administration, Federal, and State Requirements.** Nothing in this section relieves the licensee from complying with applicable U.S. Food and Drug Administration, other Federal, and State requirements governing radioactive drugs or devices.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.6 **Implementation.**

1. A licensee shall implement the provisions in Subchapter 7 on the effective date of these regulations.

2. When a requirement in Subchapter 7 differs from the requirement in an existing license condition, the requirement in this section shall govern.

3. Any existing license condition that is not affected by a requirement in Subchapter 7 remains in effect until there is a license amendment or license renewal.

4. If a license condition exempted a licensee from a provision of Subchapter 7 on the effective date of these regulations, it will continue to exempt a licensee from the corresponding provision in Subchapter 7.

5. If a license condition cites provisions in Subchapter 7 that will be deleted on the effective date of these regulations, then the license condition remains in effect until there is a license amendment or license renewal that modifies or removes this condition.

6. Licensees shall continue to comply with any license condition that requires it to implement procedures required by 1.7.67, 1.7.73 through 1.7.75 until there is a license amendment or renewal that modifies the license condition.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.7 **License Required.**

1. A person shall only manufacture, produce, prepare, acquire, receive, possess, use, or transfer radioactive material for medical use only in accordance with a specific license issued by the Agency, the Nuclear Regulatory Commission or an Agreement State, or as allowed in 1.7.7(2) or 1.7.7(3).

2. An individual may receive, possess, use, or transfer radioactive material in accordance with the regulations in Subchapter 7 under the supervision of an authorized user as provided in 1.7.15, unless prohibited by license condition.

3. An individual may prepare unsealed radioactive material for medical use in accordance with the regulations in Subchapter 7 under the supervision of an authorized nuclear pharmacist or authorized user as provided in 1.7.15, unless prohibited by license condition.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.8 **License Amendments.** A licensee shall apply for and receive a license amendment:

1. Before it receives, prepares, uses radioactive material for a type of use that is permitted under Subchapter 7, but is not authorized on the licensee's current license issued pursuant to Subchapter 7;

2. Before it permits anyone, except a visiting authorized user described in 1.7.10, to work as an authorized user, authorized nuclear pharmacist, or authorized medical physicist under the license;

3. Before it changes Radiation Safety Officer.

4. Before it receives radioactive material in excess of the amount, or in a different physical or chemical form than authorized on the license;

5. Before it adds to or changes the areas of use or address or address(es) of use identified in the application or on the license;

6. Before it changes the areas of use or address(es) of use identified in the application or on the license;

7. Before it changes statements, representations, and procedures which are incorporated into the license; and

8. Before it releases licensed facilities for unrestricted use.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.9 **Notifications.**

1. A license shall notify the Agency in writing within 30 days when:

a. an authorized user, an authorized nuclear pharmacist, a Radiation Safety Officer, or an authorized medical physicist, permanently discontinues performance of duties under the license or has a name change;

b. The licensee's mailing address changes; or

c. The licensee's name changes, but the name change does not constitute a transfer of control of the license as described in 1.3.31(2) of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.10 **Visiting Authorized User.**

1. A licensee may permit any visiting authorized user to use licensed material for medical use under the terms of the licensee's license for 60 days each calendar year if:

   a. The visiting authorized user has the prior written permission of the licensee's management and, if the use occurs on behalf of an institution, the institution's Radiation Safety Committee;

   b. The licensee has a copy of a license issued by the Agency that identifies the visiting authorized user by name as an authorized user for medical use; and

   c. Only those procedures for which the visiting authorized user is specifically authorized by the Agency license are performed by that individual.

2. A licensee need not apply for a license amendment in order to permit a visiting authorized user to use licensed material as described in 1.7.10(1).

3. A licensee shall retain copies of the records specified in 1.7.10(1) for 5 years after the visiting authorized user's last use of licensed material.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.11 **Mobile Medical Service Administrative Requirements.**

1. The Agency shall license mobile medical services or clients of such services. The mobile medical service shall be licensed if the service receives, uses, or possesses radioactive material. The client of the mobile medical service shall be licensed if the client receives or possesses radioactive material to be used by a mobile medical service.

2. Mobile medical service licensees shall obtain a letter signed by the management of each location where services are rendered that authorizes use of radioactive material at the client's address of use. This letter shall clearly delineate the authority and responsibility of both the client and the mobile medical service. If the client is licensed, the letter shall document procedures for notification,

receipt, storage and documentation of transfer of radioactive material delivered to the client's address for use by the mobile medical service.

3. A mobile medical service shall not have radioactive material delivered directly from the manufacturer or the distributor to the client's address of use, unless the client has a license allowing possession of the radioactive material. Radioactive material delivered to the client's address of use shall be received and handled in conformance with the client's license.

4. A mobile medical service shall inform the client's management who is on site at each client's address of use at the time that radioactive material is being administered.

5. A licensee providing mobile medical services shall retain the letter required in 1.7.11(2) in accordance with 1.7.93.

6. A mobile medical service licensee shall, at a minimum, maintain the following documents on each mobile unit:

   a. The current operating and emergency procedures;

   b. A copy of the license;

   c. Copies of the letter required by 1.7.11(2);

   d. Current calibration records for each survey instrument and diagnostic equipment or dose delivery device in use; and

   e. Survey records covering uses associated with the mobile unit during, at a minimum, the preceding 30 calendar days.

7. A mobile medical service licensee shall maintain all records required by Subchapters 4 and 7 of these regulations at a location within the Agency's jurisdiction that is:

   a. A single address of use:

      i. Identified as the records retention location; and

      ii. Staffed at all reasonable hours by individual(s) authorized to provide the Agency with access for purposes of inspection; or

   b When no address of use is identified on the license for records retention, the mobile unit:

      i. Identified in the license; and

      ii. Whose current client's address schedule and location schedule is reported to the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.12 **Exemptions Regarding Type A Specific Licenses of Broad Scope.** A licensee possessing a specific license of broad scope for medical use is exempt from:

1. The provisions of 1.7.8(2) regarding the need to file an amendment before permitting anyone to work as an authorized user, an authorized nuclear pharmacist or an authorized medical physicist under the license;

2. The provisions of 1.7.8(5) regarding additions to or changes in the areas of use at the addresses specified in the license; and

3. The provisions of 1.7.9 regarding notification to the Agency for new authorized users, new authorized nuclear pharmacists and new authorized medical physicists.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.13 **Authority and Responsibilities for the Radiation Protection Program.**

1. In addition to the radiation protection program requirements of 1.4.1 of these regulations, a licensee's management must approve in writing:

   a. Requests for license application, renewal, or amendments before submittal to the Agency;

   b. Any individual before allowing that individual to work as an authorized user, authorized nuclear pharmacist or authorized medical physicist; and

2. A licensee's management shall appoint a Radiation Safety Officer, who agrees in writing to be responsible for implementing the radiation protection program. The licensee, through the Radiation Safety Officer, shall ensure that radiation safety activities are being performed in accordance with licensee-approved procedures and regulatory requirements.

3. For up to sixty days each year, a licensee may permit an authorized user or an individual qualified to be a radiation safety officer to function as a temporary Radiation Safety Officer and to perform the functions of a Radiation Safety Officer, as provided in 1.7.13(5), provided the licensee takes the actions required in 1.7.13(2),(4),(5) and (8). A licensee may simultaneously appoint more than one temporary RSO, if needed, to ensure that the licensee has a temporary RSO that satisfies the requirements to be an RSO for each of the different uses of radioactive material permitted by the license.

4. A licensee shall establish in writing the authority, duties, and responsibilities of the Radiation Safety Officer.

5. A licensee shall provide the Radiation Safety Officer sufficient authority, organizational freedom, time, resources, and management prerogative, to:

   a. Identify radiation safety problems;

   b. Initiate, recommend, or provide corrective actions;

c. Stop unsafe operations; and

d. Verify implementation of corrective actions.

6. Licensees that are authorized for two or more different types of radioactive material use under 1.7.44, 1.7.52, 1.7.64, and 1.7.82, or two or more types of units under 1.7.64 shall establish a Radiation Safety Committee to oversee all uses of radioactive material permitted by the license. The Committee must include an authorized user of each type of use permitted by the license, the Radiation Safety Officer, a representative of the nursing service, and a representative of management who is neither an authorized user nor a Radiation Safety Officer, and may include other members as the licensee deems appropriate.

7. A licensee's Radiation Safety Committee shall meet as necessary, but at a minimum shall meet at intervals not to exceed 6 months. The licensee shall maintain minutes of each required meeting in accordance with 1.7.83.

8. To establish a quorum and to conduct business, one-half of the Committee's membership shall be present, including the Radiation Safety Officer and the management's representative.

9. A licensee shall retain a record of actions taken pursuant to 1.7.13(1), 1.7.13(2) and 1.7.13(4) in accordance with 1.7.83.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.14 **Duties of Authorized User and Authorized Medical Physicist.**

1. A licensee shall assure that only authorized users for the type of radioactive material used:

   a. Prescribe the radiopharmaceutical dosage and/or dose to be administered through the issuance of a written directive or reference to the diagnostic clinical procedures manual; and

   b. Direct, as specified in 1.7.15 and 1.7.16, or in license conditions, the administration of radioactive material for medical use to patients or human research subjects; and

   c. Prepare and administer, or supervise the preparation and administration of radioactive material for medical use, in accordance with 1.7.7(2), (3), and 1.7.15.

2. A licensee shall assure that only authorized medical physicists perform, as applicable:

   a. Full calibration measurements as described in 1.7.70 through 1.7.72;

   b. Periodic spot checks as described in 1.7.73, through 1.7.75; and

c. Radiation surveys as described in 1.7.77.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.15 **Supervision.**

1. A licensee that permits the receipt, possession, use, or transfer of radioactive material by an individual under the supervision of an authorized user as allowed by 1.7.7(2)shall:

   a. In addition to the requirements in 1.10.3 of these regulations, instruct the supervised individual in the licensee's written radiation protection procedures, written directive procedures, regulations of Subchapter 7, and license conditions with respect to the use of radioactive material; and

   b. Require the supervised individual to follow the instructions of the supervising authorized user for medical uses of radioactive material, written radiation protection procedures, written directive procedures, regulations of Subchapter 7, and license conditions with respect to the medical use of radioactive material.

2. A licensee that permits the preparation of radioactive material for medical use by an individual under the supervision of an authorized nuclear pharmacist or physician who is an authorized user, as allowed by 1.7.7(3), shall:

   a. Instruct the supervised individual in the preparation of radioactive material for medical use, as appropriate to that individual’s involvement with radioactive material; and

   b. Require the supervised individual to follow the instructions of the supervising authorized user or authorized nuclear pharmacist regarding the preparation of radioactive material for medical use, the written radiation protection procedures, the regulations of Subchapter 7, and license conditions.

3. Unless physical presence as described in other sections of Subchapter 7 is required, a licensee who permits supervised activities under 1.7.15(1) and 1.7.15(2) shall require an authorized user to be immediately available to communicate with the supervised individual.

4. A licensee that permits supervised activities under 1.7.15(1) and 1.7.15(2) is responsible for the acts and omissions of the supervised individual.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.16 **Written Directives.**

1. A written directive must be dated and signed by an authorized user prior to administration of I-131 sodium iodide greater than 1.11 megabecquerel (30 µCi), any therapeutic dosage of radioactive material or any therapeutic dose of radiation from radioactive material.

If, because of the emergent nature of the patient's condition, a delay in order to provide a written directive would jeopardize the patient's health, an oral directive will be acceptable, provided that the information contained in the oral directive is documented as soon as possible in the patient's record and a written directive is prepared within 48 hours of the oral directive;

2. The written directive must contain the patient or human research subject's name and the following:

   a. For an administration of a dosage of radioactive drug containing radioactive material: the radioactive drug containing radioactive material, dosage, and route of administration;

   b. For gamma stereotactic radiosurgery: the total dose, treatment site, and number of target coordinate settings per treatment for each anatomically distinct treatment site;

   c. For teletherapy: the total dose, dose per fraction, number of fractions, and treatment site;

   d. For high dose rate remote afterloading brachytherapy: the radionuclide, treatment site, dose per fraction, number of fractions, and total dose; or

   e. For all other brachytherapy including LDR, MDR, and PDR:

      i. Prior to implantation: treatment site, the radionuclide, and dose; and

      ii. After implantation but prior to completion of the procedure: the radioisotope, treatment site, number of sources, and total source strength and exposure time (or, the total dose).

3. A written revision to an existing written directive may be made provided that the revision is dated and signed by an authorized user prior to the administration of the dosage of radioactive drug containing radioactive material, the brachytherapy dose, the gamma stereotactic radiosurgery dose, the teletherapy dose, or the next fractional dose.

4. If, because of the patient's condition, a delay in order to provide a written revision to an existing written directive would jeopardize the patient's health, an oral revision to an existing written directive will be acceptable, provided that the oral revision is documented as soon as possible in the patient's record and revised written directive is signed by the authorized user within 48 hours of the oral revision.

5. The licensee shall retain the written directive in accordance with 1.7.84.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.17 **Procedures for Administrations Requiring a Written Directive.**

1. For any administration requiring a written directive, the licensee shall develop, implement, and maintain written procedures to provide high confidence that:

   a. The patient's or human research subject's identity is verified before each administration; and

   b. Each administration is in accordance with the written directive.

2. The procedures required by 1.7.17(1) must, at a minimum, address the following items that are applicable for the licensee's use of radioactive material:

   a. Verifying the identity of the patient or human research subject;

   b. Verifying that the specific details of the administration are in accordance with the treatment plan, if applicable, and the written directive;

   c. Checking both manual and computer-generated dose calculations; and

   d. Verifying that any computer-generated dose calculations are correctly transferred into the consoles of therapeutic medical units authorized by 1.7.64 or 1.7.82.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.18 **Suppliers for Sealed Sources or Devices for Medical Use.** For medical use a licensee shall use only:

1. Sealed sources or devices initially manufactured, labeled, packaged, and distributed in accordance with a license issued pursuant to Subchapter 3 of these regulations or the equivalent requirements of the Nuclear Regulatory Commission, an Agreement State or a Licensing State; or

2. Sealed sources or devices non-commercially transferred from an Agency, Nuclear Regulatory Commission, an Agreement State or a Licensing State medical use licensee.

3. Teletherapy sources manufactured and distributed in accordance with a license issued pursuant to Subchapter 3 of these regulations or the equivalent requirements of the Nuclear Regulatory Commission, an Agreement State or a Licensing State.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.19 **Training for Radiation Safety Officer.** Except as provided in 1.7.22, the licensee shall require an individual fulfilling the responsibilities of the Radiation Safety Officer (RSO) as provided in 1.7.13 to be an individual who:

1. Is certified by a specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission, or an Agreement State and who

meets the requirements in 1.7.19(4) and (5).[34] To have its certification process recognized, a specialty board shall require all candidates for certification to:

a. **Radiation Safety Officer**

i. Hold a bachelor's or graduate degree from an accredited college or university in physical science or engineering or biological science with a minimum of 20 college credits in physical science;

ii. Have 5 or more years of professional experience in health physics (graduate training may be substituted for no more than 2 years of the required experience) including at least 3 years in applied health physics; and

iii. Pass an examination administered by diplomates of the specialty board, which evaluates knowledge and competence in radiation physics and instrumentation, radiation protection, mathematics pertaining to the use and measurement of radioactivity, radiation biology, and radiation dosimetry; or

b. **Radiation Safety Officer**

i. Hold a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university;

ii. Have 2 years of full-time practical training and/or supervised experience in medical physics:

i. Under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by the Nuclear Regulatory Commission or an Agreement State; or

ii. In clinical nuclear medicine facilities providing diagnostic and/or therapeutic services under the direction of physicians who meet the requirements for authorized users in 1.7.22, 1.7.43 or 1.7.48;

iii. Pass an examination, administered by diplomates of the specialty board, that assesses knowledge and competence in clinical diagnostic radiological or nuclear medicine physics and in radiation safety; or

2. Has completed a structural educational program consisting of 200 hours of classroom and laboratory training as follows:

a. Radiation physics and instrumentation;

[34] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

b. Radiation protection;

c. Mathematics pertaining to the use and measurement of radioactivity;

d. Radiation biology;

e. Radiation dosimetry; and

f. 1 year of full time radiation safety experience under the supervision of the individual identified as the Radiation Safety Officer; on an Agency, Nuclear Regulatory Commission or Agreement State license or a permit issued by a Nuclear Regulatory Commission master material licensee that authorizes similar type(s) of use(s) of radioactive material involving the following:

i. Shipping, receiving, and performing related radiation surveys;

ii. Using and performing checks for proper operation of instruments used to determine the activity of dosages, survey meters, and instruments used to measure radionuclides;

iii. Securing and controlling radioactive material;

iv. Using administrative controls to avoid mistakes in the administration of radioactive material;

v. Using procedures to prevent or minimize radioactive contamination and using proper decontamination procedures;

vi. Using emergency procedures to control radioactive material; and

vii. Disposing of radioactive material; or

3. **Radiation Safety Officer**

a. Is a medical physicist who has been certified by a specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission, or another Agreement State under 1.7.20(1) and has experience in radiation safety for similar types of use of radioactive material for which the licensee is seeking the approval of the individual as Radiation Safety Officer and who meets the requirements in.1.7.19(4) and (5); or

b. Is an authorized user, authorized medical physicist, or authorized nuclear pharmacist identified on the licensee's license and has experience with the radiation safety aspects of similar types of use of radioactive material for which the individual has Radiation Safety Officer responsibilities; and,

4. Has obtained written attestation, signed by a preceptor Radiation Safety Officer, that the individual has satisfactorily completed the requirements in 1.7.19(5) and in 1.7.19(1)(a)(i) and (ii) or 1.7.19(1)(b)(i) and (ii) or 1.7.19(2) or 1.7.19(3)(a) or

(b), and has achieved a level of radiation safety knowledge sufficient to function independently as a Radiation Safety Officer for a medical use licensee; and

5. Has training in the radiation safety, regulatory issues, and emergency procedures for the types of use for which a licensee seeks approval. This training requirement may be satisfied by completing training that is supervised by a Radiation Safety Officer, authorized medical physicist, authorized nuclear pharmacist, or authorized user, as appropriate, who is authorized for the type(s) of use for which the licensee is seeking approval.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.20 **Training for Authorized Medical Physicist.** Except as provided in 1.7.22, the licensee shall require the authorized medical physicist to be an individual who:

1. Is certified by a specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who meets the requirements in 1.7.20(2)(b) and 1.7.20 (3).[35] To have its certification process recognized, a specialty board shall require all candidates for certification to:

   a. Hold a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university;

   b. Have 2 years of full-time practical training and/or supervised experience in medical physics:

      i. Under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by the Agency, Nuclear Regulatory Commission or an Agreement State; or

      ii. In clinical radiation facilities providing high-energy, external beam therapy (photons and electrons with energies greater than or equal to 1 million electron volts) and brachytherapy services under the direction of physicians who meet the requirements for authorized users in 1.7.22, 1.7.60, or 1.7.81; and

   c. Pass an examination, administered by diplomates of the specialty board, that assesses knowledge and competence in clinical radiation therapy, radiation safety, calibration, quality assurance, and treatment planning for external beam therapy, brachytherapy, and stereotactic radiosurgery; or

2. **Training**

   a. Holds a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university; and has completed 1 year of full-time training in

[35] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

medical physics and an additional year of full-time work experience under the supervision of an individual who meets the requirements for an authorized medical physicist for the type(s) of use for which the individual is seeking authorization. This training and work experience must be conducted in clinical radiation facilities that provide high-energy, external beam therapy (photons and electrons with energies greater than or equal to 1 million electron volts) and brachytherapy services and must include:

i. Performing sealed source leak tests and inventories;

ii. Performing decay corrections;

iii. Performing full calibration and periodic spot checks of external beam treatment units, stereotactic radiosurgery units, and remote afterloading units as applicable; and

iv. Conducting radiation surveys around external beam treatment units, stereotactic radiosurgery units, and remote afterloading units as applicable; and

b. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.20(3) and 1.7.20(1)(a) and (b), or 1.7.20(2)(a) and 1.7.20(3), and has achieved a level of competency sufficient to function independently as an authorized medical physicist for each type of therapeutic medical unit for which the individual is requesting authorized medical physicist status. The written attestation must be signed by a preceptor authorized medical physicist who meets the requirements in 1.7.20, 1.7.22, or the equivalent Nuclear Regulatory Commission or Agreement State requirements for an authorized medical physicist for each type of therapeutic medical unit for which the individual is requesting authorized medical physicist status; and

3. Has training for the type(s) of use for which authorization is sought that includes hands-on device operation, safety procedures, clinical use, and the operation of a treatment planning system. This training requirement may be satisfied by satisfactorily completing either a training program provided by the vendor or by training supervised by an authorized medical physicist authorized for the type(s) of use for which the individual is seeking authorization.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.21 **Training for an Authorized Nuclear Pharmacist.** Except as provided in 1.7.22, the licensee shall require the authorized nuclear pharmacist to be a pharmacist who:

1. Is certified by a specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who

meets the requirements in 1.7.21(2)(b).[36] To have its certification process recognized, a specialty board shall require all candidates for certification to:

a. Have graduated from a pharmacy program accredited by the American Council on Pharmaceutical Education (ACPE) or have passed the Foreign Pharmacy Graduate Examination Committee (FPGEC) examination;

b. Hold a current, active license to practice pharmacy;

c. Provide evidence of having acquired at least 4000 hours of training/experience in nuclear pharmacy practice. Academic training may be substituted for no more than 2000 hours of the required training and experience; and

d. Pass an examination in nuclear pharmacy administered by diplomates of the specialty board, that assesses knowledge and competency in procurement, compounding, quality assurance, dispensing, distribution, health and safety, radiation safety, provision of information and consultation, monitoring patient outcomes, research and development; or

2. **Training**

a. Has completed 700 hours in a structured educational program consisting of both:

i. 200 hours of classroom and laboratory training in the following areas:

i. Radiation physics and instrumentation;

ii. Radiation protection;

iii. Mathematics pertaining to the use and measurement of radioactivity;

iv. Chemistry of radioactive material for medical use; and

v. Radiation biology; and

ii. Supervised practical experience in a nuclear pharmacy involving:

i. Shipping, receiving, and performing related radiation surveys;

ii. Using and performing checks for proper operation of instruments used to determine the activity of dosages, survey meters, and, if appropriate, instruments used to measure alpha- or beta-emitting radionuclides;

[36] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

iii. Calculating, assaying, and safely preparing dosages for patients or human research subjects;

iv. Using administrative controls to avoid misadministrations in the administration of radioactive material; and

v. Using procedures to prevent or minimize radioactive contamination and using proper decontamination procedures; and

b. Has obtained written certification, signed by a preceptor authorized nuclear pharmacist, that the individual has satisfactorily completed the requirements in 1.7.21(1)(a),(b) and (c) or 1.7.21(2)(a) and has achieved a level of competency sufficient to independently operate a nuclear pharmacy.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.22 **Provisions for Experienced Radiation Safety Officer, Teletherapy or Medical Physicist, Authorized Medical Physicist, Authorized User, Nuclear Pharmacist and Authorized Nuclear Pharmacist.**

1. An individual identified as a Radiation Safety Officer, a teletherapy or medical physicist, an authorized medical physicist, a nuclear pharmacist, or an authorized nuclear pharmacist on an Agency, Nuclear Regulatory Commission, an Agreement State license or a permit issued by an Agency, Nuclear Regulatory Commission or Agreement State broad scope licensee or master material license permit or by a master material license permittee of broad scope that authorizes medical use or the practice of nuclear pharmacy, before the effective date of these regulations need not comply with the training requirements of 1.7.19, 1.7.20 and 1.7.21, respectively.

2. Physicians, dentists, or podiatrists identified as authorized users for the medical use of radioactive material on an Agency, Nuclear Regulatory Commission or Agreement State license, a permit issued by a Nuclear Regulatory Commission master material licensee, or a permit issued by an Agency, Nuclear Regulatory Commission or Agreement State broad scope licensee, or a permit issued by a Nuclear Regulatory Commission master material license broad scope permittee that authorizes medical use or the practice of nuclear pharmacy, issued before the effective date of the regulations who perform only those medical uses for which they were authorized on that date need not comply with the training requirements of 1.7.39, 1.7.43, 1.7.48, 1.7.49, 1.7.50, 1.7.51, 1.7.60, 1.7.61, 1.7.63 and 1.7.81.

3. Individuals who need not comply with training requirements as described in this section may serve as preceptors for, and supervisors of, applicants seeking authorization on Agency licenses for the same uses for which these individuals are authorized.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.23 **Recentness of Training.** The training and experience specified in Subchapter 7 must have been obtained within the 7 years preceding the date of application or the individual must have had related continuing education and experience since the required training and experience was completed.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.24 **Quality Control of Diagnostic Equipment.** Each licensee shall establish written quality control procedures for all diagnostic equipment used for radionuclide studies. As a minimum, quality control procedures and frequencies shall be those recommended by equipment manufacturers or procedures which have been approved by the Agency. The licensee shall conduct quality control procedures in accordance with written procedures.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.25 **Possession, Use, Calibration, and Check of Dose Calibrators.**

1. A medical use licensee authorized to administer radiopharmaceuticals shall possess a dose calibrator and use it to measure the amount of activity administered to each patient. In the case where the ionization type dose calibrator cannot be used effectively to verify administered activity, the licensee shall use an alternative method. Any alternative method to the use of a dose calibrator shall be approved by the Agency in writing. Any alternative method shall provide for acceptable verification of constancy, accuracy, linearity and geometry dependence as applicable.

2. Each licensee shall establish written quality control procedures for all dose calibrators used for measuring the amount of activity administered to a patient. As a minimum, quality control procedures and frequencies shall be those recommended by the American National Standards Institute or the licensee shall:

    a. Check each dose calibrator for constancy with a dedicated check source at the beginning of each day of use. To satisfy the requirement of Subchapter 7, the check shall be done on a frequently used setting with a sealed source of not less than 50 microcuries (1.85 MBq) with energies representative of the radionuclides in clinical use at the facility;

    b. Test each dose calibrator for accuracy upon installation and at intervals not to exceed 12 months thereafter by assaying at least 2 sealed sources containing different radionuclides, the activity of which the manufacturer has determined within 5 percent of the stated activity, with minimum activity of 50 microcuries (1.85 MBq) and energies representative of the radionuclides in clinical use at the facility;

    c. Test each dose calibrator for linearity upon installation and at intervals not to exceed 3 months thereafter over the range of use between 30 microcuries (1.11 MBq) and the highest dosage that will be assayed; and

    d. Test each dose calibrator for geometry dependence upon installation over the range of volumes and volume configurations for which it will be used.

The licensee shall keep a record of this test for the duration of the use of the dose calibrator.

3. A licensee shall mathematically correct dosage readings for any geometry or linearity error that exceeds 10 percent if the dosage is greater than 10 microcuries (370 kBq) and shall repair or replace the dose calibrator if the accuracy or constancy error exceeds 10 percent.

4. A licensee shall also perform checks and tests required by 1.7.25(2) following adjustment or repair of the dose calibrator.

5. A licensee shall retain a record of each check and test required by 1.7.25 in accordance with 1.7.87.

6. A licensee shall use dose calibrator reference and calibration sources traceable to the National Institute of Standards and Technology (NIST), or other standards recognized as being equivalent by the NIST.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.26 **Calibration and Check of Survey Instruments.**

1. A licensee shall ensure that the survey instruments used to show compliance with Subchapters 4 and 7 of these regulations have been calibrated before first use, annually, and following repair.

2. To satisfy the requirements of 1.7.26(1), the licensee shall:

   a. Calibrate all required scale readings up to 10 millisieverts (1000 mrem) per hour with a radiation source;

   b. Have each radiation survey instrument calibrated:

      i. At energies appropriate for use and at intervals not to exceed 12 months or after instrument servicing, except for battery changes;

      ii. For linear scale instruments, at two points located approximately one-third and two-thirds of full-scale on each scale; for logarithmic scale instruments, at mid-range of each decade, and at two points of at least one decade; and for digital instruments, at 3 points between 0.02 and 10 millisieverts (2 and 1000 mrem) per hour; and

      iii. For dose rate instruments, so that an accuracy within plus or minus 20 percent of the true radiation dose rate can be demonstrated at each point checked.

   c. Conspicuously note on the instrument the apparent dose rate from a dedicated check source as determined at the time of calibration, and the date of calibration.

3. The licensee shall not use survey instruments if the difference between the indicated exposure rate and the calculated exposure rate is greater than 20 percent.

4. A licensee shall check each survey instrument for proper operation with the dedicated check source before each use. The licensee is not required to keep records of these checks.

5. The licensee shall retain a record of each calibration required in 1.7.88 for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.27 **Determination of Dosages of Radioactive Material for Medical Use.**

1. A licensee shall determine and record the activity of each dosage prior to medical use. For photon-emitting radioactive material, this determination shall be within 30 minutes prior to medical use.

2. For a unit dosage, this determination must be made by:

   a. direct measurement of radioactivity;

   b. A decay correction, based on the activity or activity concentration determined by:

      i. a manufacturer or preparer licensed pursuant to 1.3.12(10) of these regulations or equivalent provisions of the Nuclear Regulatory Commission, Agreement State or Licensing State;

      ii. An Agency, Nuclear Regulatory Commission or Agreement State licensee for use in research in accordance with a Radioactive Drug Research Committee-approved protocol or an Investigational New Drug (IND) protocol accepted by FDA; or

      iii. A PET radioactive drug producer licensed under 1.3.8(9) or equivalent Nuclear Regulatory Commission or Agreement State requirements.

   c. For other than unit dosages, this determination must be made by:

      i. Direct measurement of radioactivity;

      ii. Combination of measurement of radioactivity and mathematical calculations; or

      iii. Combination of volumetric measurements and mathematical calculations, based on the measurement made by:

i. a manufacturer or preparer licensed under 1.3.12(10) of these regulations or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

ii. a PET radioactive drug producer licensed under 1.3.8(9) or equivalent Nuclear Regulatory Commission or Agreement State requirements.

3. Unless otherwise directed by the authorized user, a licensee shall not use a dosage if the dosage differs from the prescribed dosage by more than 20 percent.

4. A licensee shall retain a record of the dosage determination required by Subchapter 7 in accordance with 1.7.89.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.28 **Authorization for Calibration, Transmission and Reference Sources.** Any person authorized by 1.7.7 for medical use of radioactive material may receive, possess, and use the following radioactive material for check, calibration, and reference use:

1. Sealed sources manufactured and distributed by persons specifically licensed pursuant to Subchapter 3 of these regulations or equivalent provisions of the Nuclear Regulatory Commission, Agreement State or Licensing State and that do not exceed 1.11 gigabecquerels (30 mCi) each;

2. Any radioactive material with a half-life of 120 days or less in individual amounts not to exceed 555 megabecquerels (15 mCi);

3. Any radioactive material with a half-life greater than 120 days in individual amounts not to exceed the smaller of:

   a. 7.4 megabecquerels (200 µCi); or

   b. 1000 times the quantities in Appendix B of Subchapter 3 of these regulations; and

4. Technetium-99m in amounts as needed.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.29 **Requirements for Possession of Sealed Sources and Brachytherapy Sources.**

1. A licensee in possession of any sealed source or brachytherapy source shall follow the radiation safety and handling instructions supplied by the manufacturer or equivalent instructions approved by the Agency.

2. A licensee in possession of a sealed source shall:

a. Test the source for leakage before its first use unless the licensee has a certificate from the supplier indicating that the source was tested within 6 months before transfer to the licensee; and

b. Test the source for leakage at intervals not to exceed 6 months or at intervals approved by the Agency, another Agreement State, a Licensing State or the Nuclear Regulatory Commission in the Sealed Source and Device Registry.

3. To satisfy the leak test requirements of 1.7.29(2), the licensee shall assure that:

i. Leak tests are capable of detecting the presence of 0.005 microcurie (185 Bq) of radioactive material on the test sample, or in the case of radium, the escape of radon at the rate of 0.001 microcurie (37 Bq) per 24 hours;

ii. Test samples are taken from the source or from the surfaces of the device in which the source is mounted or stored on which radioactive contamination might be expected to accumulate; and

iii. Test samples are taken when the source is in the "off" position.

4. A licensee shall retain leak test records for 5 years. The records shall contain the model number, and serial number, if assigned, of each source tested, the identity of each source radionuclide and its estimated activity, the measured activity of each test sample expressed in microcuries (becquerels), a description of the method used to measure each test sample, the date of the test, and the signature of the Radiation Safety Officer.

5. If the leak test reveals the presence of 185 becquerels (0.005 μCi) or more of removable contamination, the licensee shall:

a. Immediately withdraw the sealed source from use and store, dispose, or cause it to be repaired in accordance with the requirements of Subchapters 3 and 4 of these regulations; and

b. File a report with the Agency within 5 days of receiving the leak test results in accordance with 1.7.112.

6. A licensee in possession of a sealed source or brachytherapy source, except for gamma stereotactic radiosurgery sources, shall conduct a physical inventory of all such sources at intervals not to exceed 3 months. The licensee shall retain each inventory record in accordance with 1.7.90.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.30 **Labels.** Each syringe and vial that contains a radioactive drug shall be labeled to identify the radioactive drug. Each syringe shield and vial shield shall also be labeled unless the label on the syringe or vial is visible when shielded.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.31 **Syringe Shields and Vial Shields.**

1. A licensee shall keep syringes that contain radioactive material to be administered in a radiation shield.

2. A licensee shall require each individual who prepares or administers radiopharmaceuticals to use a syringe radiation shield unless the use of the shield is contraindicated for that patient.

3. A licensee shall require each individual preparing or handling a vial that contains a radioactive drug to keep the vial in a vial radiation shield.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.32 **Surveys for Ambient Radiation Dose Rate and Contamination.**

1. A licensee shall survey with a radiation detection survey instrument at the end of each day of use all areas where radiopharmaceuticals are routinely prepared for use or administered.

2. A licensee shall survey with a radiation detection survey instrument at least once each week all areas where radiopharmaceuticals or radioactive wastes are stored.

3. A licensee shall conduct the surveys required by 1.7.32(1) and (2) so as to be able to measure dose rates as low as 1 microsievert (0.1 mrem) per hour.

4. A licensee shall establish dose rate action levels for the surveys required by 1.7.32(1) and (2) and shall require that the individual performing the survey immediately notify the Radiation Safety Officer if a dose rate exceeds an action level.

5. A licensee shall survey for removable contamination each week of use all areas where radiopharmaceuticals are routinely prepared for use or administered and each week where radioactive materials are stored.

6. A licensee shall conduct the surveys required by 1.7.32(5) so as to be able to detect contamination on each wipe sample of 2000 disintegrations per minute (33.3 Bq).

7. A licensee shall establish removable contamination action levels for the surveys required by 1.7.32(5) and shall require that the individual performing the survey immediately notify the Radiation Safety Officer if contamination exceeds action levels.

8. A licensee does not need to perform the surveys required by 1.7.32(1) in area(s) where patients or human research subjects are confined when they can not be released pursuant to 1.7.33.

9. A licensee shall retain a record of each survey in accordance with 1.7.91.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.33 **Release Individuals Containing Radioactive Drugs or Implants.**

1. A licensee may authorize the release from its control of any individual who has been administered radioactive drugs or implants containing radioactive material if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 5 millisievert (0.5 rem).[37]

2. For patients administered radioactive material for which a written directive is required, a licensee shall provide the released individual, or the individual's parent or guardian, with oral and written instructions on actions recommended to maintain doses to other individuals as low as is reasonably achievable if the total effective dose equivalent to any other individual is likely to exceed 1 millisievert (0.1 rem). If the total effective dose equivalent to a breast-feeding infant or child could exceed 1 millisievert (0.1 rem) assuming there were no interruption of breast-feeding, the instructions shall also include:

   a. Guidance on the interruption or discontinuation of breast-feeding; and

   b. Information on the potential consequences, if any, of failure to follow the guidance.

3. The licensee shall maintain a record of the basis for authorizing the release of an individual in accordance with 1.7.92.

4. The licensee shall maintain a record of instructions provided to breast-feeding women in accordance with 1.7.92.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.34 **Mobile Nuclear Medicine Service Technical Requirements.** A licensee providing mobile nuclear medicine service shall:

1. Transport to each client's address only syringes or vials containing prepared drugs or radioactive material that are intended for reconstitution of radioactive drug kits;

2. Bring into each client's address all radioactive material to be used and, before leaving, remove all unused radioactive material and associated radioactive waste;

3. Secure or keep under constant surveillance and immediate control all radioactive material when in transit or at client's address;

4. Check instruments used to measure the activity of unsealed radioactive material for proper function before medical use at each client's address or on each day of use, whichever is more frequent. At a minimum, the check for proper function shall include a constancy check;

[37] The current revision of the Nuclear Regulatory Commission NUREG–1556, Vol. 9, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Medical Licenses" describes methods for calculating doses to other individuals and contains tables of activities not likely to cause doses exceeding 5 mSv (0.5 rem).

5. Check survey instruments for consistent response with a dedicated check source before use at each client's address;

6. Prior to leaving a client's address, perform area surveys and surveys for removable contamination in all areas of use, to ensure compliance with Subchapter 4 of these regulations;

7. Use radioactive gases only in areas of use and under conditions which have been evaluated and approved by the Agency for compliance with airborne release standards; and

8. Retain a record of each survey required by 1.7.34(6) in accordance with 1.7.93.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.35 **Storage and Control of Volatiles and Gases.**

1. A licensee shall store volatile radioactive material and radioactive gases in a radiation shield and container.

2. A licensee shall store and use a multi-dose container in a properly functioning fume hood.

3. A licensee who administers radioactive aerosols or gases shall do so with a system that will keep airborne concentrations within the limits prescribed in Subchapter 4 of these regulations.

4. The system shall either be directly vented to the atmosphere through an air exhaust or provide for collection and decay or disposal of the aerosol or gas in a shielded container.

5. A licensee shall check the operation of collection systems monthly and measure the ventilation rates in areas of use at intervals not to exceed 6 months and measure the ventilation rates in areas of use at intervals not to exceed 6 months. Records of these checks and measurements shall be maintained for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.36 **Decay-In-Storage.**

1. A licensee may hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash without regard to its radioactivity if the licensee:

   a. Monitors radioactive material at the container surface before disposal as ordinary trash and determines that its radioactivity cannot be distinguished from the background radiation level with a radiation detection survey instrument set on its most sensitive scale and with no interposed shielding;

b. Removes or obliterates all radiation labels, except for material that will be handled as biomedical waste after release; and

c. Separates and monitors each generator column individually with all radiation shielding removed to ensure that its contents have decayed to background radiation level before disposal.

2. For radioactive material disposed in accordance with 1.7.36(1), the licensee shall retain a record of each disposal in accordance with 1.7.94.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.37 **Use of Unsealed Radioactive Material for Uptake, Dilution, or Excretion Studies for which a Written Directive is not Required.** A licensee may use any unsealed radioactive material, in quantities that do not require a written directive, for a diagnostic use involving measurements of uptake, dilution, or excretion that is:

1. Obtained from:

a. a manufacturer or preparer licensed pursuant to 1.3.12(10) of these regulations or equivalent regulations of an Agreement State, a Licensing State, or the Nuclear Regulatory Commission; or

b. A PET radioactive drug producer licensed under 1.3.8(9) or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

2. Excluding production of PET radionuclides, prepared by:

a. an authorized nuclear pharmacist,

b. a physician who is an authorized user and who meets the requirements specified in 1.7.43 or 1.7.48 and 1.7.43(3)(a)(ii)(vii), or

c. an individual under the supervision, as specified in 1.7.15, of the authorized nuclear pharmacist in 1.7.37(2)(a) or the physician who is an authorized user in 1.7.37(2)(b); or;

3. Obtained from and prepared by an Agency, Nuclear Regulatory Commission, Agreement State or Licensing State licensee for use in research in accordance with a Radioactive Drug Research Committee-approved protocol or an Investigational New Drug (IND) protocol accepted by FDA; or

4. Prepared by the licensee for use in research in accordance with a Radioactive Drug Research Committee-approved application or an Investigational New Drug (IND) protocol accepted by FDA.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.38 **Possession of Survey Instrument.** A licensee authorized to use radioactive material for uptake, dilution, and excretion studies shall possess a portable

radiation detection survey instrument capable of detecting dose rates over the range of 1 microsievert (0.1 mrem) per hour to 500 microsieverts (50 mrems) per hour. The instrument shall be operable and calibrated in accordance with 1.7.26.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.39 **Training for Uptake, Dilution, and Excretion Studies.** Except as provided in 1.7.22, the licensee shall require the authorized user of an unsealed radioactive material for the uses authorized under 1.7.37 to be a physician who:

1. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who meets the requirements in 1.7.39(3)(b)[38]. To have its certification process recognized, a specialty board shall require all candidates for certification to:

    a. Complete 60 hours of training and experience in basic radionuclide handling techniques and radiation safety applicable to the medical use of unsealed radioactive material for uptake, dilution, and excretion studies as described in 1.7.39(3)(a)(i) through (3)(a)(ii)(vi); and

    b. Pass an examination, administered by diplomates of the specialty board, that assesses knowledge and competence in radiation safety, radionuclide handling, and quality control; or

2. Is an authorized user under 1.7.43, 1.7.48, or equivalent Nuclear Regulatory Commission, or Agreement State requirements; or 1.7.39(3)(a)

3. **Training**

    a. Has completed 60 hours of training and experience, including a minimum of 8 hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material for uptake, dilution, and excretion studies. The training and experience must include:

        i. Classroom and laboratory training in the following areas:

            i. Radiation physics and instrumentation;

            ii. Radiation protection;

            iii. Mathematics pertaining to the use and measurement of radioactivity;

            iv. Radiation biology; and

            v. Chemistry of radioactive material for medical use; and

[38] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

ii. Work experience, under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.39, 1.7.43, 1.7.48, or equivalent Nuclear Regulatory Commission or Agreement State requirements, involving:

i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

ii. Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

iii. Calculating, measuring, and safely preparing patient or human research subject dosages;

iv. Using administrative controls to prevent a misadministration involving the use of unsealed radioactive material;

v. Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

vi. Administering dosages of radioactive drugs to patients or human research subjects; and

b. Has obtained written attestation, signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.39, 1.7.43, 1.7.48, or equivalent Nuclear Regulatory Commission, or Agreement State requirements, that the individual has satisfactorily completed the requirements in 1.7.39(1)(a) or 1.7.39(3)(a) and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under 1.7.37.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.40 **Use of Unsealed Radioactive Material for Imaging and Localization Studies for which a Written Directive is not Required.** A licensee may use, for imaging and localization studies, any radioactive material prepared for medical use, in quantities that do not require a written directive as described in 1.7.16 that is:

1. Obtained from:

a. a manufacturer or preparer licensed pursuant to 1.3.12(10) of these regulations or equivalent regulations of another Agreement State, a Licensing State, or the Nuclear Regulatory Commission;

b. A PET radioactive drug producer licensed under 1.3.8(9) or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

2. Excluding production of PET radionuclides, prepared by:

a. an authorized nuclear pharmacist;

b. a physician who is an authorized user and who meets the requirements specified in 1.7.43 or 1.7.48 and 1.7.43(3)(a)(ii)(vii); or

c. an individual under the supervision, as specified in 1.7.15, of the authorized nuclear pharmacist in 1.7.40(2)(a) or the physician who is an authorized user in 1.7.40(2)(b); or;

3. Obtained from and prepared by an Agency, Nuclear Regulatory Commission, Agreement State or Licensing State licensee for use in research in accordance with a Radioactive Drug Research Committee-approved protocol or an Investigational New Drug (IND) protocol accepted by FDA; or

4. Prepared by the licensee for use in research in accordance with a Radioactive Drug Research Committee-approved application or an Investigational New Drug (IND) protocol accepted by FDA.

5. Provided the conditions of 1.7.35 are met, a licensee shall use radioactive aerosols or gases only if specific application is made to and approved by the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.41 **Radionuclide Contaminants.**

1. A licensee shall not administer to humans a radioactive drug containing:

a. More than 0.15 kilobecquerel of molybdenum-99 per megabecquerel of technetium-99m (0.15 µCi of Mo-99 per mCi of Tc-99m);

b. More than 0.02 kilobecquerel of strontium-82 per megabecquerel of rubidium-82 chloride injection (0.02 µCi of Sr-82 per mCi of Rb-82 chloride);

c. More than 0.2 kilobecquerel of strontium-85 per megabecquerel of rubidium-82 chloride injection (0.2 µCi of Sr-85 per mCi of Rb-82).

2. To demonstrate compliance with 1.7.41(1), the licensee preparing radioactive drugs from radionuclide generators shall:

a. Measure the concentration of radionuclide contaminant in the first eluate after receipt of a molybdenum-99/technetium-99m generator;

b. Measure the concentration of radionuclide contaminant in each eluate or extract, as appropriate for other generator systems.

3. A licensee preparing technetium-99m radiopharmaceuticals from molybdenum-99/technetium-99m generators shall measure the molybdenum-99 concentration in each eluate or extract.

4. A licensee who must measure radionuclide contaminant concentration shall retain a record of each measurement in accordance with 1.7.95.

5. A licensee shall report immediately to the Agency each occurrence of concentration exceeding the limits specified in 1.7.41(1).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.42 **Possession of Survey Instruments.** A licensee authorized to use radioactive material for imaging and localization studies shall possess a portable radiation detection survey instrument capable of detecting dose rates over the range of 1 microsievert (0.1 mrem) per hour to 500 microsieverts (50 mrems) per hour, and a portable radiation measurement survey instrument capable of measuring dose rates over the range of 10 microsieverts (1 mrem) per hour to 10 millisieverts (1000 mrems) per hour. The instruments shall be operable and calibrated in accordance with 1.7.26.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.43 **Training for Imaging and Localization Studies.** Except as provided in 1.7.22, the licensee shall require the authorized user of unsealed radioactive material for the uses authorized under 1.7.40 to be a physician who:

1. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission, or an Agreement State and who meets the requirements in 1.7.43(3)(b).[39] To have its certification process recognized, a specialty board shall require all candidates for certification to:

   a. Complete 700 hours of training and experience in basic radionuclide handling techniques and radiation safety applicable to the medical use of unsealed radioactive material for imaging and localization studies as described in 1.7.43(3)(a)(i) through (3)(a)(ii)(vii); and

   b. Pass an examination, administered by diplomates of the specialty board, which assesses knowledge and competence in radiation safety, radionuclide handling, and quality control; or

2. Is an authorized user under 1.7.48 and meets the requirements in 1.7.43(3)(a)(ii)(vii), or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

3. **Training**

   a. Has completed 700 hours of training and experience, including a minimum of 80 hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of

[39] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

unsealed radioactive material for imaging and localization studies. The training and experience must include, at a minimum:

i. Classroom and laboratory training in the following areas:

i. Radiation physics and instrumentation;

ii. Radiation protection;

iii. Mathematics pertaining to the use and measurement of radioactivity;

iv. Chemistry of radioactive material for medical use; and

v. Radiation biology.

ii. Work experience under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.43, or 1.7.43(3)(a)(ii)(vii) and 1.7.48, or equivalent Nuclear Regulatory Commission or Agreement State requirements, involving:

i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

ii. Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

iii. Calculating measuring, and safely preparing patient or human research subject dosages;

iv. Using administrative controls to prevent a misadministration involving the use of unsealed radioactive material;

v. Using procedures to safely contain spilled radioactive material and using proper decontamination procedures;

vi. Administering dosages of radioactive drugs to patients or human research subjects; and

vii. Eluting generator systems, appropriate for preparation of radioactive drugs for imaging and localization studies, measuring and testing the eluate for radionuclidic purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs; and

b. Has obtained written attestation, signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.43, or 1.7.48 and 1.7.43(3)(a)(ii)(vii), or equivalent Nuclear Regulatory Commission or Agreement State requirements, that the individual has satisfactorily

completed the requirements in 1.7.43(1)(a) or 1.7.43(3)(a) and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under 1.7.37 and 1.7.40.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.44 **Use of Unsealed Radioactive Material for Which a Written Directive is Required.** A licensee may use any unsealed radioactive material for diagnostic or therapeutic medical use for which a written directive is required that has been:

1. Obtained from:

   a. a manufacturer or preparer licensed in accordance with 1.3.12(10) of these regulations or equivalent regulations of another Agreement State, a Licensing State, or the Nuclear Regulatory Commission; or

   b. A PET radioactive drug producer licensed under 1.3.8(9) or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

2. Excluding production of PET radionuclides, prepared by

   a. an authorized nuclear pharmacist,

   b. a physician who is an authorized user and who meets the requirements specified in 1.7.43 or 1.7.48, or

   c. an individual under the supervision, as specified in 1.7.15; of the authorized nuclear pharmacist in 1.7.44(2)(a) or the physician who is an authorized user in 1.7.44(2)(b); or

3. Obtained from and prepared by an Agency, Nuclear Regulatory Commission, Agreement State, or Licensing State licensee in accordance with a Radioactive Drug Research Committee-approved protocol or an Investigational New Drug (IND) protocol accepted by the FDA for use in research; or

4. Prepared by the licensee for use in research in accordance with a Radioactive Drug Research Committee-approved application or an IND protocol accepted by FDA.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.45 **Safety Instruction.** In addition to the requirements of 1.10.3 of these regulations:

1. A licensee shall provide radiation safety instruction for all personnel caring for patients or human research subjects that have received therapy with a radioactive drug, and cannot be released in accordance with 1.7.33. The training must be provided initially and at least annually. The instruction must be appropriate to the personnel's assigned duties and include the following:

2. To satisfy 1.7.45(1), the instruction shall describe the licensee's procedures for:

a. Patient or human research subject control;

b. Visitor control to include the following;

i. Routine visitation to hospitalized individuals in accordance with Subchapter 4 of these regulations;

ii. Contamination control;

iii. Waste control; and

iv. Notification of the Radiation Safety Officer, or his or her designee, and the authorized user if the patient or the human research subject dies or has a medical emergency.

3. A licensee shall keep a record of individuals receiving instruction required in accordance with 1.7.96.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.46 **Safety Precautions.**

1. For each patient or the human research subject receiving radiopharmaceutical therapy and hospitalized for compliance with 1.7.33, a licensee shall:

a. Quarter the patient or the human research subject either in:

i. A private room with a private sanitary facility; or

ii. A room, with a private sanitary facility, with another individual who also has received similar radiopharmaceutical therapy and who cannot be released in accordance with 1.7.33; and

b. Visibly post the patient's or the human research subject’s door with a "Caution: Radioactive Material(s)" sign and note on the door or on the patient's or the human research subject’s chart where and how long visitors may stay in the patient's or the human research subject’s room;

c. Authorize visits by individuals under 18 years of age only on a case-by-case basis with the approval of the authorized user after consultation with the Radiation Safety Officer;

d. Promptly after administration of the dosage, measure the dose rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument to demonstrate compliance with the requirements of Subchapter 4 of these regulations and retain for 3 years a record of each survey that includes the time and date of the survey, a plan of the area or list of points surveyed, the measured dose rate at several points expressed in millirems per hour, the instrument used to make the survey, and the initials of the individual who made the survey;

e. Either monitor material and items removed from the patient's or the human research subject's room to determine that any contamination cannot be distinguished from the natural background radiation level with a radiation detection survey instrument set on its most sensitive scale and with no interposed shielding, or handle these materials and items as radioactive waste;

f. Survey the patient's or the human research subject's room and private sanitary facility for removable contamination with a radiation detection survey instrument before assigning another patient or another human research subject to the room. The room must not be reassigned until removable contamination is less than 200 disintegrations per minute (3.33 Bq) per 100 square centimeters; and

g. Measure the thyroid burden of each individual who helped prepare or administer a dosage of iodine-131 within 3 days after administering the dosage, and retain for the period required by 1.3.49 of these regulations a record of each thyroid burden measurement, date of measurement, the name of the individual whose thyroid burden was measured, and the initials of the individual who made the measurements. Other procedures acceptable to the Agency may be used for individuals who only prepare, but do not administer doses of stabilized I-131.

2. The Radiation Safety Officer, or his or her designee, and the authorized user shall be notified immediately if the hospitalized patient dies or has a medical emergency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.47 **Possession of Survey Instruments.** A licensee authorized to use radioactive material for which a written directive is required, imaging and localization studies shall possess a portable radiation detection survey instrument capable of detecting dose rates over the range of 1 microsievert (0.1 mrem) per hour to 500 microsieverts (50 mrems) per hour, and a portable radiation measurement survey instrument capable of measuring dose rates over the range of 10 microsieverts (1 mrem) per hour to 10 millisieverts (1000 mrems) per hour. The instruments shall be operable and calibrated in accordance with 1.7.26.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.48 **Training for Use of Unsealed Radioactive Material for Which a Written Directive Is Required.** Except as provided in 1.7.22, the licensee shall require an authorized user of unsealed radioactive material for the uses authorized under 1.7.44 to be a physician who:

1. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who meets the requirements in 1.7.48(2)(a)(ii)(vi) and 1.7.48(2)(b).[40]

[40] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

To be recognized, a specialty board shall require all candidates for certification to:

a. Successfully complete residency training in a radiation therapy or nuclear medicine training program or a program in a related medical specialty. These residency training programs must include 700 hours of training and experience as described in 1.7.48(2)(a)(i) through (2)(a)(ii)(v). Eligible training programs must be approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education, the Royal College of Physicians and Surgeons of Canada, or the Committee on Post-Graduate Training of the American Osteopathic Association; and

b. Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, quality assurance, and clinical use of unsealed radioactive material for which a written directive is required; or

2. **Training**

a. Has completed 700 hours of training and experience, including a minimum of 200 hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material requiring a written directive. The training and experience must include:

i. Classroom and laboratory training in the following areas:

i. Radiation physics and instrumentation;

ii. Radiation protection;

iii. Mathematics pertaining to the use and measurement of radioactivity;

iv. Chemistry of radioactive material for medical use; and

v. Radiation biology; and

ii. Work experience, under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.48, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A supervising authorized user, who meets the requirements in 1.7.48(2), must also have experience in administering dosages in the same dosage category or categories (i.e., 1.7.48(2)(a)(ii)(vi)) as the individual requesting authorized user status. The work experience must involve:

i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

ii. Performing quality control procedures on instruments used to determine the activity of dosages, and performing checks for proper operation of survey meters;

iii. Calculating, measuring, and safely preparing patient or human research subject dosages;

iv. Using administrative controls to prevent a misadministration involving the use of unsealed radioactive material;

v. Using procedures to contain spilled radioactive material safely and using proper decontamination procedures;

vi. Administering dosages to patients or human research subjects, involving a minimum of three cases in each of the following categories for which the individual is requesting authorized user status—

i. Oral administration of less than or equal to 1.22 gigabecquerels (33 millicuries) of sodium iodide I–131, for which a written directive is required;

ii. Oral administration of greater than 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131[41];

iii. Parenteral administration of any beta emitter, or a photon- emitting radionuclide with a photon energy less than 150 keV, for which a written directive is required; and/or

iv. Parenteral administration of any other radionuclide, for which a written directive is required; and

b. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.48(1)(a) and 1.7.48(2)(a)(ii)(vi) or 1.7.48(2)(a) of this section, and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under 1.7.44. The written attestation must be signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.48 or equivalent Nuclear Regulatory Commission or Agreement State requirements. The preceptor authorized user, who meets the requirements in 1.7.48(2) must have experience in administering dosages in the same dosage category or categories (i.e., 1.7.48(2)(a)(ii)(vi)) as the individual requesting authorized user status.

SOURCE: Miss. Code Ann. §45-14-11

[41] Experience with at least 3 cases in Category (vi)(2) also satisfies the requirements Category (vi)(1)

Rule 1.7.49 **Training for the Oral Administration of Sodium Iodide I-131 Requiring a Written Directive in Quantities Less Than or Equal to 1.22 Gigabecquerels (33 Millicuries).** Except as provided in 1.7.22, the licensee shall require an authorized user for the oral administration of sodium iodide I-131 requiring a written directive in quantities less than or equal to 1.22 Gigabecquerels (33 millicuries), to be a physician who:

1. Is certified by a medical specialty board whose certification process includes all of the requirements in 1.7.49(3)(a) and (3)(b) and whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who meets the requirements in 1.7.49 (3)(c)[42]; or

2. Is an authorized user under 1.7.48 for uses listed in 1.7.48(2)(a)(ii)(vi)(1) or (2), 1.7.50, or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

3. **Training**

   a. Has successfully completed 80 hours of classroom and laboratory training, applicable to the medical use of sodium iodide I-131 for procedures requiring a written directive. The training must include:

      i. Radiation physics and instrumentation;

      ii. Radiation protection;

      iii. Mathematics pertaining to the use and measurement of radioactivity;

      iv. Chemistry of radioactive material for medical use; and

      v. Radiation biology; and

   b. Has work experience, under the supervision of an authorized user who meets the requirements in 1.7.22 1.7.48, 1.7.49, 1.7.50, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A supervising authorized user who meets the requirements in 1.7.48(2) must also have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(1) or (2). The work experience must involve:-

      i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

      ii. Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

      iii. Calculating, measuring, and safely preparing patient or human research subject dosages;

[42] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

iv. Using administrative controls to prevent a misadministration involving the use of radioactive material;

v. Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

vi. Administering dosages to patients or human research subjects, that includes at least 3 cases involving the oral administration of less than or equal to 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131; and

c. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.49(3)(a) and 1.7.49(3)(b) and has achieved a level of competency sufficient to function independently as an authorized user for medical uses authorized under 1.7.44 The written attestation must be signed by a preceptor authorized user who meets the requirements in 1.7.22 1.7.48, 1.7.49, 1.7.50, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A preceptor authorized user, who meets the requirement in 1.7.48(2), must also have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(1) or (2).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.50 **Training for the oral administration of sodium iodide I-131 requiring a written directive in quantities greater than 1.22 gigabecquerels (33 millicuries).** Except as provided in 1.7.22, the licensee shall require an authorized user for the oral administration of sodium iodide I-131 requiring a written directive in quantities greater than 1.22 Gigabecquerels (33 millicuries), to be a physician who:

1. Is certified by a medical specialty board whose certification process includes all of the requirements in 1.7.50(3)(a) and (3)(b), and whose certification has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State, and who meets the requirements in 1.7.50(3)(c).[43]; or

2. Is an authorized user under 1.7.48 for uses listed in 1.7.48(2)(a)(ii)(vi)(ii) or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

3. **Training**

a. Has successfully completed 80 hours of classroom and laboratory training, applicable to the medical use of sodium iodide I-131 for procedures requiring a written directive. The training must include

i. Radiation physics and instrumentation;

[43] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

ii. Radiation protection;

iii. Mathematics pertaining to the use and measurement of radioactivity;

iv. Chemistry of radioactive material for medical use; and

v. Radiation biology; and

b. Has work experience, under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.48, 1.7.50, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A supervising authorized user, who meets the requirements in 1.7.48(2), must also have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(2). The work experience must involve:

i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

ii. Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

iii. Calculating, measuring, and safely preparing patient or human research subject dosages;

iv. Using administrative controls to prevent a misadministration involving the use of radioactive material;

v. Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

vi. Administering dosages to patients or human research subjects, that includes at least 3 cases involving the oral administration of greater than 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131; and

c. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.50(3)(a) and 1.7.50(3)(b), and has achieved a level of competency sufficient to function independently as an authorized user for medical uses authorized under 1.7.44. The written attestation must be signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.48, 1.7.50, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A preceptor authorized user, who meets the requirements in 1.7.48(2), must also have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(2).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.51 **Training for the Parenteral Administration of Unsealed Radioactive Material Requiring a Written Directive.** Except as provided in 1.7.22, the

licensee shall require an authorized user for the parenteral administration requiring a written directive, to be a physician who:

1. Is an authorized user under 1.7.48 for uses listed in 1.7.48(2)(a)(ii)(vi)(iii) or 1.7.48(2)(a)(ii)(vi)(iv), or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

2. Is an authorized user under 1.7.60, 1.7.81, or equivalent Nuclear Regulatory Commission or Agreement State requirements and who meets the requirements in 1.7.51(4); or

3. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State under 1.7.60 or 1.7.81, and who meets the requirements in 1.7.51(4).

4. **Training**

   a. Has successfully completed 80 hours of classroom and laboratory training, applicable to parenteral administrations, for which a written directive is required, of any beta emitter, or any photon-emitting radionuclide with a photon energy less than 150 keV, and/or parenteral administration of any other radionuclide for which a written directive is required. The training must include

      i. Radiation physics and instrumentation;

      ii. Radiation protection;

      iii. Mathematics pertaining to the use and measurement of radioactivity;

      iv. Chemistry of radioactive material for medical use; and

      v. Radiation biology; and

   b. Has work experience, under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.48, 1.7.51, or equivalent Nuclear Regulatory Commission or Agreement State requirements, in the parenteral administration, for which a written directive is required, of any beta emitter, or any photon-emitting radionuclide with a photon energy less than 150 keV, and/or parenteral administration of any other radionuclide for which a written directive is required. A supervising authorized user who meets the requirements in 1.7.48 must have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(iii) and/or 1.7.48(2)(a)(ii)(vi)(iv). The work experience must involve:

      i. Ordering, receiving, and unpacking radioactive materials safely, and performing the related radiation surveys;

ii. Performing quality control procedures on instruments used to determine the activity of dosages, and performing checks for proper operation of survey meters;

iii. Calculating, measuring, and safely preparing patient or human research subject dosages;

iv. Using administrative controls to prevent a misadministration involving the use of unsealed radioactive material;

v. Using procedures to contain spilled radioactive material safely, and using proper decontamination procedures; and

vi. Administering dosages to patients or human research subjects, that include at least 3 cases involving the parenteral administration, for which a written directive is required, of any beta emitter, or any photon-emitting radionuclide with a photon energy less than 150 keV and/or at least 3 cases involving the parenteral administration of any other radionuclide, for which a written directive is required; and

c. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.51(2) or (3) of this section, and has achieved a level of competency sufficient to function independently as an authorized user for the parenteral administration of unsealed radioactive material requiring a written directive. The written attestation must be signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.48, 1.7.51, or equivalent Nuclear Regulatory Commission or Agreement State requirements. A preceptor authorized user, who meets the requirements in 1.7.48, must have experience in administering dosages as specified in 1.7.48(2)(a)(ii)(vi)(iii) and/or 1.7.48(2)(a)(ii)(vi)(iv).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.52 **Use of Sealed Sources for Manual Brachytherapy.** A licensee shall use brachytherapy sources for therapeutic medical uses:

1. As approved in the Sealed Source and Device Registry; or

2. In research in accordance with an effective Investigational Device Exemption (IDE) application accepted by the FDA provided the requirements of 1.7.18(1) are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.53 **Surveys After Source Implant and Removal.**

1. Immediately after implanting sources in a patient or a human research subject, the licensee shall perform a survey to locate and account for all sources that have not been implanted.

2. Immediately after removing the last temporary implant source from a patient or a human research subject, the licensee shall perform a radiation survey of the patient with a radiation detection survey instrument to confirm that all sources have been removed.

3. A licensee shall retain a record of surveys in accordance with 1.7.97.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.54 **Brachytherapy Sources Inventory.**

1. A licensee shall maintain accountability at all times for all brachytherapy sources in storage or use.

2. Promptly after removing sources from a patient or a human research subject, a licensee shall return brachytherapy sources to a secure storage area.

3. A licensee shall maintain a record of the brachytherapy source accountability in accordance with 1.7.98.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.55 **Safety Instruction.** In addition to the requirements of 1.10.3 of these regulations:

1. The licensee shall provide radiation safety instruction, initially and at intervals not to exceed 1 year, to all personnel caring for a patients or human research subjects that are undergoing implant therapy and cannot be released in accordance with 1.7.33. Instruction must be commensurate with the duties of the personnel and shall include the following. Refresher training shall be provided at intervals not to exceed 1 year.

   a. Size and appearance of the brachytherapy sources;

   b. Safe handling and shielding instructions in case of a dislodged source;

   c. Patient or human research subject control;

   d. Visitor control, including both:

      i. Routine visitation of hospitalized individuals in accordance with 1.3.14(1)(a). of these regulations; and

      ii. Visitation authorized in accordance with 1.3.14(3) of these regulations; and

   e. Notification of the Radiation Safety Officer, or his or her designee, and or an authorized user if the patient or human research subject dies or has a medical emergency.; and

2. A licensee shall maintain retain a record of individuals receiving instruction required by 1.7.96.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.56 **Safety Precautions for Patients or Human Research Subjects Receiving Brachytherapy.**

1. For each patient or human research subject that is patient receiving implant therapy and cannot be released in accordance with 1.7.33, a licensee shall:

   a. Not place the patient or human research subject in the same room with a patient who is not receiving brachytherapy;

   b. Visibly post the patient's or human research subject's door with a "Caution: Radioactive Material(s)" sign and note on the door or the patient's or human research subject's chart where and how long visitors may stay in the patient's or human research subject's room;

   c. Authorize visits by individuals under 18 years of age only on a case-by-case basis with the approval of the authorized user after consultation with the Radiation Safety Officer; and

   d. Promptly after implanting the sources, survey the dose rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument to demonstrate compliance with Subchapter 4 of these regulations and retain for 3 years a record of each survey that includes the time and date of the survey, a sketch of the area or list of points surveyed, the measured dose rate at several points expressed in millirems (μSv) per hour, the instrument used to make the survey, and the initials of the individual who made the survey.

2. A licensee shall have emergency response equipment available near each treatment room to respond to a source that inadvertently becomes:

   a. Dislodged from the patient; or

   b. Lodged within the patient following removal of the source applicators.

3. The Radiation Safety Officer or his or her designee, and the authorized user shall be notified immediately if the patient or human research subject dies or has a medical emergency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.57 **Calibration Measurements of Brachytherapy Sealed Sources.**

1. Prior to the first medical use of a brachytherapy sealed source on or after the effective date of these regulations, a licensee shall perform the following:

   a. Determine the source output or activity using a dosimetry system that meets the requirements of 1.7.69(1);

   b. Determine source positioning accuracy within applicators; and

c. Use published protocols accepted by nationally recognized bodies to meet the requirements of 1.7.57(1)(a) and 1.7.57(1)(b).

2. A licensee may use measurements provided by the source manufacturer or by a calibration laboratory accredited by the American Association of Physicists in Medicine that are made in accordance with 1.7.57(1).

3. A licensee shall mathematically correct the outputs or activities determined in 1.7.57(1) of this section for physical decay at intervals consistent with 1.0 percent physical decay.

4. An authorized medical physicist shall perform or review the calculation measurements made pursuant to 1.7.57(1), 1.7.57(2), or 1.7.57(3).

5. Only an authorized medical physicist shall calculate the activity of each strontium-90 source that is used to determine the treatment times for ophthalmic treatments. The decay must be based on the activity determined in accordance with paragraphs 1.7.57(1), 1.7.57(2), and 1.7.57(3).

6. A licensee shall retain a record of each calibration in accordance with 1.7.99.

7. A licensee shall retain a record of decay calculations required by 1.7.57(5) in accordance with 1.7.100.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.58 **Therapy-related Computer Systems.** The licensee shall perform acceptance testing on the treatment planning system in accordance with published protocols accepted by nationally recognized bodies. At a minimum, the acceptance testing must include, as applicable, verification of:

1. The source-specific input parameters required by the dose calculation algorithm;

2. The accuracy of dose, dwell time, and treatment time calculations at representative points;

3. The accuracy of isodose plots and graphic displays; and

4. The accuracy of the software used to determine radioactive source positions from radiographic images.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.59 **Possession of Survey Instruments.** A licensee authorized to use manual brachytherapy sources shall possess a portable radiation detection survey instrument capable of detecting dose rates over the range of 1 microsievert (0.1 mrem) per hour to 500 microsieverts (50 mrems) per hour, and a portable radiation measurement survey instrument capable of measuring dose rates over the range of 10 microsieverts (1 mrem) per hour to 10 millisieverts (1000 mrems) per hour. The instruments shall be operable and calibrated in accordance with 1.7.26.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.60 **Training for Use of Manual Brachytherapy Sources.** Except as provided in 1.7.22, the licensee shall require the authorized user of a manual brachytherapy source for the uses authorized under 1.7.52 for therapy to be a physician who:

1. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State, and who meets the requirements in 1.7.60(2)(c).[44] To have its certification process recognized, a specialty board shall require all candidates for certification to:

    a. Successfully complete a minimum of 3 years of residency training in a radiation oncology program approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or the Royal College of Physicians and Surgeons of Canada or the Committee on Post-Graduate Training of the American Osteopathic Association; and

    b. Pass an examination, administered by diplomates of the specialty board, that tests knowledge and competence in radiation safety, radionuclide handling, treatment planning, quality assurance, and clinical use of manual brachytherapy; or

2. **Training**

    a. Has completed a structured educational program in basic radionuclide handling techniques applicable to the use of manual brachytherapy sources that includes:

        i. 200 hours of classroom and laboratory training in the following areas;

            i. Radiation physics and instrumentation;

            ii. Radiation protection;

            iii. Mathematics pertaining to the use and measurement of radioactivity; and

            iv. Radiation biology.

        ii 500 hours of work experience under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.60 or equivalent Nuclear Regulatory Commission or Agreement State requirements at a medical institution, involving:

[44] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

i. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

ii. Checking survey meters for proper operation;

iii. Preparing, implanting, and removing brachytherapy sources;

iv. Maintaining running inventories of material on hand

v. Using administrative controls to prevent a misadministration involving the use of radioactive material; and

vi. Using emergency procedures to control radioactive material; and

b. Has completed 3 years of supervised clinical experience in radiation oncology, under an authorized user who meets the requirements in 1.7.22, 1.7.60 or equivalent Nuclear Regulatory Commission or Agreement State requirements, as part of a formal training program approved by the Residency Review Committee for Radiation Oncology of the Accreditation Council for Graduate Medical Education or the Royal College of Physicians and Surgeons of Canada or the Committee on Postdoctoral Training of the American Osteopathic Association. This experience may be obtained concurrently with the supervised work experience required by 1.7.60(2)(a)(ii); and

c. Has obtained written attestation, signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.60 or equivalent Nuclear Regulatory Commission or Agreement State requirements, that the individual has satisfactorily completed the requirements in 1.7.60(1)(a), or (2)(a) and 1.7.60.(2)(b) and has achieved a level of competency sufficient to function independently as an authorized user of manual brachytherapy sources for the medical uses authorized under 1.7.52.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.61 **Training for Ophthalmic Use of Strontium-90.** Except as provided in 1.7.22, the licensee shall require the authorized user of a strontium-90 for ophthalmic uses authorized under 1.7.52 to be a physician who:

1. Is an authorized user under 1.7.60 or equivalent Nuclear Regulatory Commission or Agreement State requirements; or

2. **Training**

a. Has completed 24 hours of classroom and laboratory training applicable to the medical use of strontium-90 for ophthalmic radiotherapy. The training must involve:

i. Radiation physics and instrumentation;

ii. Radiation protection;

iii. Mathematics pertaining to the use and measurement of radioactivity; and

iv. Radiation biology; and

b. Supervised clinical training in ophthalmic radiotherapy under the supervision of an authorized user at a medical institution, clinic, or private practice that includes the use of strontium-90 for the ophthalmic treatment of five individuals. This supervised clinical training must involve:

i. Examination of each individual to be treated;

ii. Calculation of the dose to be administered;

iii. Administration of the dose; and

iv. Follow-up and review of each individual's case history; and

c. Has obtained written attestation, signed by a preceptor authorized user who meets the requirements 1.7.22, 1.7.60, 1.7.61, or equivalent Nuclear Regulatory Commission or Agreement State requirements, that the individual has satisfactorily completed the requirements in 1.7.61(1) and (2) and has achieved a level of competency sufficient to function independently as an authorized user of strontium-90 for ophthalmic use.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.62 **Use of Sealed Sources for Diagnosis.** A licensee shall only use sealed sources for diagnostic medical uses:

1. Approved in the Sealed Source and Device Registry; and

2. Handled in accordance with the manufacturer's radiation safety instructions.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.63 **Training for Use of Sealed Sources for Diagnosis.** Except as provided in 1.7.22, the licensee shall require the authorized user of a diagnostic sealed source for the use in a device authorized under 1.7.52 to be a physician, dentist, or podiatrist who:

1. Is certified by a specialty board whose certification process includes all of the requirements in 1.7.63(2) and (3)[45] and whose certification has been recognized by the Agency, Nuclear Regulatory Commission, or an Agreement State; or

[45] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

2. Has completed 8 hours of classroom and laboratory training in basic radionuclide handling techniques specifically applicable to the use of the device. The training must include~~s~~:

   a. Radiation physics and instrumentation;

   b. Radiation protection;

   c. Mathematics pertaining to the use and measurement of radioactivity;

   d. Radiation biology; and

3. Has completed training in the use of the device for the uses requested.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.64 **Use of Sealed Sources in a Remote Afterloader Unit, Teletherapy Unit, or Gamma Stereotactic Radiosurgery Unit.** A licensee shall use sealed sources in photon emitting remote afterloader units, teletherapy units, or gamma stereotactic radiosurgery units for therapeutic medical uses:

1. As approved in the Sealed Source and Device Registry; or

2. In research in accordance with an effective Investigational Device Exemption (IDE) application accepted by the FDA provided the requirements of 1.7.18(a) are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.65 **Surveys of Patients and Human Research Subjects Treated with a Remote Afterloader Unit.**

1. Before releasing a patient or a human research subject from licensee control, a licensee shall make a survey of the patient or the human research subject and the remote afterloader unit with a portable radiation detection survey instrument to confirm that the source(s) has been removed from the patient or human research subject and returned to the safe, shielded position.

2. A licensee shall retain a record of the surveys in accordance with 1.7.97.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.66 **Installation, Maintenance, Adjustment, and Repair.**

1. Only a person specifically licensed by the Agency, the Nuclear Regulatory Commission or an Agreement State shall install, maintain, adjust, or repair a remote afterloader unit, teletherapy unit, or gamma stereotactic radiosurgery unit that involves work on the source(s) shielding, the source(s) driving unit, or other electronic or mechanical component that could expose the source(s), reduce the

shielding around the source(s), or compromise the radiation safety of the unit or the source(s).

2. Except for low dose-rate remote afterloader units, only a person specifically licensed by the Agency, an Agreement State, Licensing State or the Nuclear Regulatory Commission shall install, replace, relocate, or remove a sealed source or source contained in other remote afterloader units, teletherapy units, or gamma stereotactic radiosurgery units.

3. For a low dose-rate remote afterloader unit, only a person specifically licensed by the Agency, an Agreement State, Licensing State or the Nuclear Regulatory Commission, or an authorized medical physicist shall install, replace, relocate, or remove a sealed source(s) contained in the unit.

4. A licensee shall retain a record of the installation, maintenance, adjustment and repair done on remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units in accordance with 1.7.101.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.67 **Safety Procedures and Instructions for Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units.**

1. A licensee shall:

   a. Secure the unit, the console, the console keys, and the treatment room when not in use or unattended;

   b. Permit only individuals approved by the authorized user, Radiation Safety Officer, or authorized medical physicist to be present in the treatment room during treatment with the source(s);

   c. Prevent dual operation of more than one radiation producing device in a treatment room, if applicable; and

   d. Develop, implement, and maintain written procedures for responding to an abnormal situation when the operator is unable to place the source(s) in the shielded position, or remove the patient or human research subject from the radiation field with controls from outside the treatment room. This procedure must include:

      i. Instructions for responding to equipment failures and the names of the individuals responsible for implementing corrective actions;

      ii. The process for restricting access to and posting of the treatment area to minimize the risk of inadvertent exposure; and

      iii. The names and telephone numbers of the authorized users, the authorized medical physicist, and the Radiation Safety Officer to be contacted if the unit or console operates abnormally.

2. A copy of the procedures required by 1.7.67(1)(d) must be physically located at the unit console.

3. A licensee shall post instructions at the unit console to inform the operator of:

   a. The location of the procedures required by 1.7.67(1)(d); and

   b. The names and telephone numbers of the authorized users, the authorized medical physicist, and the Radiation Safety Officer to be contacted if the unit or console operates abnormally.

4. A licensee shall provide instruction, initially and at least annually, to all individuals who operate the unit, as appropriate to the individual's assigned duties, in:

   a. The procedures identified in 1.7.67(1)(d); and

   b. The operating procedures for the unit.

5. A licensee shall ensure that operators, authorized medical physicists, and authorized users participate in drills of the emergency procedures, initially and at least annually.

6. A licensee shall retain a record of individuals receiving instruction required by 1.7.67(4), in accordance with 1.7.96.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.68 **Safety Precautions for Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units.**

1. A licensee shall control access to the treatment room by a door at each entrance.

2. A licensee shall equip each entrance to the treatment room with an electrical interlock system that will:

   a. Prevent the operator from initiating the treatment cycle unless each treatment room entrance door is closed;

   b. Cause the source(s) to be shielded promptly when an entrance door is opened; and

   c. Prevent the source(s) from being exposed following an interlock interruption until all treatment room entrance doors are closed and the source(s) on-off control is reset at the console.

3. A licensee shall have in each treatment room a permanent radiation monitor capable of continuously monitoring beam status.

   a. Each radiation monitor shall be capable of providing visible notice of a teletherapy unit malfunction that results in an exposed or partially

exposed source. The visible indicator of high radiation levels shall be observable by an individual entering the teletherapy room.

b. Each radiation monitor shall be equipped with a backup power supply separate from the power supply to the teletherapy unit. This backup power supply may be a battery system.

c. A radiation monitor shall be checked with a dedicated check source for proper operation each day before the teletherapy unit is used for treatment of patients.

d. A licensee shall maintain a record of the check required by 1.7.68(3)(c) for 3 years. The record shall include the date of the check, notation that the monitor indicates when the source is exposed, and the initials of the individual who performed the check.

e. If a radiation monitor is inoperable, the licensee shall require any individual entering the treatment room to use a survey instrument or audible alarm personal dosimeter to monitor for any malfunction of the source exposure mechanism. The instrument or dosimeter shall be checked with a dedicated check source for proper operation at the beginning of each day of use. The licensee shall keep a record as described in 1.7.68(3)(d).

f. A licensee shall promptly repair or replace the radiation monitor if it is inoperable.

4. Except for low-dose remote afterloader units, a licensee shall construct or equip each treatment room with viewing and intercom systems to permit continuous observation of the patient or the human research subject from the treatment console during irradiation.

5. For licensed activities where sources are placed within the patient's or human research subject's body, a licensee shall only conduct treatments which allow for expeditious removal of a decoupled or jammed source.

6. In addition to the requirements specified in 1.7.68(1) through 1.7.68(5), a licensee shall:

a. For medium dose-rate, and pulsed dose-rate remote afterloader units, require:

i. An authorized medical physicist and either an authorized user or a physician, under the supervision of an authorized user, who has been trained in the operation and emergency response for the unit to be physically present during the initiation of all patient treatments involving the unit; and

ii. An authorized medical physicist and either an authorized user or an individual, under the supervision of an authorized user, who has been trained to remove the source applicator(s) in the event of an

emergency involving the unit, to be immediately available during continuation of all patient treatments involving the unit.

b. For high dose-rate remote afterloader units, require:

i. An authorized user and an authorized medical physicist to be physically present during the initiation of all patient treatments involving the unit; and

ii. An authorized medical physicist and either an authorized user or a physician, under the supervision of an authorized user, who has been trained in the operation and emergency response for the unit, to be physically present during continuation of all patient treatments involving the unit.

c. For gamma stereotactic radiosurgery units, require an authorized user and an authorized medical physicist to be physically present throughout all patient treatments involving the unit.

d. Notify the Radiation Safety Officer, or his or her designee, and an authorized user as soon as possible, if the patient or human research subject has a medical emergency and, immediately, if the patient dies.

7. A licensee shall have emergency response equipment available near each treatment room to respond to a source that inadvertently:

a. Remains in the unshielded position; or

b. Lodges within the patient following completion of the treatment.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.69 **Dosimetry Equipment.**

1. Except for low dose-rate remote afterloader sources where the source output or activity is determined by the manufacturer, a licensee shall have a calibrated dosimetry system available for use. To satisfy this requirement, one of the following two conditions shall be met:

a. The system shall have been calibrated using a system or source traceable to the National Institute of Standards and Technology (NIST) and published protocols accepted by nationally recognized bodies; or by a calibration laboratory accredited by the American Association of Physicists in Medicine (AAPM). The calibration shall have been performed within the previous 2 years and after any servicing that may have affected system calibration; or

b. The system shall have been calibrated within the previous 4 years; 18 to 30 months after that calibration, the system shall have been intercompared with another dosimetry system that was calibrated within the past 24 months by the National Institute of Standards and Technology (NIST) or

by a calibration laboratory accredited by the American Association of Physicists in Medicine (AAPM). The results of the intercomparison meeting must have indicated that the calibration factor of the licensee's system had not changed by more than 2 percent. The licensee shall not use the intercomparison result to change the calibration factor. When intercomparing dosimetry systems to be used for calibrating sealed sources for therapeutic units, the licensee shall use a comparable unit with beam attenuators or collimators, as applicable, and sources of the same radionuclide as the source used at the licensee's facility.

2. The licensee shall have available for use a dosimetry system for spot-check measurements. To meet this requirement, the system may be compared with a system that has been calibrated in accordance with 1.7.69(1). This comparison shall have been performed within the previous year and after each servicing that may have affected system calibration. The spot-check system shall be the same system used to meet the requirement in 1.7.69(1).

3. The licensee shall maintain a record of each calibration, intercomparison, and comparison in accordance with 1.7.102.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.70 **Full Calibration Measurements on Teletherapy Units.**

1. A licensee authorized to use a teletherapy unit for medical use shall perform full calibration measurements on each teletherapy unit:

   a. Before the first medical use of the unit;

   b. Before medical use under the following conditions:

      i. Whenever spot-check measurements indicate that the output differs by more than 5 percent from the output obtained at the last full calibration corrected mathematically for radioactive decay;

      ii. Following replacement of the source or following reinstallation of the teletherapy unit in a new location; and

      iii. Following any repair of the teletherapy unit that includes removal of the source or major repair of the components associated with the source exposure assembly; and

   c. At intervals not exceeding 1 year.

2. To satisfy the requirement of 1.7.70(1), full calibration measurements shall include determination of:

   a. The output within +/-3 percent for the range of field sizes and for the distance or range of distances used for medical use;

b. The coincidence of the radiation field and the field indicated by the light beam localizing device;

c. The uniformity of the radiation field and its dependence on the orientation of the useful beam;

d. Timer accuracy, constancy, and linearity;

e. "On-off" error; and

f. The accuracy of all distance measuring and localization devices in medical use.

3. A licensee shall use the dosimetry system described in 1.7.69 to measure the output for one set of exposure conditions. The remaining radiation measurements required in 1.7.70(2)(a) may then be made using a dosimetry system that indicates relative dose rates.

4. A licensee shall make full calibration measurements required by 1.7.70(1) in accordance with published protocols accepted by nationally recognized bodies.

5. A licensee shall correct mathematically the outputs determined in 1.7.70(2)(a) for physical decay for intervals not exceeding 1 month for cobalt-60, 6 months for cesium-137, or at intervals consistent with 1 percent decay for all other nuclides.

6. Full calibration measurements required by 1.7.70(1) and physical decay corrections required by 1.7.70(5) shall be performed by a medical physicist.

7. A licensee shall maintain a record of each calibration in accordance with 1.7.103.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.71 **Full Calibration Measurements on Remote Afterloader Units.**

1. A licensee authorized to use a remote afterloader unit for medical use shall perform full calibration measurements on each unit:

a. Before the first medical use of the unit;

b. Before medical use under the following conditions:

i. Following replacement of the source or following reinstallation of the unit in a new location outside the facility; and

ii. Following any repair of the unit that includes removal of the source or major repair of the components associated with the source exposure assembly; and

c. At intervals not exceeding 1 quarter for high dose-rate, medium dose-rate, and pulsed dose-rate remote afterloader units with sources whose half-life exceeds 75 days; and

d. At intervals not exceeding 1 year for low dose-rate remote afterloader units.

2. To satisfy the requirement of 1.7.71(1), full calibration measurements must include, as applicable, determination of:

a. The output within +/- 5 percent;

b. Source positioning accuracy to within +/- 1 millimeter;

c. Source retraction with backup battery upon power failure;

d. Length of the source transfer tubes;

e. Timer accuracy and linearity over the typical range of use;

f. Length of the applicators; and

g. Function of the source transfer tubes, applicators, and transfer tube-applicator interfaces.

3. In addition to the requirements for full calibrations for low dose-rate remote afterloader units in 1.7.71(2), a licensee shall perform an autoradiograph of the source(s) to verify inventory and source(s) arrangement at intervals not exceeding one quarter.

4. A licensee shall use the dosimetry system described in 1.7.69(1) to measure the output.

5. A licensee shall make full calibration measurements required by 1.7.71(1) of this section in accordance with published protocols accepted by nationally recognized bodies.

6. For low dose-rate remote afterloader units, a licensee may use measurements provided by the source manufacturer that are made in accordance with 1.7.71(1) through 1.7.71(5).

7. A licensee shall mathematically correct the outputs determined in 1.7.71(2)(a) for physical decay at intervals consistent with 1 percent physical decay.

8. Full calibration measurements required by 1.7.71(1) and physical decay corrections required by 1.7.71(7) must be performed by the authorized medical physicist.

9. A licensee shall retain a record of each calibration in accordance with 1.7.103.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.72 **Full Calibration Measurements on Gamma Stereotactic Radiosurgery Units.**

1. A licensee authorized to use a gamma stereotactic radiosurgery unit for medical use shall perform full calibration measurements on each unit:

a. Before the first medical use of the unit;

b. Before medical use under the following conditions:

i. Whenever spot-check measurements indicate that the output differs by more than 5 percent from the output obtained at the last full calibration corrected mathematically for radioactive decay;

ii. Following replacement of the sources or following reinstallation of the gamma stereotactic radiosurgery unit in a new location; and

iii. Following any repair of the gamma stereotactic radiosurgery unit that includes removal of the sources or major repair of the components associated with the source assembly; and

c. At intervals not exceeding 1 year, with the exception that relative helmet factors need only be determined before the first medical use of a helmet and following any damage to a helmet.

2. To satisfy the requirement of 1.7.72(1), full calibration measurements must include determination of:

a. The output within +/-3 percent;

b. Relative helmet factors;

c. Isocenter coincidence;

d. Timer accuracy and linearity over the range of use;

e. On-off error;

f. Trunnion centricity;

g. Treatment table retraction mechanism, using backup battery power or hydraulic backups with the unit off;

h. Helmet microswitches;

i. Emergency timing circuits; and

j. Stereotactic frames and localizing devices (trunnions).

3. A licensee shall use the dosimetry system described in 1.7.69(1) to measure the output for one set of exposure conditions. The remaining radiation measurements required in 1.7.72(2)(a) may be made using a dosimetry system that indicates relative dose rates.

4. A licensee shall make full calibration measurements required by 1.7.72(1) in accordance with published protocols accepted by nationally recognized bodies.

5. A licensee shall mathematically correct the outputs determined in 1.7.72(2)(a) at intervals not exceeding 1 month for cobalt-60 and at intervals consistent with 1 percent physical decay for all other radionuclides.

6. Full calibration measurements required by 1.7.72(1) and physical decay corrections required by 1.7.72(5) must be performed by the authorized medical physicist.

7. A licensee shall retain a record of each calibration in accordance with 1.7.103.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.73 **Periodic Spot-Checks for Teletherapy Units.**

1. A licensee authorized to use teletherapy units for medical use shall perform output spot-checks on each teletherapy unit at intervals not to exceed 1 month that include determination of:

   a. Timer constancy and timer linearity over the range of use;

   b. "On-off" error;

   c. The coincidence of the radiation field and the field indicated by the light beam localizing device;

   d. The accuracy of all distance measuring and localization devices used for medical use;

   e. The output for one typical set of operating conditions measured with the dosimetry system described in 1.7.69(2) and

   f. The difference between the measurement made in 1.7.73(1)(e) and the anticipated output, expressed as a percentage of the anticipated output (i.e., the value obtained at last full calibration corrected mathematically for physical decay).

2. A licensee shall perform spot-checks required by 1.7.73(1) in accordance with procedures established by the authorized medical physicist. The authorized medical physicist teletherapy physicist does not need to actually perform the spot-check measurements.

3. A licensee shall have the authorized medical physicist teletherapy physicist review the results of each spot-check within 15 days. The authorized medical physicist teletherapy physicist shall promptly notify the licensee in writing of the results of each spot-check.

4. A licensee authorized to use a teletherapy unit for medical use shall perform safety spot-checks of each teletherapy facility at intervals not to exceed 1 month. and after each source installation to assure proper operation of:

   a. Electrical interlocks at each teletherapy room entrance;

b. Electrical or mechanical stops installed for the purpose of limiting use of the primary beam of radiation (restriction of source housing angulation or elevation, carriage or stand travel and operation of the beam "on-off" mechanism);

c. Source exposure indicator lights on the teletherapy unit, on the control console, and in the facility;

d. Viewing and intercom systems;

e. Treatment room doors from inside and outside the treatment room; and

f. Electrically assisted treatment room doors with the teletherapy unit electrical power turned "off".

5. If the results of the checks required in 1.7.73(4) indicate the malfunction of any system, A the licensee shall lock the control console in the "off" position and not use the unit except as may be necessary to repair, replace, or check the malfunctioning system.

6. A licensee shall maintain a record of each spot-check required by 1.7.73(1) and (4) in accordance with 1.7.104.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.74 **Periodic Spot-Checks for Remote Afterloader Units.**

1. A licensee authorized to use remote afterloader units for medical use shall perform spot-checks of each remote afterloader facility and on each unit:

a. At the beginning of each day of use of a high dose-rate, medium dose-rate or pulsed dose-rate remote afterloader unit;

b. Prior to each patient treatment with a low dose-rate remote afterloader unit; and

c. After each source installation.

2. The licensee shall have the authorized medical physicist establish written procedures for performing the spot-checks required in 1.7.74(1). The authorized medical physicist need not actually perform the spot-check measurements.

3. A licensee shall have the authorized medical physicist review the results of each spot-check within 15 days. The authorized medical physicist shall notify the licensee as soon as possible in writing of the results of each spot check.

4. To satisfy the requirements of 1.7.74(1), spot-checks must, at a minimum, assure proper operation of:

a. Electrical interlocks at each remote afterloader unit room entrance;

b. Source exposure indicator lights on the remote afterloader unit, on the control console, and in the facility;

c. Viewing and intercom systems in each high dose-rate, medium dose-rate and pulsed dose-rate remote afterloader facility;

d. Emergency response equipment;

e. Radiation monitors used to indicate the source position;

f. Timer accuracy;

g. Clock (date and time) in the unit's computer; and

h. Decayed source(s) activity in the unit's computer.

5. If the results of the checks required in 1.7.74(4) indicate the malfunction of any system, a licensee shall lock the control console in the off position and not use the unit except as may be necessary to repair, replace, or check the malfunctioning system.

6. A licensee shall retain a record of each check required by 1.7.74(4) in accordance with 1.7.105.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.75 **Periodic Spot-Checks for Gamma Stereotactic Radiosurgery Units.**

1. A licensee authorized to use a gamma stereotactic radiosurgery unit for medical use shall perform spot-checks of each gamma stereotactic radiosurgery facility and on each unit:

a. Monthly;

b. At the beginning of each day of use; and

c. After each source installation.

2. The licensee shall have the authorized medical physicist:

a. Establish written procedures for performing the spot-checks required in 1.7.75(1); and

b. Review the results of each spot-check required by 1.7.75(1)(a) within 15 days of the check. The authorized medical physicist need not actually perform the spot-check measurements. The authorized medical physicist shall notify the licensee as soon as possible, in writing, of the results of the spot check.

3. To satisfy the requirements of 1.7.75(1)(a), spot-checks must, at a minimum:

a. Assure proper operation of:

i. Treatment table retraction mechanism, using backup battery power or hydraulic backups with the unit off;

ii. Helmet microswitches;

iii. Emergency timing circuits; and

iv. Stereotactic frames and localizing devices (trunnions).

b. Determine :

i. The output for one typical set of operating conditions measured with the dosimetry system described in 1.7.69(2);

ii. The difference between the measurement made in 1.7.75(3)(b)(i) and the anticipated output, expressed as a percentage of the anticipated output (i.e., the value obtained at last full calibration corrected mathematically for physical decay);

iii. Source output against computer calculation;

iv. Timer accuracy and linearity over the range of use;

v. On-off error; and

vi. Trunnion centricity.

4. To satisfy the requirements of 1.7.75(1)(b) and 1.7.75(1)(c), spot-checks must assure proper operation of:

a. Electrical interlocks at each gamma stereotactic radiosurgery room entrance;

b. Source exposure indicator lights on the gamma stereotactic radiosurgery unit, on the control console, and in the facility;

c. Viewing and intercom systems;

d. Timer termination;

e. Radiation monitors used to indicate room exposures; and

f. Emergency off buttons.

5. A licensee shall arrange for prompt repair of any system identified in 1.7.75(3) that is not operating properly.

6. If the results of the checks required in 1.7.75(4) indicate the malfunction of any system, a licensee shall lock the control console in the off position and not use the unit except as may be necessary to repair, replace, or check the malfunctioning system.

7. A licensee shall retain a record of each check required by 1.7.75(3) and 1.7.75(4) in accordance with 1.7.106.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.76 **Additional Technical Requirements for Mobile Remote Afterloader Units.**

1. A licensee providing mobile remote afterloader service shall:

   a. Check survey instruments for consistent response before medical use at each address of use or on each day of use, whichever is more frequent; and

   b. Account for all sources before departure from a client's address of use.

2. In addition to the periodic spot-checks required by 1.7.74, a licensee authorized to use mobile afterloaders for medical use shall perform checks on each remote afterloader unit before use at each address of use. At a minimum, checks must be made to verify the operation of :

   a. Electrical interlocks on treatment area access points;

   b. Source exposure indicator lights on the remote afterloader unit, on the control console, and in the facility;

   c. Viewing and intercom systems;

   d. Applicators, source transfer tubes, and transfer tube-applicator interfaces;

   e. Radiation monitors used to indicate room exposures;

   f. Source positioning (accuracy); and

   g. Radiation monitors used to indicate whether the source has returned to a safe shielded position.

3. In addition to the requirements for checks in 1.7.76(2), a licensee shall ensure overall proper operation of the remote afterloader unit by conducting a simulated cycle of treatment before use at each address of use.

4. If the results of the checks required in 1.7.76(2) indicate the malfunction of any system, a licensee shall lock the control console in the off position and not use the unit except as may be necessary to repair, replace, or check the malfunctioning system.

5. A licensee shall retain a record of each check required by 1.7.76(2) in accordance with 1.7.107.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.77 **Radiation Surveys.**

1. In addition to the survey requirements in 1.4.17 of these regulations, a person licensed pursuant to Subchapter 7 shall make surveys to ensure that the maximum radiation levels and average radiation levels from the surface of the main source safe with the source(s) in the shielded position does not exceed the levels stated in the Sealed Source and Device Registry.

2. The licensee shall make the survey required by 1.7.77(1) at installation of a new source and following repairs to the source(s) shielding, the source(s) driving unit, or other electronic or mechanical component that could expose the source, reduce the shielding around the source(s), or compromise the radiation safety of the unit or the source(s).

3. A licensee shall retain a record of the radiation surveys required by 1.7.77(1) in accordance with 1.7.108.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.78 **Five-Year Inspection for Teletherapy and Gamma Stereotactic Radiosurgery Units.**

1. A licensee shall have each teletherapy unit and gamma stereotactic radiosurgery unit fully inspected and serviced during source replacement or at intervals not to exceed 5 years, whichever comes first, to assure proper functioning of the source exposure mechanism.

2. This inspection and servicing may only be performed by persons specifically licensed to do so by the Agency, an Agreement State, a Licensing State or the Nuclear Regulatory Commission.

3. A licensee shall keep a record of the inspection and servicing in accordance with 1.7.109.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.79 **Therapy-Related Computer Systems.** The licensee shall perform acceptance testing on the treatment planning system in accordance with published protocols accepted by nationally recognized bodies. At a minimum, the acceptance testing must include, as applicable, verification of:

1. The source-specific input parameters required by the dose calculation algorithm;

2. The accuracy of dose, dwell time, and treatment time calculations at representative points;

3. The accuracy of isodose plots and graphic displays;

4. The accuracy of the software used to determine radioactive source positions from radiographic images; and

5. The accuracy of electronic transfer of the treatment delivery parameters to the treatment delivery unit from the treatment planning system.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.80 **Possession of Survey Instruments.** A licensee authorized to use radioactive material in remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units shall possess a portable radiation detection survey instrument capable of detecting dose rates over the range of 1 microsievert (0.1 mrem) per hour to 500 microsieverts (50 mrems) per hour, and a portable radiation measurement survey instrument capable of measuring dose rates over the range of 10 microsieverts (1 mrem) per hour to 10 millisieverts (1000 mrems) per hour. The instruments shall be operable and calibrated in accordance with 1.7.26.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.81 **Training for Use of Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units.** Except as provided in 1.7.22, the licensee shall require the authorized user of a sealed source specified in 1.7.67 to be a physician who:

1. Is certified by a medical specialty board whose certification process has been recognized by the Agency, Nuclear Regulatory Commission or an Agreement State and who meets the requirements in 1.7.81(2)(c) and (3)[46]. To have its certification process recognized, a specialty board shall require all candidates for certification to:

    a. Successfully complete a minimum of 3 years of residency training in a radiation therapy program approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or the Royal College of Physicians and Surgeons of Canada or the Committee on Post-Graduate Training of the American Osteopathic Association; and

    b. Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, treatment planning, quality assurance, and clinical use of stereotactic radiosurgery, remote afterloaders and external beam therapy; or

2. **Training**

    a. Has completed a structured educational program in basic radionuclide techniques applicable to the use of a sealed source in a therapeutic medical unit that includes:

        i. 200 hours of classroom and laboratory training in the following area:

            i. Radiation physics and instrumentation;

            ii. Radiation protection;

[46] The names of board certifications which have been recognized by the Agency, Nuclear Regulatory Commission (NRC) or another Agreement State will be posted on the NRC's Web page.

iii. Mathematics pertaining to the use and measurement of radioactivity; and

iv. Radiation biology; and

ii. 500 hours of work experience, under the supervision of an authorized user who meets the requirements in 1.7.22, 1.7.81 or equivalent Agreement State or Nuclear Regulatory Commission requirements at a medical institution, involving:

i. Reviewing of the full calibration measurements and periodic spot-checks;

ii. Preparing treatment plans and calculating treatment doses and times;

iii. Using administrative controls to prevent misadministrations involving the use of radioactive material;

iv. Implementing emergency procedures to be followed in the event of the abnormal operation of a medical unit or console; and

v. Checking and using survey meters; and

vi. Selecting the proper dose and how it is to be administered; and

b. Has completed 3 years of supervised clinical experience in radiation therapy, under an authorized user who meets the requirements in 1.7.22, 1.7.81, or equivalent Agreement State or Nuclear Regulatory Commission requirements, as part of a formal training program approved by the Residency Review Committee for Radiation Oncology of the Accreditation Council for Graduate Medical Education or the Royal College of Physicians and Surgeons of Canada or the Committee on Postdoctoral Training of the American Osteopathic Association. This experience may be obtained concurrently with the supervised work experience required by 1.7.81(2)(a)(ii); and

c. Has obtained written attestation that the individual has satisfactorily completed the requirements in 1.7.81(1)(a) or 1.7.81(2)(a) and 1.7.81(2)(b), and 1.7.81(3), and has achieved a level of competency sufficient to function independently as an authorized user of each type of therapeutic medical unit for which the individual is requesting authorized user status. The written attestation must be signed by a preceptor authorized user who meets the requirements in 1.7.22, 1.7.81 or equivalent Nuclear Regulatory Commission or Agreement State requirements for an authorized user for each type of therapeutic medical unit for which the individual is requesting authorized user status; and

3. Has received training in device operation, safety procedures, and clinical use for the type(s) of use for which authorization is sought. This training requirement may be satisfied by satisfactory completion of a training program provided by the vendor for new users or by receiving training supervised by an authorized user or authorized medical physicist, as appropriate, who is authorized for the type(s) of use for which the individual is seeking authorization.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.82 **Other Medical Uses of Radioactive Material or Radiation from Radioactive Material.** A licensee may use radioactive material or a radiation source approved for medical use that is not specifically addressed in Subchapter 7 if:

1. The applicant or licensee has submitted the information required by 1.7.8(2), 1.7.8(3), and 1.7.8(4); and

2. The applicant or licensee has received written approval from the Agency, Nuclear Regulatory Commission, an Agreement State, or Licensing State in a license and uses the material in accordance with the regulations and specific conditions the Agency, Nuclear Regulatory Commission, Agreement State, or Licensing State considers necessary for the medical use of the material.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.83 **Records of Authority and Responsibilities for Radiation Protection Programs.**

1. A licensee shall retain a record of actions taken by the licensee's management in accordance with 1.7.13(1) for 5 years. The record must include a summary of the actions taken and a signature of licensee management.

2. The licensee shall retain a current copy of the authorities, duties and responsibilities of the Radiation Safety Officer as required by 1.7.13(4), and a signed copy of the Radiation Safety Officer's agreement to be responsible for implementing the radiation safety program, as required by 1.7.13(2). The record must include the signature of the Radiation Safety Officer and licensee management.

3. The minutes of each Radiation Safety Committee meeting held in accordance with 1.7.13(7) shall include:

   a. The date of the meeting;

   b. Members present;

   c. Members absent; and

   d. Summary of deliberations and discussions.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.84 **Records of Written Directives.** A licensee shall retain a copy of each written directive as required by 1.7.16 for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.85 **Records of Misadministrations.** A licensee shall retain a record of misadministrations reported in accordance with 1.7.110 for 3 years. The record must contain the licensee's name; names of the individuals involved; the social security number or other identification number if one has been assigned, of the individual who is the subject of the misadministration; a brief description of the event; why it occurred; the effect, if any, on the individual; the actions, if any, taken, or planned, to prevent recurrence; and, whether the licensee notified the individual (or the individual's responsible relative or guardian) and, if not, whether such failure to notify was based on guidance from the referring physician.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.86 **Record of a Dose to an Embryo/Fetus or a Nursing Child.** A licensee shall retain a record of a dose to an embryo/fetus or a nursing child reported in accordance with 1.7.111 for 3 years. The record must contain the licensee's name; names of all the individuals involved; social security number or other identification number if one has been assigned to the embryo/fetus, pregnant individual, or nursing child who is the subject of the event; a brief description of the event; why it occurred; the effect, if any, on the embryo/fetus or nursing child; the actions, if any, taken, or planned, to prevent recurrence; and whether the licensee notified the pregnant individual or mother (or the mother's or child's responsible relative or guardian) and, if not, whether such failure to notify was based on guidance from the referring physician.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.87 **Records of Calibrations of Instruments Used to Measure the Activity of Unsealed Radioactive Material.** A licensee shall maintain a record of instrument calibrations required by 1.7.25 for 3 years. The records must include the model and serial number of the instrument, the date of the calibration, the results of the calibration, and the name of the individual who performed the calibration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.88 **Records of Survey Instrument Calibrations.** A licensee shall maintain a record of survey instrument calibrations required by 1.7.26 for 3 years. The record must include the model and serial number of the instrument, the date of the calibration, the results of the calibration, and the name of the individual who performed the calibration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.89 **Records of Dosages of Unsealed Radioactive Material for Medical Use.** A licensee shall maintain a record of dosage determinations required by 1.7.27 for 3

years. The record must contain the radioactive drug; the patient's or human research subject's name, or identification number if one has been assigned; prescribed dosage; the determined dosage, or a notation that the total activity is less than 1.1 megabecquerels (30 μCi); the date and time of the dosage determination; and the name of the individual who determined the dosage.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.90 **Records of Possession of Sealed Sources and Brachytherapy Sources.** A licensee shall retain a record of the physical inventory of sealed sources and brachytherapy sources required by 1.7.29(6) for 3 years. The inventory record must contain the model number of each source, and serial number if one has been assigned, the identity of each source radionuclide and its nominal activity, the location of each source, and the name of the individual who performed the inventory.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.91 **Records of Surveys for Ambient Radiation Exposure Rate.** A licensee shall retain a record of each survey required by 1.7.32 for 3 years. The record must include the date of the survey, the results of the survey, the instrument used to make the survey, and the name of the individual who performed the survey.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.92 **Records of the Release of Individuals Containing Radioactive Drugs or Implants Containing Radioactive Material.**

1. A licensee shall retain a record, signed by the authorized user, of the basis for authorizing the release of an individual, for 3 years after the date of release.

2. A licensee shall retain a record, for 3 years after the date of release, that the instructions required by 1.7.33(2) were provided to a breast-feeding woman if the radiation dose to the infant or child from continued breast-feeding could result in a total effective dose equivalent exceeding 15 millisievert (0.1 rem).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.93 **Records of Administrative and Technical Requirements that Apply to the Provision of Mobile Services.**

1. A licensee shall retain a copy of the letter(s) that permits the use of radioactive material at a client's address of use, as required by 1.7.11(2), for 3 years after the last provision of service.

2. A licensee shall retain the record of each survey required by 1.7.36(6) for 3 years. The record must include the date of the survey, the results of the survey, the instrument used to make the survey, and the name of the individual who performed the survey.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.94 **Records of Decay-in-Storage.** A licensee shall maintain records of the disposal of licensed materials, as required by 1.7.36, for 3 years. The record must include the date of the disposal, the survey instrument used, the background radiation level, the radiation level measured at the surface of each waste container, and the name of the individual who performed the survey.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.95 **Records of Radionuclide Purity.** A licensee shall maintain a record of the radionuclide contaminant concentration tests required by 1.7.41 for 3 years. The record must include, for each measured elution of radionuclide used to prepare a radioactive drug, the ratio of the measures expressed as kilobecquerel of contaminant per megabecquerel of desired radionuclide (microcuries/millicurie), or microgram of contaminant per megabecquerel of desired radionuclide (microgram/millicurie), the time and date of the measurement, and the name of the individual who made the measurement.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.96 **Records of Safety Instruction and Training.** A licensee shall maintain a record of safety instructions and training required by 1.7.45, 1.7.55 and 1.7.67 for 3 years. The record must include a list of the topics covered, the date of the instruction or training, the name(s) of the attendee(s), and the name(s) of the individual(s) who provided the instruction.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.97 **Records of Radiation Surveys of Patients and Human Research Subjects.** A licensee shall maintain a record of the surveys required by 1.7.53 and 1.7.65 for 3 years. Each record must include the date and results of the survey, the survey instrument used, and the name of the individual who made the survey.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.98 **Records of Brachytherapy Source Inventory.**

1. A licensee shall maintain a record of brachytherapy source accountability required by 1.7.54 for 3 years.

2. For temporary implants, the record must include:

   a. The number and activity of sources removed from storage, the time and date they were removed from storage, the name of the individual who removed them from storage, and the location of use; and

   b. The number and activity of sources not implanted, the time and date they were returned to storage, and the name of the individual who returned them to storage.

3. For permanent implants, the record must include:

a. The number and activity of sources removed from storage, the date they were removed from storage, and the name of the individual who removed them from storage;

b. The number and activity of sources returned to storage, the date they were returned to storage, and the name of the individual who returned them to storage; and

c. The number and activity of sources permanently implanted in the patient or human research subject.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.99 **Records of Calibration Measurements on Brachytherapy Sources.** A licensee shall maintain a record of the calibrations on brachytherapy sources required by 1.7.57 for 3 years after the last use of the source. The record must include the date of the calibration; the manufacturer's name, model number, and serial number for the source and the instruments used to calibrate the source; the source output or activity; source positioning accuracy within applicators; and the signature of the authorized medical physicist.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.100 **Records of Decay of Strontium-90 Sources for Opthalmic Treatments.** The licensee shall maintain a record of the activity of a strontium-90 source required by 1.7.67 for the life of the source. The record must include the date and initial activity of the source as determined under 1.7.57, and for each decay calculation, the date, the source activity and the signature of the authorized medical physicist.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.101 **Records of Installation, Maintenance, Adjustment, and Repair.** A licensee shall retain a record of the installation, maintenance, adjustment, and repair of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units as required by 1.7.66 for 3 years. For each installation, maintenance, adjustment and repair, the record must include the date, description of the service, and name(s) of the individual(s) who performed the work.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.102 **Records of Dosimetry Equipment.**

1. A licensee shall retain a record of the calibration, intercomparison, and comparisons of its dosimetry equipment done in accordance with 1.7.69 for the duration of the license.

2. For each calibration, intercomparison, or comparison, the record must include:

a. The date;

b. The manufacturer's name, model numbers and serial numbers of the instruments that were calibrated, intercompared, or compared as required by 1.7.69(1) and 1.7.69(2);

c. The correction factor that was determined from the calibration or comparison or the apparent correction factor that was determined from an intercomparison; and

d. The names of the individuals who performed the calibration, intercomparison, or comparison.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.103 **Records of Teletherapy, Remote Afterloader, and Gamma Stereotactic Radiosurgery Full Calibrations.**

1. A licensee shall maintain a record of the teletherapy, remote afterloader, and gamma stereotactic radiosurgery full calibrations required by 1.7.70, 1.7.71, and 1.7.72 for 3 years.

2. The record must include:

a. The date of the calibration;

b. The manufacturer's name, model number, and serial number for the teletherapy, remote afterloader, and gamma stereotactic radiosurgery unit(s), the source(s), and instruments used to calibrate the unit;

c. The results and assessments of the full calibrations;

d. The results of the autoradiograph required for low dose-rate remote afterloader units; and

e. The signature of the authorized medical physicist who performed the full calibration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.104 **Records of Periodic Spot-Checks for Teletherapy Units.**

1. A licensee shall retain a record of each periodic spot-check for teletherapy units required by 1.7.73 for 3 years.

2. The record must include:

a. The date of the spot-check;

b. The manufacturer's name, model number, and serial number for the teletherapy unit, source and instrument used to measure the output of the teletherapy unit;

c. An assessment of timer linearity and constancy;

d. The calculated on-off error;

e. A determination of the coincidence of the radiation field and the field indicated by the light beam localizing device;

f. The determined accuracy of each distance measuring and localization device;

g. The difference between the anticipated output and the measured output;

h. Notations indicating the operability of each entrance door electrical interlock, each electrical or mechanical stop, each source exposure indicator light, and the viewing and intercom system and doors; and

i. The name of the individual who performed the periodic spot-check and the signature of the authorized medical physicist who reviewed the record of the spot-check.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.105 **Records of Periodic Spot-Checks for Remote Afterloader Units.**

1. A licensee shall retain a record of each spot-check for remote afterloader units required by 1.7.74 for 3 years.

2. The record must include, as applicable:

a. The date of the spot-check;

b. The manufacturer's name, model number, and serial number for the remote afterloader unit and source;

c. An assessment of timer accuracy;

d. Notations indicating the operability of each entrance door electrical interlock, radiation monitors, source exposure indicator lights, viewing and intercom systems, and clock and decayed source activity in the unit's computer; and

e. The name of the individual who performed the periodic spot-check and the signature of the authorized medical physicist who reviewed the record of the spot-check.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.106 **Records of Periodic Spot-Checks for Gamma Stereotactic Radiosurgery Units.**

1. A licensee shall retain a record of each spot-check for gamma stereotactic radiosurgery units required by 1.7.75 for 3 years.

2. The record must include:

a. The date of the spot-check;

b. The manufacturer's name, model number, and serial number for the gamma stereotactic radiosurgery unit and the instrument used to measure the output of the unit;

c. An assessment of timer linearity and accuracy;

d. The calculated on-off error;

e. A determination of trunnion centricity;

f. The difference between the anticipated output and the measured output;

g. An assessment of source output against computer calculations;

h. Notations indicating the operability of radiation monitors, helmet microswitches, emergency timing circuits, emergency off buttons, electrical interlocks, source exposure indicator lights, viewing and intercom systems, timer termination, treatment table retraction mechanism, and stereotactic frames and localizing devices (trunnions); and

i. The name of the individual who performed the periodic spot-check and the signature of the authorized medical physicist who reviewed the record of the spot-check.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.107 **Records of Additional Technical Requirements for Mobile Remote Afterloader Units.**

1. A licensee shall retain a record of each check for mobile remote afterloader units required by 1.7.76 for 3 years.

2. The record must include:

a. The date of the check;

b. The manufacturer's name, model number, and serial number of the remote afterloader unit;

c. Notations accounting for all sources before the licensee departs from a facility;

d. Notations indicating the operability of each entrance door electrical interlock, radiation monitors, source exposure indicator lights, viewing and intercom system, applicators and source transfer tubes, and source positioning accuracy; and

e. The signature of the individual who performed the check.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.108 **Records of Surveys of Therapeutic Treatment Units.**

1. A licensee shall maintain a record of radiation surveys of treatment units made in accordance with 1.7.77 for the duration of use of the unit.

2. The record must include:

   a. The date of the measurements;

   b. The manufacturer's name, model number and serial number of the treatment unit, source, and instrument used to measure radiation levels;

   c. Each dose rate measured around the source while the unit is in the off position and the average of all measurements; and

   d. The signature of the individual who performed the test.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.109 **Records of 5-Year Inspection for Teletherapy and Gamma Stereotactic Surgery Units.**

1. A licensee shall maintain a record of the 5-year inspections for teletherapy and gamma stereotactic radiosurgery units required by 1.7.78 for the duration of use of the unit.

2. The record must contain:

   a. The inspector's radioactive materials license number;

   b. The date of inspection;

   c. The manufacturer's name and model number and serial number of both the treatment unit and source;

   d. A list of components inspected and serviced, and the type of service; and

   e. The signature of the inspector.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.110 **Reports and Notifications of Misadministrations.**

1. Other than events that result from intervention by a patient or human research subject, a licensee shall report any event in which the administration of radioactive material or radiation from radioactive material results in:

   a. A dose that differs from the prescribed dose by more than 0.05 Sievert (5 rem) effective dose equivalent, 0.5 Sievert (50 rem) to an organ or tissue, or 0.5 Sievert (50 rem) shallow dose equivalent to the skin; and either

i. The total dose delivered differs from the prescribed dose by 20 percent or more;

ii. The total dosage delivered differs from the prescribed dosage by 20 percent or more or falls outside the prescribed dosage range; or

iii. The fractionated dose delivered differs from the prescribed dose, for a single fraction, by 50 percent or more.

b. A dose that exceeds 0.05 Sievert (5 rem) effective dose equivalent, 0.5 Sievert (50 rem) to an organ or tissue, or 0.5 Sievert (50 rem) shallow dose equivalent to the skin from any of the following:

i. An administration of a wrong radioactive drug;

ii. An administration of a radioactive drug containing radioactive material by the wrong route of administration;

iii. An administration of a dose or dosage to the wrong individual or human research subject;

iv. An administration of a dose or dosage delivered by the wrong mode of treatment; or

v. A leaking sealed source.

c. A dose to the skin or an organ or tissue other than the treatment site that exceeds by 0.5 Sievert (50 rem) to an organ or tissue and 50 percent of the dose expected from the administration defined in the written directive (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site).

2. A licensee shall report any event resulting from intervention of a patient or human research subject in which the administration of radioactive material or radiation from radioactive material results, or will result in, unintended permanent functional damage to an organ or a physiological system, as determined by a physician.

3. The licensee shall notify the Agency by telephone no later than the next calendar day after discovery of the misadministration.

4. The licensee shall submit a written report to the Agency within 15 days after discovery of the misadministration.

a. The written report must include:

i. The licensee's name;

ii. The name of the prescribing physician;

iii. A brief description of the event;

iv. Why the event occurred;

v. The effect, if any, on the individual(s) who received the administration;

vi. Actions, if any, that have been taken, or are planned, to prevent recurrence;

vii. Certification that the licensee notified the individual (or the individual's responsible relative or guardian), and if not, why not; and

b. The report may not contain the individual's name or any other information that could lead to identification of the individual.

5. The licensee shall provide notification of the misadministration to the referring physician and also notify the individual who is the subject of the misadministration no later than 24 hours after its discovery, unless the referring physician personally informs the licensee either that he or she will inform the individual or that, based on medical judgment, telling the individual would be harmful. The licensee is not required to notify the individual without first consulting the referring physician. If the referring physician or the affected individual cannot be reached within 24 hours, the licensee shall notify the individual as soon as possible thereafter. The licensee may not delay any appropriate medical care for the individual, including any necessary remedial care as a result of the misadministration, because of any delay in notification. To meet the requirements of this paragraph, the notification of the individual who is the subject of the misadministration may be made instead to that individual's responsible relative or guardian. If a verbal notification is made, the licensee shall inform the individual, or appropriate responsible relative or guardian, that a written description of the event can be obtained from the licensee upon request. The licensee shall provide such a written description if requested.

6. Aside from the notification requirement, nothing in this section affects any rights or duties of licensees and physicians in relation to each other, to individuals affected by the misadministration, or to that individual's responsible relatives or guardians.

7. A licensee shall retain a record of a misadministration in accordance with 1.7.85. A copy of the record required under 1.7.85 shall be provided to the referring physician if other than the licensee, within 15 days after discovery of the misadministration.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.111 **Report and Notification of a Dose to an Embryo/Fetus or a Nursing Child.**

1. A licensee shall report any dose to an embryo/fetus that is greater than 5 millisievert (500 mrem) dose equivalent that is a result of an administration of radioactive material or radiation from radioactive material to a pregnant

individual unless the dose to the embryo/fetus was specifically approved, in advance, by the authorized user.

2. A licensee shall report any dose to a nursing child, that was not specifically approved, in advance, by the authorized user, that is a result of an administration of radioactive material to a breast feeding individual that:

   a. Is greater than 5 millisievert (500 mrem) total effective dose equivalent; or

   b. Has resulted in unintended permanent functional damage to an organ or a physiological system of the child, as determined by a physician.

3. The licensee shall notify by telephone the Agency no later than the next calendar day after discovery of a dose to the embryo/fetus or nursing child that requires a report in 1.7.111(1) or 1.7.111(2).

4. The licensee shall submit a written report to the Agency within 15 days after discovery of a dose to the embryo/fetus or nursing child that requires a report in 1.7.111(1) or 1.7.111(2).

   a. The written report must include:

      i. The licensee's name;

      ii. The name of the prescribing physician;

      iii. A brief description of the event;

      iv. Why the event occurred;

      v. The effect on the embryo/fetus or the nursing child;

      vi. What actions, if any, have been taken, or are planned, to prevent recurrence; and

      vii. Certification that the licensee notified the pregnant individual or mother (or the mother's or child's responsible relative or guardian), and if not, why not.

   b. The report must not contain the individual's or child's name or any other information that could lead to identification of the individual or child.

5. The licensee shall notify the referring physician and also notify the pregnant individual or mother, both hereafter referred to as the mother, no later than 24 hours after of discovery of an event that would require reporting under 1.7.111(1) or 1.7.111(2), unless the referring physician personally informs the licensee either that he or she will inform the mother or that, based on medical judgment, telling the mother would be harmful. The licensee is not required to notify the mother without first consulting with the referring physician. If the referring physician or mother cannot be reached within 24 hours, the licensee shall make the

appropriate notifications as soon as possible thereafter. The licensee may not delay any appropriate medical care for the embryo/fetus or for the nursing child, including any necessary remedial care as a result of the event, because of any delay in notification. To meet the requirements of this paragraph, the notification may be made to the mother's or child's responsible relative or guardian instead of the mother, when appropriate. If a verbal notification is made, the licensee shall inform the mother, or the mother's or child's responsible relative or guardian, that a written description of the event can be obtained from the licensee upon request. The licensee shall provide such a written description if requested.

6. A licensee shall retain a record of a dose to an embryo/fetus or a nursing child in accordance with 1.7.86. A copy of the record required under 1.7.97 shall be provided to the referring physician, if other than the licensee, within 15 days after discovery of the event.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.7.112 **Reports of Leaking Sources.** A licensee shall file a report with the Agency within 5 days if a leakage test required by 1.7.29 reveals the presence of 185 Becquerel (0.005 μCi) or more of removable contamination. The written report must include the model number and serial number if assigned, of the leaking source; the radionuclide and its estimated activity; the results of the test; the date of the test; and the action taken.

SOURCE: Miss. Code Ann. §45-14-11

Subchapter 8 Radiation Safety Requirements For Analytical X-Ray Equipment

Rule 1.8.1 **Purpose and Scope.** This section provides special requirements for analytical x- ray equipment. The requirements of this section are in addition to, and not in substitution for, applicable requirements in other sections of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.8.2 **Definitions.** As used in this section, the following definitions apply:

1. "Analytical x-ray equipment" means equipment used for x-ray diffraction or fluorescence analysis.

2. "Analytical x-ray system" means a group of components utilizing x- or gamma-rays to determine the elemental composition or to examine the microstructure of materials.

3. "Fail-safe characteristics" mean a design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon the failure of a safety or warning device.

4. "Local components" mean part of an analytical x-ray system and include areas that are struck by x-rays such as radiation source

housings, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors, and shielding, but do not include power supplies, transformers, amplifiers, readout devices, and control panels.

5. "Normal operating procedures" mean step-by-step instructions necessary to accomplish the analysis. These procedures shall include sample insertion and manipulation, equipment alignment, routine maintenance by the registrant, and data recording procedures, which are related to radiation safety.

6. "Open-beam configuration" means an analytical x-ray system in which an individual could accidentally place some part of his body in the primary beam path during normal operation.

7. "Primary beam" means radiation which passes through an aperture of the source housing by a direct path from the x-ray tube or a radioactive source located in the radiation source housing.

SOURCE: Miss. Code Ann. §45-14-11

General Regulatory Provisions and Specific Requirements

Rule 1.8.3 **Equipment Requirements.**

1. **Safety Device.** A device which prevents the entry of any portion of an individual's body into the primary x-ray beam path or which causes the beam to be shut off upon entry into its path shall be provided on all open- beam configurations. A registrant may apply to the Agency for an exemption from the requirements of a safety device. Such application shall include:

   a. a description of the various safety devices that have been evaluated;

   b. the reason each of these devices cannot be used; and

   c. a description of the alternative methods that will be employed to minimize the possibility of an accidental exposure, including procedures to assure that operators and others in the area will be informed of the absence of safety devices.

2. **Warning Devices**

   a. Open-beam configurations shall be provided with a readily discernible indication of:

      i. x-ray tube "on-off" status located near the radiation source housing, if the primary beam is controlled in this manner; and/or

      ii. shutter "open-closed" status located near each port on the radiation source housing, if the primary beam is controlled in this

manner.

b. An easily visible warning light labeled with the words "X-RAY ON", or words having a similar intent, shall be located:

i. near any switch that energizes an x-ray tube and shall be illuminated only when the tube is energized; or

ii. in the case of a radioactive source, near any switch that opens a housing shutter and shall be illuminated only when the shutter is open.

c. Warning devices shall be labeled so that their purpose is easily identified. On equipment installed after June 30, 1978, warning devices shall have fail-safe characteristics.

3. **Ports.** Unused ports on radiation source housings shall be secured in the closed position in a manner which will prevent casual opening.

4. **Labeling.** All analytical x-ray equipment shall be labeled with a readily discernible sign or signs bearing the radiation symbol and the words:

a. **"CAUTION - HIGH INTENSITY X-RAY BEAM"**, or words having a similar intent, on the x-ray source housing; and

b. **"CAUTION RADIATION - THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED"**, or words having a similar intent, near any switch that energizes an x-ray tube if the radiation source is an x-ray tube; or

c. **"CAUTION - RADIOACTIVE MATERIAL",** or words having a similar intent, on the source housing in accordance with 1.4.29 of these regulations if the radiation source is a radionuclide.

5. **Shutters.** On open-beam configurations installed after January 12, 1980, each port on the radiation source housing shall be equipped with a shutter that cannot be opened unless a collimator or a coupling has been connected to the port.

6. **Radiation Source Housing.** Each radiation source housing shall be subject to the following requirements:

a. Each x-ray tube housing shall be equipped with an interlock that shuts off the tube if it is removed from the radiation source housing or if the housing is disassembled.

b. Each radioactive source housing or port cover or each x-ray tube housing shall be so constructed that, with all shutters closed, the radiation measured at a distance of 5 centimeters from its surface is not capable of producing a dose in excess of 2.5 millirems (0.025 mSv) in one hour. For systems utilizing x-ray tubes, this limit shall

be met at any specified tube rating.

7. **Generator Cabinet.** Each x-ray generator shall be supplied with a protective cabinet which limits leakage radiation measured at a distance of 5 centimeters from its surface such that it is not capable of producing a dose in excess of 0.25 millirem (2.5 µSv) in one hour.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.8.4 **Area Requirements**

1. **Radiation Levels.** The local components of an analytical x-ray system shall be located and arranged and shall include sufficient shielding or access control such that no radiation levels exist in any area surrounding the local component group which could result in a dose to an individual present therein in excess of the dose limits given in 1.4.14 of these regulations. For systems utilizing x-ray tubes, these levels shall be met at any specified tube rating.

2. **Surveys**

   a. Radiation surveys, as required by 1.4.17 of these regulations, of all analytical x-ray systems sufficient to show compliance with 1.8.4(1) shall be performed:

      i. upon installation of the equipment, and at least once every 12 months thereafter;

      ii. following any change in the initial arrangement, number, or type of local components in the system;

      iii. following any maintenance requiring the disassembly or removal of a local component in the system;

      iv. during the performance of maintenance and alignment procedures if the procedures require the presence of a primary x-ray beam when any local component in the system is disassembled or removed;

      v. any time a visual inspection of the local components in the system reveals an abnormal condition; and

      vi. whenever personnel monitoring devices show a significant increase over the previous monitoring period or the readings are approaching the limits specified in 1.4.6 of these regulations.

   b. Radiation survey measurements shall not be required if a registrant can demonstrate compliance with 1.8.4(1) to the satisfaction of the Agency.

3. Posting. Each area or room containing analytical x-ray equipment shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words "CAUTION - X-RAY EQUIPMENT" or words having a similar intent in accordance with 1.4.29 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.8.5 **Operating Requirements.**

1. **Procedures.** Normal operating procedures shall be written and available to all analytical x-ray equipment workers. No individual shall be permitted to operate analytical x-ray equipment in any manner other than that specified in the procedures unless such individual has obtained written approval of the radiation safety officer.

2. **Bypassing.** No individual shall bypass a safety device or interlock unless such individual has obtained the approval of the radiation safety officer. Such approval shall be for a specified period of time. When a safety device or interlock has been bypassed, a readily discernible sign bearing the words "SAFETY DEVICE NOT WORKING", or words having a similar intent, shall be placed on the radiation source housing.

3. **Repair or Modification of X-Ray Tube Systems.** Except as specified in 1.8.5(2), no operation involving removal of covers, shielding materials or tube housings or modifications to shutters, collimators, or beam stops shall be performed without ascertaining that the tube is off and will remain off until safe conditions have been restored. The main switch, rather than interlocks, shall be used for routine shutdown in preparation for repairs.

4. **Radioactive Source Replacement, Testing, or Repair.** Radioactive source housings shall be opened for source replacement, leak testing, or other maintenance or repair procedures only by individuals authorized to specifically conduct such procedures under a license issued by the U.S. Nuclear Regulatory Commission (NRC), an Agreement State, or a Licensing State.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.8.6 **Personnel Requirements.**

1. Instruction. No individual shall be permitted to operate or maintain analytical x-ray equipment unless such individual has received instruction in and demonstrated competence as to:

   a. identification of radiation hazards associated with the use of the equipment;

   b. significance of the various radiation warning, safety devices, and interlocks incorporated into the equipment, or the reasons they have not been installed on certain pieces of equipment and the extra precautions required in such cases;

c. proper operating procedures for the equipment;

d. recognition of symptoms of an acute localized exposure; and

e. proper procedures for reporting an actual or suspected exposure.

2. **Personnel Monitoring**

a. Finger or wrist dosimetric devices shall be provided to and shall be used by:

i. analytical x-ray equipment workers using systems having an open- beam configuration and not equipped with a safety device; and

ii. personnel maintaining analytical x-ray equipment if the maintenance procedures require the presence of a primary x-ray beam when any local component in the analytical x-ray system is disassembled or removed.

b. Reported dose values shall not be used for the purpose of determining compliance with 1.4.6 of these regulations unless evaluated by a qualified expert.

SOURCE: Miss. Code Ann. §45-14-11

Subchapter 9 Radiation Safety Requirements for Particle Accelerators

Rule 1.9.1 **Purpose and Scope**

1. This Section establishes procedures for the registration and the use of particle accelerators.

2. In addition to the requirements of this section, all registrants are subject to the requirements of Subchapters 1, 2, 4, and 10 of these regulations. Registrants engaged in industrial radiographic operations are subject to the requirements of Subchapter 5 of these regulations, and registrants and/or licensees engaged in the healing arts are subject to the requirements of Subchapters 6, 7 and 15 of these regulations. Registrants whose operations result in the production of radioactive material are subject to the requirements of Subchapter 3 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.2 **Registration Requirements.** No person shall receive, possess, use, transfer, own, or acquire a particle accelerator except as authorized in a registration issued pursuant to Subchapter 2 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.3 **General Requirements for the Issuance of a Registration for Particle Accelerators. In addition to the requirements of Subchapter 2 of these regulations, a registration application for use of a particle accelerator will be approved only if the Agency determines that:**

1. the applicant is qualified by reason of training and experience to use the accelerator in question for the purpose requested in accordance with this section and Subchapters 4 and 10 of these regulations in such a manner as to minimize danger to public health and safety or property;

2. the applicant's proposed or existing equipment, facilities, and operating and emergency procedures are adequate to protect health and minimize danger to public health and safety or property;

3. the issuance of the registration will not be inimical to the health and safety of the public, and the applicant satisfies any applicable special requirement in 1.9.4;

4. the applicant has appointed a radiation safety officer;

5. the applicant and the applicant's staff has substantial experience in the use of particle accelerators and training sufficient for application to its intended uses;

6. the applicant has established a radiation safety committee to approve, in advance, proposals for uses of particle accelerators, whenever deemed necessary by the Agency; and

7. the applicant has an adequate training program for operators of particle accelerators.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.4 **Reserved.**

Rule 1.9.5 **Reserved.**

Rule 1.9.6 **Limitations.**

1. No registrant shall permit any individual to act as an operator of a particle accelerator until such individual:

   a. has been instructed in radiation safety and shall have demonstrated an understanding thereof;

   b. has received copies of and instruction in this section and the applicable requirements of Subchapters 4 and 10 of these regulations, pertinent registration conditions and the registrant's operating and emergency procedures, and shall have demonstrated understanding thereof; and

c. has demonstrated competence to use the particle accelerator, related equipment, and survey instruments which will be employed.

2. The radiation safety committee or the radiation safety officer shall have the authority to terminate the operations at a particle accelerator facility if such action is deemed necessary to minimize danger to public health and safety or property.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.7 **Shielding and Safety Design Requirements.**

1. A qualified expert, acceptable to the Agency, shall be consulted in the design of a particle accelerator installation and called upon to perform a radiation survey when the accelerator is first capable of producing radiation.

2. Each particle accelerator installation shall be provided with such primary and secondary barriers as are necessary to assure compliance with 1.4.6 and 1.4.14 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.8 **Particle Accelerator Controls and Interlock Systems.**

1. Instrumentation, readouts, and controls on the particle accelerator control console shall be clearly identified and easily discernible.

2. Each entrance into a target room or other high radiation area shall be provided with a safety interlock that shuts down the machine under conditions of barrier penetration.

3. Each safety interlock shall be on a circuit which shall allow it to operate independently of all other safety interlocks.

4. All safety interlocks shall be designed so that any defect or component failure in the safety interlock system prevents operation of the accelerator.

5. When a safety interlock system has been tripped, it shall only be possible to resume operation of the accelerator by manually resetting controls at the position where the safety interlock has been tripped and, lastly, at the main control console.

6. A scram button or other emergency power cutoff switch shall be located and easily identifiable in all high radiation areas. Such a cutoff switch shall include a manual reset so that the accelerator cannot be restarted from the accelerator control console without resetting the cutoff switch.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.9 **Warning Devices**

1. Each location designated as high radiation area, and each entrance to such location, shall be equipped with easily observable warning lights that operate when, and only when, radiation is being produced.

2. Except in facilities designed for human exposure, each high radiation area shall have an audible warning device which shall be activated for 15 seconds prior to the possible creation of such high radiation area. Such warning device shall be clearly discernible in all high radiation areas.

3. Barriers, temporary or otherwise, and pathways leading to high radiation areas shall be posted in accordance with 1.4.30 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.10 **Operating Procedures.**

1. Particle accelerators, when not in operation, shall be secured to prevent unauthorized use.

2. The safety interlock system shall not be used to turn off the accelerator beam except in an emergency.

3. All safety and warning devices, including interlocks, shall be checked for proper operation at intervals not to exceed three months. Results of such tests shall be maintained at the accelerator facility for inspection by the Agency.

4. Electrical circuit diagrams of the accelerator and the associated safety interlock systems shall be kept current and maintained for inspection by the Agency and shall be available to the operator at each accelerator facility.

5. If, for any reason, it is necessary to intentionally bypass a safety interlock or interlocks, such action shall be:

   a. authorized by the radiation safety committee and/or radiation safety officer;

   b. recorded in a permanent log and a notice posted at the accelerator control console; and

   c. terminated as soon as possible.

6. A copy of the current operating and the emergency procedures shall be maintained at the accelerator control panel.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.11 **Radiation Monitoring Requirements.**

1. There shall be available, at each particle accelerator facility, appropriate portable monitoring equipment which is operable and has been appropriately calibrated for the radiations being produced at the facility. Such equipment shall be tested for proper operation daily and calibrated at intervals not to exceed one year and after each servicing and repair.

2. A radiation protection survey shall be performed and documented by a qualified expert, acceptable to the Agency, when changes have been made in shielding, operation, equipment, or occupancy of adjacent areas.

3. Radiation levels in all high radiation areas shall be continuously monitored. The monitoring devices shall be electrically independent of the accelerator control and safety interlock systems and capable of providing a read-out at the control panel.

4. All area monitors shall be calibrated at intervals not to exceed one year and after each servicing and repair.

5. Whenever applicable, periodic surveys shall be made to determine the amount of airborne particulate radioactivity present.

6. Whenever applicable, periodic smear surveys shall be made to determine the degree of contamination.

7. All surveys shall be made in accordance with the written procedures established by a qualified expert, acceptable to the Agency, or the radiation safety officer.

8. Records of all radiation protection surveys, calibrations, and instrumentation tests shall be maintained at the accelerator facility for inspection by the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.9.12 **Ventilation Systems.**

1. Ventilation systems shall be provided to ensure that personnel entering any area where airborne radioactivity may be produced will not be exposed to airborne radioactive material in excess of those limits specified in Subchapter 4, Appendix B, Table I of these regulations.

2. A registrant, as required by 1.4.15 of these regulations, shall not vent, release, or otherwise discharge airborne radioactive material to an unrestricted area which exceeds the limits specified in Subchapter 4, Appendix B, Table I of these regulations, except as authorized pursuant to 1.4.15(3) of these regulations. For purposes of 1.9.12(2), concentrations may be averaged over a period not greater than one year. Every effort should be made to maintain releases of radioactive material to unrestricted areas as far below these limits as is reasonably achievable.

SOURCE: Miss. Code Ann. §45-14-11

Subchapter 10 Notices, Instructions, and Reports to Workers; Inspections

Rule 1.10.1 **Purpose and Scope.** This section establishes requirements for notices, instructions, and reports by licensees or registrants to individuals engaged in activities under a license or registration and options available to such individuals in connection with Agency inspections of licensees or registrants to ascertain compliance with the provisions of the Act and regulations, orders, and licenses issued thereunder regarding radiological working conditions. The regulations in this section apply to all persons who receive, possess, use, own, or transfer sources of radiation registered with or licensed by the Agency pursuant to Subchapters 2 and 3 of these regulations.

Source: Miss. Code Ann. §45-14-11

Rule 1.10.2 **Posting of Notices to Workers.**

1. Each licensee or registrant shall post current copies of the following documents:

   a. the regulations in this section and in Subchapter 4 of these regulations;

   b. the license, certificate of registration, conditions or documents incorporated into the license by reference and amendments thereto;

   c. the operating procedures applicable to activities under the license or registration; and

   d. any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to Subchapter 1 of these regulations, and any response from the licensee or registrant.

2. If posting of a document specified in 1.10.2(1)(a), (b), or (c) is not practicable, the licensee or registrant may post a notice which describes the document and states where it may be examined.

3. Agency Form RH-5 "Notice to Employees" shall be posted by each licensee or registrant as required by these regulations.

4. Agency documents posted pursuant to 1.10.2(1)(d) shall be posted within 5 working days after receipt of the documents from the Agency; the licensee's or registrant's response, if any, shall be posted within five working days after dispatch from the licensee or registrant. Such documents shall remain posted for a minimum of five working days or until action correcting the violation has been completed, whichever is later.

5. Documents, notices, or forms posted pursuant to 1.10.2 shall appear in a sufficient number of places to permit individuals engaged in work under the license or registration to observe them on the way to or from any particular work location to which the document applies, shall be conspicuous, and shall be replaced if defaced or altered.

Source: Miss. Code Ann. §45-14-11

Rule 1.10.3 **Instructions to Workers.**

1. All individuals who in the course of employment are likely to receive in a year an occupational dose in excess of 100 millirems (l mSv):

   a. shall be kept informed of the storage, transfer, or use of sources of radiation;

   b. shall be instructed in the health protection problems associated with exposure to radiation or radioactive material in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed;

   c. shall be instructed in, and required to observe, to the extent within the worker's control, the applicable provisions of these regulations, licenses, and registrations for the protection of personnel from exposures to radiation and/or radioactive material;

   d. shall be instructed of their responsibility to report promptly to the licensee or registrant any condition which may lead to, or cause a violation of the Act, these regulations, licenses, and registrations or unnecessary exposure to radiation and/or radioactive material;

   e. shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and

   f. shall be advised as to the radiation exposure reports which workers may request pursuant to 1.10.4.

2. In determining those individuals subject to the requirements of 1.10.3(1) of this section, licensees or registrants must take into consideration assigned activities during normal and abnormal situations involving exposure to radiation and/or radioactive material which can reasonably be expected to occur during the life of a licensed or registered facility. The extent of these instructions must be commensurate with potential radiological health protection problems present in the work place.

Source: Miss. Code Ann. §45-14-11

Rule 1.10.4 **Notifications and Reports to Individuals.**

1. Radiation exposure data for an individual and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual shall be reported to the individual as specified in 1.10.4. The information reported shall include data and results obtained pursuant to these regulations, orders, or license and registration conditions, as shown in records maintained by the licensee or registrant pursuant to 1.4.47 of these regulations. Each notification and report shall:

   a. be in writing;

   b. include appropriate identifying data such as the name of the licensee or registrant, the name of the individual, and the individual's identification number, preferably social security number;

c. include the individual's exposure information; and

d. contain the following statement:

"This report is furnished to you under the provisions of the Mississippi State Board of Health Regulations for Control of Radiation, Subchapter 10. You should preserve this report for further reference."

2. Each licensee or registrant shall make dose information available to workers as shown in records maintained by the licensee or registrant pursuant to 1.4.47 of these regulations. The licensee shall provide an annual report to each individual monitored under 1.4.18 of the dose received in that monitoring year if:

a. The individual's occupational dose exceeds 1mSv (100mrem) TEDE or 1 mSv (100 mrem) to any individual organ or tissue; or

b. The individual requests their annual dose report.

3. Each licensee or registrant shall furnish a report of the worker's exposure to sources of radiation at the request of a worker formerly engaged in activities controlled by the licensee or registrant. The report shall include the dose record for each year the worker was required to be monitored pursuant to 1.4.18 of these regulations. Such report shall be furnished within 30 days from the date of the request, or within 30 days after the dose of the individual has been determined by the licensee or registrant, whichever is later. The report shall cover the period of time that the worker's activities involved exposure to sources of radiation and shall include the dates and locations of work under the license or registration in which the worker participated during this period.

4. When a licensee or registrant is required pursuant to 1.4.53, 1.4.54, or 1.4.55 of these regulations to report to the Agency any exposure of an individual to sources of radiation, the licensee or the registrant shall also provide the individual a report on the exposure data included therein. Such reports shall be transmitted at a time not later than the transmittal to the Agency.

5. At the request of a worker who is terminating employment with the licensee or registrant in work involving exposure to radiation or radioactive material, during the current year, each licensee or registrant shall provide at termination to each such worker, or to the worker's designee, a written report regarding the radiation dose received by that worker from operations of the licensee or registrant during the current year or fraction thereof. If the most recent individual monitoring results are not available at that time, a written estimate of the dose shall be provided together with a clear indication that this is an estimate.

Source: Miss. Code Ann. §45-14-11

Rule 1.10.5 **Presence of Representatives of Licensees or Registrants and Workers during Inspections.**

1. Each licensee or registrant shall afford to the Agency at all reasonable times opportunity to inspect materials, machines, activities, facilities, premises, and records pursuant to these regulations.

2. During an inspection, Agency inspectors may consult privately with workers as specified in 1.10.6. The licensee or registrant may accompany Agency inspectors during other phases of an inspection.

3. If, at the time of inspection, an individual has been authorized by the workers to represent them during Agency inspections, the licensee or registrant shall notify the inspectors of such authorization and shall give the workers' representative an opportunity to accompany the inspectors during the inspection of physical working conditions.

4. Each worker's representative shall be routinely engaged in work under control of the licensee or registrant and shall have received instructions as specified in 1.10.3.

5. Different representatives of licensees or registrants and workers may accompany the inspectors during different phases of an inspection if there is no resulting interference with the conduct of the inspection. However, only one workers' representative at a time may accompany the inspectors.

6. With the approval of the licensee or registrant and the workers' representative, an individual who is not routinely engaged in work under control of the licensee or registrant, for example, a consultant to the licensee or registrant or to the workers' representative, shall be afforded the opportunity to accompany Agency inspectors during the inspection of physical working conditions.

7. Notwithstanding the other provisions of 1.10.5, Agency inspectors are authorized to refuse to permit accompaniment by any individual who deliberately interferes with a fair and orderly inspection. With regard to areas containing information classified by an Agency of the U.S. Government in the interest of national security, an individual who accompanies an inspector may have access to such information only if authorized to do so. With regard to any area containing proprietary information, the workers' representative for that area shall be an individual previously authorized by the licensee or registrant to enter that area.

Source Miss. Code Ann. §45-14-11

Rule 1.10.6 **Consultation with Workers During Inspections.**

1. Agency inspectors may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of these regulations and licenses to the extent the inspectors deem necessary for the conduct of an effective and thorough inspection.

2. During the course of an inspection, any worker may bring privately to the attention of the inspectors, either orally or in writing, any past or present condition which the worker has reason to believe may have contributed to or caused any violation of the Act, these regulations, or license condition, or any

unnecessary exposure of an individual to sources of radiation under the licensee's or registrant's control. Any such notice in writing shall comply with the requirements of 1.10.7(1).

3. The provisions of 1.10.6(2) shall not be interpreted as authorization to disregard instructions pursuant to 1.10.3.

Source Miss. Code Ann. §45-14-11

Rule 1.10.7 **Requests by Workers for Inspections.**

1. Any worker or representative of workers believing that a violation of the Act, these regulations, or license and registration conditions exists or has occurred in work under a license or registration with regard to radiological working conditions in which the worker is engaged may request an inspection by giving notice of the alleged violation to the Division of Radiological Health, Mississippi State Department of Health. Any such notice shall be in writing, shall set forth the specific grounds for the notice, and shall be signed by the worker or representative of the workers. A copy shall be provided to the licensee or registrant by the Division of Radiological Health no later than at the time of inspection except that, upon the request of the worker giving such notice, such worker's name and the name of individuals referred to therein shall not appear in such copy or on any record published, released, or made available by the Agency, except for good cause shown.

2. If, upon receipt of such notice, the Director of the Division of Radiological Health determines that the complaint meets the requirements set forth in 1.10.7(1), and that there are reasonable grounds to believe that the alleged violation exists or has occurred, an inspection shall be made as soon as practicable to determine if such alleged violation exists or has occurred. Inspections pursuant to 1.10.6 should not be limited to matters referred to in the complaint.

3. No licensee, registrant, or contractor or subcontractor of a licensee or registrant shall discharge or in any manner discriminate against any worker because such worker has filed any complaint or instituted or caused to be instituted any proceeding under these regulations or has testified or is about to testify in any such proceeding or because of the exercise by such worker on behalf of such worker or others of any option afforded by this section.

Source Miss. Code Ann. §45-14-11

Rule 1.10.8 **Inspections Not Warranted; Informal Review.**

1. If the Director of the Division of Radiological Health, Mississippi Department of Health determines, with respect to a complaint under 1.10.7, that an inspection is not warranted because there are no reasonable grounds to believe that a violation exists or has occurred, the Director of the Division of Radiological Health shall notify the complainant in writing of such determination. The complainant may obtain review of such determination by submitting a written statement of position with the State Health Officer, Mississippi Department of Health. Such Agency

will provide the licensee or registrant with a copy of such statement by certified mail, excluding, at the request of the complainant, the name of the complainant. The licensee or registrant may submit an opposing written statement of position with the State Health Officer, Mississippi Department of Health. Such agency will provide the complainant with a copy of such statement by certified mail.

2. Upon the request of the complainant, the State Health Officer, Mississippi Department of Health may hold an informal conference in which the complainant and the licensee or registrant may orally present their views. An informal conference may also be held at the request of the licensee or registrant, but disclosure of the identity of the complainant will be made only following receipt of written authorization from the complainant. After considering all written and oral views presented, the State Health Officer, Mississippi Department of Health shall affirm, modify, or reverse the determination of the Division of Radiological Health and furnish the complainant and the licensee or registrant a written notification of the decision and the reason therefore.

3. If the Director of the Division of Radiological Health determines that an inspection is not warranted because the requirements of 1.10.7(1) have not been met, the complainant shall be notified in writing of such determination. Such determination shall be without prejudice to the filing of a new complaint meeting the requirements of 1.10.7(1).

Source Miss. Code Ann. §45-14-11

Subchapter 11 Licensing of Naturally Occurring Radioactive Materials (Norm)

Rule 1.11.1 **Purpose**. This section establishes radiation protection standards for the possession, use, transfer, transport, storage and disposal of naturally occurring radioactive materials, NORM, not subject to regulation under the Atomic Energy Act of 1954, as amended.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.2 **Scope**. These regulations apply to any person who engages in the extraction, mining, beneficiating, processing, use, transfer, transport, storage, waste generation or disposal of NORM in such a manner as to alter the chemical properties or physical state of the NORM or its potential exposure pathways to humans.

1. The regulations in this section address the introduction of NORM into materials or products in which neither the NORM nor the radiation emitted from the NORM is considered to be beneficial to the materials or products. The manufacture and distribution of materials or products containing NORM in which the NORM and/or its associated radiation(s) is considered to be a beneficial attribute are licensed under the provisions of Subchapter 3.

2. These regulations also apply to sludges and scale deposits in tubulars and equipment and to soil or water contaminated by the cleaning of scale deposits. These regulations include the contamination of soil from produced

waters.

3. This section also addresses waste generation, waste management, transfer, and disposal with regard to both inactive and active sites and facilities involved in storage and/or cleaning of tubulars and contaminated equipment. In the case of closed or inactive pits, surveys are required only at the time of transfer for unrestricted use.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.3 **Definitions**. As used in this section, the following definitions apply:

1. "Beneficial attribute" or "beneficial to the product" means the radioactivity of the product is necessary to the use of the product.

2. "Beneficiating" means the processing of materials for the purpose of altering the chemical or physical properties to improve the quality, purity or assay grade.

3. "Decontamination" means the removal of NORM contaminants from surfaces or equipment to reduce levels of radiation.

4. "Decontamination facility" means a facility that provides services to reduce levels of NORM contamination.

5. "Equipment" means tubulars, wellheads, separators, condensers, or any other related apparatus associated with the potential enhancement of NORM.

6. "Facility" means all contiguous land and structures, other appurtenances, and improvements on land or water that contain NORM.

7. "Fluid" means any material or substance which flows or moves, whether in a semi-solid, liquid, sludge, gas, or any other form or state.

8. "Naturally occurring radioactive material (NORM)" means any nuclide which is radioactive in its natural physical state (i.e., not man-made), but does not include byproduct, source or special nuclear material.

9. "Product" means something produced, made, manufactured, refined, or beneficiated.

10. "Storage" means the containment of NORM waste in such a manner as not to constitute disposal of NORM waste.

11. "Technologically enhanced" means natural sources of radiation which would not normally appear without some technological activity not expressly designed to produce radiation.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.4 **Exemptions.**

1. Persons who receive, possess, use, process, transfer, transport, store, distribute, and dispose of NORM are exempt from the requirements of these regulations if:

   a. The materials contain, or are contaminated at, concentrations less than 5 picocuries per gram of radium - 226 or radium - 228 above background; or, concentrations less than 30 picocuries per gram (1.11 kBq/kg) of technologically enhanced radium-226 or radium-228, averaged over any 100 square meters, provided the radon emanation rate does not exceed 20 picocuries (740 mBq) per square meter per second, or 150 picocuries per gram (5.55 kBq/kg) of any other NORM radionuclide, provided that these concentrations are not exceeded at any time; or

   b. Equipment does not exceed 25 microroentgens per hour above background radiation at any accessible point.

2. Persons who receive products or materials containing NORM distributed in accordance with a specific license issued by the Agency pursuant to 1.11.15(1) or an equivalent license issued by another Licensing State are exempt from these regulations.

3. The manufacturing, distribution, use, transportation, and disposal of potassium and potassium compounds which have not been isotopically enriched in the radionuclide K-40 are exempt from the requirements of these regulations.

4. The wholesale and retail distribution (including custom blending), possession, and use of the following products or materials are exempt from the requirements of these regulations;

   a. Phosphate and potash fertilizer; and

   b. Phosphogypsum for agricultural uses provided such commercial distribution and uses meet the requirements of 40 CFR 61.204.

5. The possession, use, and transportation of natural gas, and natural gas products, and crude oil, and crude oil products as a fuel are exempt from the requirements of these regulations. The manufacturing and distribution of natural gas and crude oil and natural gas and crude oil products are exempt from the specific license requirements of this section but are subject to the general license requirements in 1.11.10, 1.11.11, and 1.11.12.

6. Produced waters from crude oil and natural gas production are exempt from the requirements of these regulations if the produced waters are reinjected in a well approved by the Mississippi State Oil and Gas Board and Mississippi Department of Environmental Quality and as a Class II Injection and Disposal well.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.5 **Reserved**.

Rule 1.11.6 **Radiation Survey Instruments**.

1. Radiation survey instruments used to determine exposure rates pursuant to this section shall be capable of measuring 1 microroentgen per hour through at least 500 microroentgens per hour.

2. Radiation survey instruments used to make surveys required by this section shall be calibrated and operable.

3. Each radiation survey instrument shall be calibrated:

   a. by person licensed by the Agency, another Agreement State, or the U.S. Nuclear Regulatory Commission to perform such service;

   b. at energies and radiation levels appropriate for the licensee's use;

   c. at intervals not to exceed six months and after each instrument servicing other than battery replacement; and

   d. to demonstrate an accuracy within plus or minus 20 percent of the true radiation level on each scale.

4. Records of these calibrations shall be maintained for 3 years after the calibration date for inspection by the Agency.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.7 **Reserved.**

Rule 1.11.8 **Reserved.**

Rule 1.11.9 **Reserved.**

Rule 1.11.10 **General Licenses.**

1. A general license is hereby issued to mine, extract, receive, possess, own, use, process, and transfer NORM not exempted in 1.11.4 without regard to quantity. This general license does not authorize the manufacturing or distribution of products containing NORM in concentrations greater than those specified in 1.11.4(1) nor the disposal of wastes from other persons.

2. Facilities and equipment contaminated with NORM in excess of the levels set forth in Appendix A of this section shall not be released for unrestricted use. The decontamination of equipment, facilities and land shall be performed only by persons specifically licensed by the Agency or another Licensing State to conduct such work. Each general licensee shall establish and submit to this Agency written procedures for performing on- site maintenance on contaminated equipment, components and facilities and for surveying (or screening) equipment, components and facilities prior to release for

unrestricted use to ensure that the levels in Appendix A of this section are not exceeded.

3. person shall transfer land for unrestricted use contaminated with technologically enhanced radium-226 or radium-228, averaged over any 100 square meters, in which the radon emanation rate is less than 20 picocuries (740 mBq) per square meter per second and in which the concentrations of technologically enhanced radium-226 or radium-228 are in excess of 30 picocuries per gram (1.11 kBq/kg), averaged over a maximum depth of 15 cm of soil below the surface. No person shall transfer land contaminated with technologically enhanced radium-226 or radium-228, averaged over any 100 square meters, in which the radon emanation rate is 20 picocuries (740 mBq) per square meter per second or more and in which concentrations of technologically enhanced radium-226 or radium-228 are in excess of:

   a. 5 pCi/g (185 Bq/kg), averaged over the first 15 cm of soil below the surface; and

   b. 15 pCi/g (555 Bq/kg), averaged over 15 cm thick layers of soil more than 15 cm below the surface.

4. Equipment contaminated with NORM in excess of the levels set forth in Appendix A of this section may be released for maintenance and/or overhaul provided the recipient is specifically licensed to perform the activity on contaminated equipment.

5. The decontamination of equipment and facilities, as described in 1.11.13(2), shall only be performed by persons specifically licensed by the Agency or another Licensing State to conduct such work.

6. The transfer of NORM not exempt from these regulations from one general licensee to another general licensee shall be authorized by the Agency if:

   a. The equipment and facilities contaminated with NORM are to be used by the recipient for the same purpose or at the same site;

   b. The transfer of control or ownership of land contaminated with NORM includes an annotation of the deed records to indicate the presence of NORM; or

   c. The materials being transferred are ores or raw materials for processing or refinement.

7. Transfers made under 1.11.10(6)(i) do not relieve the general licensee who makes the transfer from the responsibilities of assessing the extent of NORM contamination or material present, evaluating the hazards of the NORM, informing the general licensee receiving the NORM of these assessments and evaluations, and maintaining records required by these regulations prior to and

up to the time of documented transfers.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.11 **Protection of Workers and the General Population**. Each person subject to the general license in 1.11.10 or a specific license shall conduct operations in compliance with the standards for radiation protection set out in Subchapters 4 and 10, except for disposal, which shall be governed by 1.11.12.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.12 **Disposal and Transfer of Waste for Disposal**.

1. Each person subject to the general license in 1.11.10 or a specific license shall manage and dispose of wastes containing NORM:

   a. in accordance with the applicable requirements of the U.S. Environmental Protection Agency for disposal of such wastes;

   b. in a manner equivalent to the requirements for uranium and thorium byproduct materials in 40 CFR 192;

   c. by transfer of the wastes for disposal to a land disposal facility licensed by the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State; or

   d. in accordance with alternate methods authorized by the Agency upon application or upon the Agency's initiative.

2. Records of disposal, including manifests, shall be maintained pursuant to the provisions of Subchapter 4 of these regulations.

3. Transfers of waste containing NORM for disposal shall be made only to a person specifically authorized to receive such waste.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.13 **Specific Licenses**.

1. Unless otherwise exempted under the provisions of 1.11.4 or licensed under the provisions of Subchapter 3 of the regulations, the manufacturing and distribution of any material or product containing NORM shall be specifically licensed pursuant to the requirements of this section or pursuant to equivalent regulations of another Licensing State.

2. Persons conducting the following activities involving equipment or facilities contaminated with NORM in excess of the levels set forth in Appendix A of this section and land contaminated with radium-226 or radium-228 in excess of the limits set forth in 1.11.10(3) shall be specifically licensed pursuant to the requirements of this section:

a. Decontamination of equipment, facilities, and land; or

b. Disposal of the resulting waste.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.14 **Filing Application for Specific Licenses**. Applications for specific licenses shall be filed in accordance with 1.3.8 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.15 **Requirements for the Issuance of Specific Licenses.**

1. In addition to the requirements set forth in 1.3.9, and application for a specific license to decontaminate equipment, land, or facilities contaminated with NORM in excess of the levels set forth in 1.11.4(1), 1.11.10(3), or Appendix A of this section, as applicable and to dispose of the resulting waste will be approved if:

   a. The applicant has adequately addressed the following items in the application:

      i. Procedures and equipment for protection of workers;

      ii. An evaluation of the radiation levels and concentrations of contamination expected during normal operations;

      iii. Operating and emergency procedures, including procedures for waste reduction and quality assurance of items released for unrestricted use; and

      iv. Method of disposing of the NORM removed from contaminated equipment, facilities, and/or land.

2. An application for a specific license to manufacture and/or initially transfer products or materials containing NORM to persons exempted from these regulations pursuant to 1.11.4(2), will be approved if:

   a. The NORM is not contained in any food, beverage, cosmetic, drug, or other commodity designed for ingestion or inhalation by, or application to, a human being; and

   b. The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling or marking, and conditions of handling, storage, use, and disposal of the NORM material or product to demonstrate that the material or product will meet the safety criteria set forth in 1.11.16. The information shall include:

      i. A description of the material or product and its intended use or uses;

ii. The type, quantity, and concentration of NORM in each material or product;

iii. The chemical and physical form of the NORM in the material or product, and changes in chemical and physical form that may occur during the useful life of the material or product;

iv. An analysis of the solubility in water and body fluids of the NORM in the material or product;

v. The details of manufacture and design of the material or product relating to containment and shielding of the NORM and other safety features under normal and severe conditions of handling, storage, use, reuse, and disposal of the material or product;

vi. The degree of access of human beings to the material or product during normal handling, use, and disposal;

vii. The total quantity of NORM expected to be distributed annually in the material or product;

viii. The expected useful life of the material or product;

ix. The proposed method of labeling or marking each unit of the material or product with identification of the manufacturer and/or initial transferor of the product and the radionuclide(s) and quantity of NORM in the material or product;

x. The procedures for prototype testing of the material or product to demonstrate the effectiveness of the containment, shielding, and other safety features under both normal and severe conditions of handling, storage, use, reuse, and disposal;

xi. The results of the prototype testing of the material or product, including any change in the form of the NORM contained in it, the extent to which the NORM may be released to the environment, any change in radiation levels, and any other changes in safety features;

xii. The estimated external radiation doses and dose commitments relevant to the safety criteria in 1.11.16 and the basis for such estimates;

xiii. A determination that the probabilities with respect to doses referred to 1.11.16 meet the safety criteria;

xiv. The quality control procedures to be followed in the production of production lots of the material or product, and the

quality control standards the material or product will be required to meet; and

xv. Any additional information, including experimental studies and tests, required by the Agency to facilitate a determination of the radiation safety of the material or product.

3. Notwithstanding the provisions of 1.11.16(2), the Agency may deny an application for a specific license if the end uses of the product are frivolous or cannot be reasonably foreseen.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.16 **Safety Criteria**. An applicant for a license under 1.11.15(2) shall demonstrate that the product is designed and will be manufactured so that:

1. In normal use and disposal, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of NORM, excluding radon and radon decay products, in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or NORM from the material or product, will exceed the doses in Column I of 1.11.17

2. In normal handling and storage of the quantities of the material or product likely to accumulate in one location during marketing, distribution, installation, and servicing of the material or product, it is unlikely that the external radiation dose in any one year, or the dose commitment resulting from the intake of NORM, excluding radon, in any one year, to a suitable sample of the group of individuals expected to be most highly exposed to radiation or NORM from the material or product, will exceed the doses in Column II of 1.11.17

3. In normal use, disposal, handling, and storage, it is unlikely that the radon released from the material or product will result in an increase in the average concentration in air of more than 0.4 picocurie per liter (14.8Bq/m3).

4. It is unlikely that there will be a significant reduction in the effectiveness of the containment, shielding, or other safety features of the material or product from wear and abuse likely to occur in normal handling and use of the material or product during its useful life.

Table of Organ Doses.

	Column I*	Column II*
Part of Body	Dose in Rem	Dose in Rem
Whole body; head and trunk; active blood-forming organs;		

gonads; or lens of eye	0.005 (0.05 mSv)	0.5 (5 mSv)
Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter	0.075 (0.75 mSv)	7.5 (75 mSv)
Other organs	0.015 (0.15 mSv)	1.5 (15 mSv)

*Dose limit is the dose above background from the product.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.17 **Issuance of Specific Licenses**. The Agency will issue a specific license in accordance with 1.3.14 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.18 **Conditions of Licenses Issued Under 1.11.15.**

1. Each license issued pursuant to this section shall be subject to all the requirements set forth in 1.3.15.

2. Each person licensed by the Agency pursuant to this section is subject to the general license provisions of 1.11.11.

3. In addition to the requirements set forth in 1.3.15 each person listed under 1.11.15(2) shall:

   a. Carry out adequate control procedures in the manufacture of the material or product to assure that each production lot meets the quality control standards approved by the Agency;

   b. Label or mark each unit to identify the manufacturer, processor, producer, or initial transferor of the material or product and the NORM in the material or product; and

   c. Maintain records identifying, by name and address, each person to whom NORM is transferred for use under 1.11.4(2) or the equivalent regulations of another Licensing State, and stating the kinds, quantities and uses of NORM transferred. An annual summary report stating the total quantity of each radionuclide transferred under the specific license shall be filed with the Agency. Each report shall cover the year ending December 31, and shall be filed within 30 days thereafter. If no transfers of NORM have been made pursuant to 1.11.15(2) during the reporting period, the report shall so indicate.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.19 **Expiration and Termination of Licenses.** Each licensee shall comply with the provisions in 1.3.16 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.20 **Renewal of License.** Applications for renewal of specific licenses shall be filed in accordance with 1.3.17 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.21 **Amendment of Licenses at Request of Licensee**. Applications for amendment of a license shall be filed in accordance with 1.3.18 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.22 **Agency Action on Application to Renew and Amend**. In considering an application by a licensee to renew or amend the license, the Agency will apply the criteria set forth in 1.3.19 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.23 **Modification and Revocation of Licenses**. The terms and conditions of all licenses shall be subject 1.3.25 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

Rule 1.11.24 **Reciprocal Recognition of Licenses**. The out-of-state licensee shall comply with the provisions of 1.3.26 of these regulations.

SOURCE: Miss. Code Ann. §45-14-3

APPENDIX A

Acceptable Surface Contamination Levels For Norm

RADIONUCLIDE[a]	AVERAGE[bcf]	MAXIMUM[bdfg]	REMOVABLE[bcef]
U-nat, U-235, U-238, and associated products (including Po-210), except Ra-226, Th-230, Ac-227, and Pa-231	5,000 dpm alpha/100 cm^2	15,000 dpm alpha/100 cm^2	1,000 dpm alpha/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230 Th-228, Pa-231, Ac-227	100 dpm/ 100 cm^2	300 dpm/ 100 cm^2	20 pm/ 100 cm^2
Th-nat, Th-232, Ra-223, Ra-224, U-232	1,000 dpm/ 100 cm^2	3,000 dpm/ 100 cm^2	200 dpm/ 100 cm^2
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission, including Pb-210), except others noted above.	5,000 dpm beta, gamma/100 cm^2	15,000 dpm beta, gamma/100 cm^2	1,000 dpm beta, gamma/100 cm^2

(a) Where surface contamination by both alpha and beta-gamma emitting radionuclides exists, the limits established for alpha and beta-gamma emitting radionuclides should apply independently.

(b) As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

(c) Measurements of average contamination levels should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each object.

(d) The maximum contamination level applies to an area of not more than 100 cm2.

(e) The amount of removable radioactive material per 100 cm2 of surface area should be

determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

(f) The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr (2 µGy/hr) at 1 cm and 1.0 mrad/hr (10 µGy/hr) at 1 cm respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

(g) Equipment containing NORM shall not exceed a maximum radiation exposure level of 25 microroentgens per hour above background radiation at any accessible point.

Subchapter 12 Licensing And Radiation Safety Requirements For Irradiators

Rule 1.12.1 **Purpose and Scope.**

1. Subchapter 12 contains requirements for the issuance of a license authorizing the use of sealed sources containing radioactive material in irradiators used to irradiate objects or materials using gamma radiation. This section also contains radiation safety requirements for operating irradiators. The requirements of this section are in addition to other requirements of these regulations. In particular, the provisions of Subchapters 1, 3, 4 and 10 of these regulations apply to applications and licenses subject to this section. Nothing in this section relieves the licensee from complying with other applicable federal, state and local regulations governing the siting, zoning, land use, and building code requirements for industrial facilities.

2. The regulations in this section apply to panoramic irradiators that have either dry or wet storage of the radioactive sealed sources and to underwater irradiators in which both the source and the product being irradiated are under water. Irradiators whose dose rates exceed 500 rads (5 grays) per hour at 1 meter from the radioactive sealed sources in air or in water, as applicable for the irradiator type, are covered by this section.

3. The regulations in this section do not apply to self-contained dry-source- storage irradiators (those in which both the source and the area subject to irradiation are contained within a device and are not accessible by personnel), medical radiology or teletherapy, radiography (the irradiation of materials for nondestructive testing purposes), gauging, or open-field (agricultural) irradiations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.2 **Definitions.** As used in Subchapter 12:

1. "Annually" means either (1) at intervals not to exceed one year, or (2) once per year, at about the same time each year (plus or minus one month).

2. "Doubly encapsulated sealed source" means a sealed source in which the radioactive material is sealed within a capsule and that capsule is sealed within another capsule.

3. "Irradiator" means a facility that uses radioactive sealed sources for the irradiation of objects or materials and in which radiation doses rates exceeding 500 rads (5 grays) per hour exist at 1 meter from the sealed radioactive sources in air or water, as applicable for the irradiator type, but does not include irradiators in which both the sealed source and the area subject to irradiation are contained within a device and are not accessible to personnel.

4. "Irradiator operator" means an individual who has successfully completed the training and testing described in 1.12.18 and is authorized by the terms of the license to operate the irradiator without a supervisor present.

5. "Panoramic dry-source-storage irradiator" means an irradiator in which the irradiations occur in air in areas potentially accessible to personnel and in which the sources are stored in shields made of solid materials. The term includes beam-type dry-source-storage irradiators in which only a narrow beam of radiation is produced for performing irradiations.

6. "Panoramic irradiator" means an irradiator in which the irradiations are done in air in areas potentially accessible to personnel. The term includes beam- type irradiators.

7. "Panoramic wet-source-storage irradiator" means an irradiator in which the irradiations occur in air in areas potentially accessible to personnel and in which the sources are stored under water in a storage pool.

8. "Pool irradiator" means any irradiator in which the sources are stored or used in a pool of water including panoramic wet-source-storage irradiators and underwater irradiators.

9. "Product conveyor system" means a system for moving the product to be irradiated to, from, and within the area where irradiation takes place.

10. "Radiation room" means a shielded room in which irradiations take place. Underwater irradiators do not have radiation rooms.

11. "Sealed source" means any radioactive material that is used as a source of radiation and is encased in a capsule designed to prevent leakage or escape of the radioactive material.

12. "Seismic area" means any area where the probability of horizontal acceleration in rock of more than 0.3 times the acceleration of gravity in 250 years is greater than 10%, as designated by the U.S. Geological Survey.

13. "Underwater irradiator" means an irradiator in which the sources always remain shielded under water and humans do not have access to the sealed sources or the space subject to irradiation without entering the pool.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.3 **Specific Licenses for Irradiators.** The Agency will approve an application for a specific license for the use of licensed material in an irradiator if the applicant meets the requirements contained in this section.

1. The applicant shall satisfy the general requirements specified in Subchapter 3 of these regulations and the requirements contained in this section.

2. The application must describe the training provided to irradiator operator including:

   a. Classroom training;

b. On-the-job or simulator training;

c. Safety reviews;

d. Means employed by the applicant to test each operator's understanding of the Agency's regulations and licensing requirements and the irradiator operating, safety, and emergency procedures; and

e. Minimum training and experience of personnel who may provide training.

3. The application must include an outline of the written operating and emergency procedures listed in 1.12.19 that describes the radiation safety aspects of the procedures.

4. The application must describe the organizational structure for managing the irradiator, specifically the radiation safety responsibilities and authorities of the radiation safety officer and those management personnel who have important radiation safety responsibilities or authorities. In particular, the application must specify who, within the management structure, has the authority to stop unsafe operations. The application must also describe the training and experience required for the position of radiation safety officer.

5. The application must include a description of the access control systems required by 1.12.8., the radiation monitors required by 1.12.11, the method of detecting leaking sources required by 1.12.22, including the sensitivity of the method, and a diagram of the facility that shows the locations of all required interlocks and radiation monitors.

6. If the applicant intends to perform leak testing of dry-source-storage sealed sources, the applicant shall establish procedures for leak testing and submit a description of these procedures to the Agency. The description must include the:

a. Instruments to be used;

b. Methods of performing the analysis; and

c. Pertinent experience of the individual who analyzes the samples.

7. If licensee personnel are to load or unload sources, the applicant shall describe the qualifications and training of the personnel and the procedures to be used. If the applicant intends to contract for source loading or unloading at its facility, the loading or unloading must be done by an organization specifically authorized by the Agency, an Agreement State, a Licensing State or the U.S. Nuclear Regulatory Commission to load or unload irradiator sources.

8. The applicant shall describe the inspection and maintenance checks,

including the frequency of the checks required by 1.12.23.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.4 **Start of Construction**. The applicant may not begin construction of a new irradiator prior to the submission to the Agency of an application for a license for the irradiator and the fee required by Subchapter 1.3.8(1) of these regulations. As used in this section, the term "construction" includes the construction of any portion of the permanent irradiator structure on the site but does not include: engineering and design work, purchase of a site, site surveys or soil testing, site preparation, site excavation, construction of warehouse or auxiliary structures, and other similar tasks. Any activities undertaken prior to the issuance of a license are entirely at the risk of the applicant and have no bearing on the issuance of a license with respect to the requirements of the Act, regulations, and orders issued under the Act.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.5 **Applications for Exemptions**. Any application for a license or for amendment of a license authorizing use of a teletherapy-type unit for irradiation of materials or objects may include proposed alternatives for the requirements of this section. The Agency will approve the proposed alternatives if the applicant provides adequate rationale for the proposed alternatives and demonstrates that they are likely to provide an adequate level of safety for workers and the public.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.6 **Request for Written Statements**. Each license is issued with the condition that the licensee will, at any time before expiration of the license, upon the Agency's request, submit written statements to enable the Agency to determine whether the license should be modified, suspended, or revoked.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.7 **Performance Criteria for Sealed Sources.**

1. Requirements for sealed sources installed after August 9, 1996:

   a. Must have been evaluated in accordance with 10 CFR 32.210 or equivalent Agreement State regulations;

   b. Must be doubly encapsulated;

   c. Must use radioactive material that is as nondispersible as practical and that is as insoluble as practical if the source is used in a wet-source-storage or wet-source-change irradiator;

d. Must be encapsulated in a material resistant to general corrosion and to localized corrosion, such as 316L stainless steel or other material with equivalent resistance if the sources are for use in irradiator pools; and

e. In prototype testing of the sealed source, must have been leak tested and found leak-free after each of the tests described in 1.12.7(2) through (7).

2. **Temperature**. The test source must be held at -40˚C for 20 minutes, 600˚C for one hour, and then be subjected to thermal shock test with a temperature drop from 600˚C to 20˚C within 15 seconds.

3. **Pressure.** The test source must be twice subjected for at least five minutes to an external pressure (absolute) of 2 million newtons per square meter.

4. **Impact.** A 2-kilogram steel weight, 2.5 centimeters in diameter, must be dropped from a height of 1 meter onto the test source.

5. **Vibration**. The test source must be subjected three times for ten minutes each to vibrations sweeping from 25 hertz to 500 hertz with a peak amplitude of five times the acceleration of gravity. In addition, each test source must be vibrated for 30 minutes at each resonant frequency found.

6. **Puncture.** A 50-gram weight and pin, 0.3-centimeter pin diameter, must be dropped from a height of 1 meter onto the test source.

7. **Bend.** If the length of the source is more than 15 times larger than the minimum cross-sectional dimension, the test source must be subjected to a force of 2000 newtons at its center equidistant from two support cylinders, the distance between which is ten times the minimum cross-sectional dimension of the source.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.8 **Access Control.**

1. Each entrance to a radiation room at a panoramic irradiator must have a door or other physical barrier to prevent inadvertent entry of personnel if the sources are not in the shielded position. Product conveyor systems may serve as barriers as long as they reliably and consistently function as a barrier. It must not be possible to move the sources out of their shielded position if the door or barrier is open. Opening the door or barrier while the sources are exposed must cause the sources to return promptly to the shielded position. The personnel entrance door or barrier must have a lock that is operated by the same key used to move the sources. The doors and barriers must not prevent any individual in the radiation room from leaving.

2. In addition, each entrance to a radiation room at a panoramic irradiator must have an independent backup access control to detect personnel entry while the sources are exposed. Detection of entry while the sources are exposed must cause the sources to return to their fully shielded position and must also activate a visible and audible alarm to make the individual entering the room aware of the hazard. The alarm must also alert at least one other individual who is onsite of the entry. That individual shall be trained on how to respond to the alarm and prepared to promptly render or summon assistance.

3. A radiation monitor must be provided to detect the presence of high radiation levels in the radiation room of a panoramic irradiator before personnel entry. The monitor must be integrated with personnel access door locks to prevent room access when radiation levels are high. Attempted personnel entry while the monitor measures high radiation levels, must activate the alarm described in 1.12.8(2). The monitor may be located in the entrance (normally referred to as the maze) but not in the direct radiation beam.

4. Before the sources move from their shielded position in a panoramic irradiator, the source control must automatically activate conspicuous visible and audible alarms to alert people in the radiation room that the sources will be moved from their shielded position. The alarms must give individuals enough time to leave the room before the sources leave the shielded position.

5. Each radiation room at a panoramic irradiator must have a clearly visible and readily accessible control that would allow an individual in the room to make the sources return to their fully shielded position.

6. Each radiation room of a panoramic irradiator must contain a control that prevents the sources from moving from the shielded position unless the control has been activated and the door or barrier to the radiation room has been closed within a preset time after activation of the control.

7. Each entrance to the radiation room of a panoramic irradiator and each entrance to the area within the personnel access barrier of an underwater irradiator must have a sign bearing the radiation symbol and the words, "CAUTION (or DANGER) RADIOACTIVE MATERIAL(S)." Panoramic irradiators must also have a sign stating "GRAVE DANGER, VERY HIGH RADIATION AREA," but the sign may be removed, covered, or otherwise made inoperative when the sources are fully shielded.

8. If the radiation room of a panoramic irradiator has roof plugs or other movable shielding, it must not be possible to operate the irradiator unless the shielding is in its proper location. The requirement may be met by interlocks that prevent operation if shielding is not placed properly or by an operating procedure requiring inspection of shielding before operating.

9. Underwater irradiators must have a personnel access barrier around the pool

which must be locked to prevent access when the irradiator is not attended. Only operators and facility management may have access to keys to the personnel access barrier. There must be an intrusion alarm to detect unauthorized entry when the personnel access barrier is locked. Activation of the intrusion alarm must alert an individual (not necessarily onsite) who is prepared to respond or summon assistance.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.9 **Shielding**.

1. The radiation dose rate in areas that are normally occupied during operation of a panoramic irradiator may not exceed 2 millirems (0.02 millisievert) per hour at any location 30 centimeters or more from the wall of the room when the sources are exposed. The dose rate must be averaged over an area not to exceed 100 square centimeters having no linear dimension greater than 20 centimeters. Areas where the radiation dose rate exceeds 2 millirems (0.02 millisievert) per hour must be locked, roped off, or posted.

2. The radiation dose at 30 centimeters over the edge of the pool of a pool irradiator may not exceed 2 millirems (0.02 millisievert) per hour when the sources are in the fully shielded position.

3. The radiation dose rate at 1 meter from the shield of a dry-source-storage panoramic irradiator when the source is shielded may not exceed 2 millirems (0.02 millisievert) per hour and at 5 centimeters from the shield may not exceed 20 millirems per hour (0.2 millisievert)

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.10 **Fire Protection.**

1. The radiation room at a panoramic irradiator must have heat and smoke detectors. The detectors must activate an audible alarm. The alarm must be capable of alerting a person who is prepared to summon assistance promptly. The sources must automatically become fully shielded if a fire is detected.

2. The radiation room at a panoramic irradiator must be equipped with a fire extinguishing system capable of extinguishing a fire without the entry of personnel into the room. The system for the radiation room must have a shut-off valve to control flooding into unrestricted areas.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.11 **Radiation Monitors.**

1. Irradiators with automatic product conveyor systems must have a radiation monitor with an audible alarm located to detect loose radioactive sources that are carried toward the product exit. If the monitor detects a source, an alarm must sound and product conveyors must stop automatically. The alarm must be capable of alerting an individual in the facility who is prepared to summon assistance. Underwater irradiators in which the product moves within an enclosed stationary tube are exempt from the requirements of this section.

2. Underwater irradiators that are not in a shielded radiation room must have a radiation monitor over the pool to detect abnormal radiation levels. The monitor must have an audible alarm and a visible indicator at entrances to the personnel access barrier around the pool. The audible alarm may have a manual shut-off. The alarm must be capable of alerting an individual who is prepared to respond promptly.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.12 **Control of Source Movement.**

1. The mechanism that moves the sources of a panoramic irradiator must require a key to actuate. Actuation of the mechanism must cause an audible signal to indicate that the sources are leaving the shielded position. Only one key may be in use at any time, and only operators or facility management may possess it. The key must be attached to a portable radiation survey meter by a chain or cable. The lock for source control must be designed so that the key may not be removed if the sources are in an unshielded position. The door to the radiation room must require the same key.

2. The console of a panoramic irradiator must have a source position indicator that indicates when the sources are in the fully shielded position, when they are in transit, and when the sources are exposed.

3. The control console of a panoramic irradiator must have a control that promptly returns the sources to the shielded position.

4. Each control for a panoramic irradiator must be clearly marked as to its function.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.13 **Irradiator Pools.**

1. For licenses initially issued after August 9, 1996, irradiator pools must either:

   a. Have a water-tight stainless steel liner or a liner metallurgically compatible with other components in the pool; or

b. Be constructed so that there is a low likelihood of substantial leakage and have a surface designed to facilitate decontamination. In either case, the licensee shall have a method to safely store the sources during repairs of the pool.

2. For licenses initially issued after August 9, 1996, irradiator pools must have no outlets more than 0.5 meter below the normal low water level that could allow water to drain out of the pool. Pipes that have intakes more than 0.5 meter below the normal low water level and that could act as siphons must have siphon breakers to prevent the siphoning of pool water.

3. A means must be provided to replenish water losses from the pool.

4. A visible indicator must be provided in a clearly observable location to indicate if the pool water level is below the normal low water level or above the normal high water level.

5. Irradiator pools must be equipped with a purification system designed to be capable of maintaining the water during normal operation at a conductivity of 20 microsiemens per centimeter or less and with a clarity so that the sources can be seen clearly.

6. A physical barrier, such as a railing or cover, must be used around or over irradiator pools during normal operation to prevent personnel from accidentally falling into the pool. The barrier may be removed during maintenance, inspection, and service operations.

7. If long-handled tools or poles are used in irradiator pools, the radiation dose rate on the handling areas of the tools may not exceed 2 millirems (0.02 millisievert) per hour.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.14 **Source Rack Protection.** If the product to be irradiated moves on a product conveyor system, the source rack and the mechanism that moves the rack must be protected by a barrier or guides to prevent products and product carriers from hitting or touching the rack or mechanism.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.15 **Power Failures.**

1. If electrical power at a panoramic irradiator is lost for longer than ten seconds, the sources must automatically return to the shielded position.

2. The lock on the door of the radiation room of a panoramic irradiator may not be deactivated in the event of a power failure.

3. During a power failure, the area of any irradiator where sources are located may

be entered only when using an operable and calibrated radiation survey meter.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.16 **Design Requirements**. Irradiators whose construction begins after August 9,1996, must meet the design requirements of this section.

1. **Shielding**. For panoramic irradiators, the licensee shall design shielding walls to meet generally accepted building code requirements for reinforced concrete and design the walls, wall penetrations, and entranceways to meet the radiation shielding requirements of 1.12.9. If the irradiator will use more than 5 million curies (2 x 1017 becquerels) of activity, the licensee shall evaluate the effects of heating of the shielding walls by the irradiator sources.

2. **Foundations**. For panoramic irradiators, the licensee shall design the foundation, with consideration given to soil characteristics, to ensure it is adequate to support the weight of the facility shield walls.

3. **Pool Integrity.** For pool irradiators, the licensee shall design the pool to assure that it is leak resistant, that it is strong enough to bear the weight of the pool water and shipping casks, that a dropped cask would not fall on sealed sources, that all outlets or pipes meet the requirements of 1.12.13(2), and that metal components are metallurgically compatible with other components in the pool.

4. **Water Handling System**. For pool irradiators, the licensee shall verify that the design of the water purification system is adequate to meet the requirements of 1.12.13(5). The system must be designed so that water leaking from the system does not drain to unrestricted areas without being monitored.

5. **Radiation Monitors**. For all irradiators, the licensee shall evaluate the location and sensitivity of the monitor to detect sources carried by the product conveyor system as required by 1.12.11(1). The licensee shall verify that the product conveyor is designed to stop before a source on the product conveyor would cause a radiation overexposure to any person. For pool irradiators, if the licensee uses radiation monitors to detect contamination under 1.12.11(2), the licensee shall verify that the design of radiation monitoring systems to detect pool contamination includes sensitive detectors located close to where contamination is likely to concentrate.

6. **Source Rack.** For pool irradiators, the licensee shall verify that there are no crevices on the source or between the source and source holder that would promote corrosion on a critical area of the source. For panoramic irradiators, the licensee shall determine that source rack drops due to loss of power will not damage the source rack and that source rack drops due to failure of cables (or alternate means of support) will not cause loss of integrity of sealed

sources. For panoramic irradiators, the licensee shall review the design of the mechanism that moves the sources to assure that the likelihood of a stuck source is low and that, if the rack sticks, a means exists to free it with minimal risk to personnel.

7. **Access Control**. For panoramic irradiators, the licensee shall verify from the design and logic diagram that the access control system will meet the requirements of 1.12.8.

8. **Fire Protection.** For panoramic irradiators, the licensee shall verify that the number, locations, and spacing of the smoke and heat detectors are appropriate to detect fires and that the detectors are protected from mechanical and radiation damage. The licensee shall verify that the design of the fire extinguishing system provides the necessary discharge patterns, densities, and flow characteristics for complete coverage of the radiation room and that the system is protected from mechanical and radiation damage.

9. **Source Return.** For panoramic irradiators, the licensee shall verify that the source rack will automatically return to the fully shielded position if offsite power is lost for more than ten seconds.

10. **Seismic.** For panoramic irradiators to be built in seismic areas, the licensee shall design the reinforced concrete radiation shields to retain their integrity in the event of an earthquake by designing to the seismic requirements of an appropriate source such as American Concrete Institute Standard ACI 318-89, "Building Code Requirements for Reinforced Concrete," Chapter 21, "Special Provisions for Seismic Design," or local building codes, if current.

11. **Wiring.** For panoramic irradiators, the licensee shall verify that electrical wiring and electrical equipment in the radiation room are selected to minimize failures due to prolonged exposure to radiation.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.17 **Construction Monitoring and Acceptance Testing.** The requirements of this section must be met for irradiators whose construction begins after August 9, 1996 The requirements must be met prior to loading sources.

1. **Shielding**. For panoramic irradiators, the licensee shall monitor the construction of the shielding to verify that its construction meets design specifications and generally accepted building code requirements for reinforced concrete.

2. **Foundations.** For panoramic irradiators, the licensee shall monitor the construction of the foundations to verify that their construction meets design specifications.

3. **Pool Integrity.** For pool irradiators, the licensee shall verify that the pool

meets design specifications and shall test the integrity of the pool. The licensee shall verify that outlets and pipes meet the requirements of 1.12.13(2).

4. **Water Handling System.** For pool irradiators, the licensee shall verify that the water purification system, the conductivity meter, and the water level indicators operate properly.

5. **Radiation Monitors.** For all irradiators, the licensee shall verify the proper operation of the monitor to detect sources carried on the product conveyor system and the related alarms and interlocks required by 1.12.11(1). For pool irradiators, the licensee shall verify the proper operation of the radiation monitors and the related alarm if used to meet 1.12.22(2). For underwater irradiators, the licensee shall verify the proper operation of the over-the-pool monitor, alarms, and interlocks required by 1.12.11(2).

6. **Source Rack.** For panoramic irradiators, the licensee shall test the movement of the source racks for proper operation prior to source loading; testing must include source rack lowering due to simulated loss of power. For all irradiators with product conveyor systems, the licensee shall observe and test the operation of the conveyor system to assure that the requirements in 1.12.14 are met for protection of the source rack and the mechanism that moves the rack; testing must include tests of any limit switches and interlocks used to protect the source rack and mechanism that moves that rack from moving product carriers.

7. **Access Control**. For panoramic irradiators, the licensee shall test the completed access control system to assure that it functions as designed and that all alarms, controls, and interlocks work properly.

8. **Fire Protection.** For panoramic irradiators, the licensee shall test the ability of the heat and smoke detectors to detect a fire, to activate alarms, and to cause the source rack to automatically become fully shielded. The licensee shall test the operability of the fire extinguishing system.

9. **Source Return.** For panoramic irradiators, the licensee shall demonstrate that the source racks can be returned to their fully shielded positions without offsite power.

10. **Computer Systems.** For panoramic irradiators that use a computer system to control the access control system, the licensee shall verify that the access control system will operate properly if offsite power is lost and shall verify that the computer has security features that prevent an irradiator operator from commanding the computer to override the access control system when it is required to be operable.

11. **Wiring.** For panoramic irradiators, the licensee shall verify that the

electrical wiring and electrical equipment that were installed meet the design specifications.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.18 **Training.**

1. Before an individual is permitted to operate an irradiator without a supervisor present, the individual must be instructed in:

   a. The fundamentals of radiation protection applied to irradiators (including the differences between external radiation and radioactive contamination, units of radiation dose, dose limits, why large radiation doses must be avoided, how shielding and access controls prevent large doses, how an irradiator is designed to prevent contamination, the proper use of survey meters and personnel dosimeters, other radiation safety features of an irradiator, and the basic function of the irradiator);

   b. The requirements of Subchapters 10 and 12 of these regulations that are relevant to the irradiator;

   c. The operation of the irradiator;

   d. Those operating and emergency procedures listed in 1.12.19 that the individual is responsible for performing; and

   e. Case histories of accidents or problems involving irradiators.

2. Before an individual is permitted to operate an irradiator without a supervisor present, the individual shall pass a written test on the instruction received consisting primarily of questions based on the licensee's operating and emergency procedures that the individual is responsible for performing and other operations necessary to safely operate the irradiator without supervision.

3. Before an individual is permitted to operate an irradiator without a supervisor present, the individual must have received on-the-job training or simulator training in the use of the irradiator as described in the license application. The individual shall also demonstrate the ability to perform those portions of the operating and emergency procedures that he or she is to perform.

4. The licensee shall conduct safety reviews for irradiator operators at least annually. The licensee shall give each operator a brief written test on the information. Each safety review must include, to the extent appropriate, each of the following:

   a. Changes in operating and emergency procedures since the last review, if any;

b. Changes in regulations and license conditions since the last review, if any;

c. Reports on recent accidents, mistakes, or problems that have occurred at irradiators, if any;

d. Relevant results of inspections of operator safety performance;

e. Relevant results of the facility's inspection and maintenance checks; and

f. A drill to practice an emergency or abnormal event procedure.

5. The licensee shall evaluate the safety performance of each irradiator operator at least annually to ensure that regulations, license conditions, and operating, safety, and emergency procedures are followed. The licensee shall discuss the results of the evaluation with the operator and shall instruct the operator on how to correct any mistakes or deficiencies observed.

6. Individuals who will be permitted unescorted access to the radiation room of the irradiator or the area around the pool of an underwater irradiator, but who have not received the training required for operators and the radiation safety officer, shall be instructed and tested in any precautions they should take to avoid radiation exposure, any procedures or parts of procedures listed in 1.12.19 that they are expected to perform or comply with, and their proper response to alarms required in this section. Tests may be oral.

7. Individuals who must be prepared to respond to alarms required by 1.12.8(2) and (9), 1.12.10(1), 1.12.11(1) and (2), and 1.12.22(2) shall be trained and tested on how to respond. Each individual shall be retested at least once a year. Tests may be oral.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.19 **Operating and Emergency Procedures.**

1. The licensee shall have and follow written operating procedures for:

a. Operation of the irradiator, including entering and leaving the radiation room;

b. Use of personnel dosimeters;

c. Surveying the shielding of panoramic irradiators;

d. Monitoring pool water for contamination while the water is in the

pool and before release of pool water to unrestricted areas;

e. Leak testing of sources;

f. Inspection and maintenance checks required by 1.12.23;

g. Loading, unloading, and repositioning sources, if the operations will be performed by the licensee; and

h. Inspection of movable shielding required by 1.12.8(8), if applicable.

2. The licensee shall have and follow emergency or abnormal event procedures, appropriate for the irradiator type, for:

a. Sources stuck in the unshielded position;

b. Personnel overexposures;

c. A radiation alarm from the product exit portal monitor or pool monitor;

d. Detection of leaking sources, pool contamination, or alarm caused by contamination of pool water;

e. A low or high water level indicator, an abnormal water loss, or leakage from the source storage pool;

f. A prolonged loss of electrical power;

g. A fire alarm or explosion in the radiation room;

h. An alarm indicating unauthorized entry into the radiation room, area around pool, or another alarmed area;

i. Natural phenomena, including an earthquake, a tornado, flooding, or other phenomena as appropriate for the geographical location of the facility; and

j. The jamming of automatic conveyor systems.

3. The licensee may revise operating and emergency procedures only with Agency approval and if all of the following conditions are met:

a. The revisions do not reduce the safety of the facility;

b. The revisions are consistent with the outline or summary of procedures submitted with the license application;

c. The revisions have been reviewed and approved by the radiation safety officer; and

d. The users or operators are instructed and tested on the revised procedures before they are put into use.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.20 **Personnel Monitoring.**

1. Irradiator operators shall wear a personnel dosimeter that is processed and evaluated by an accredited National Voluntary Laboratory Accreditation Program (NVLAP) processor while operating a panoramic irradiator or while in the area around the pool of an underwater irradiator. The personnel dosimeter processor must be accredited for high energy photons in the normal and accident dose ranges (see 1.4.17(3). Each personnel dosimeter must be assigned to and worn by only one individual. Film badges must be processed at least monthly, and other personnel dosimeters must be processed at least quarterly.

2. Other individuals who enter the radiation room of a panoramic irradiator shall wear a dosimeter, which may be a pocket dosimeter. For groups of visitors, only two people who enter the radiation room are required to wear dosimeters. If pocket dosimeters are used to meet the requirements of the section, a check of their response to radiation must be done at least annually. Acceptable dosimeters must read within 30% of the true radiation dose.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.21 **Radiation Surveys.**

1. A radiation survey of the area outside the shielding of the radiation room of a panoramic irradiator must be conducted with the sources in the exposed position before the facility starts to operate. A radiation survey of the area above the pool of pool irradiators must be conducted after the sources are loaded but before the facility starts to operate. Additional radiation surveys of the shielding must be performed at intervals not to exceed three years and before resuming operation after addition of new sources or any modification to the radiation room shielding or structure that might increase dose rates.

2. If the radiation levels specified in 1.12.9 are exceeded, the facility must be modified to comply with the requirements in 1.12.9.

3. Portable radiation survey meters must be calibrated at least annually to an accuracy of 20% for the gamma energy of the sources in use. The calibration must be done at two points on each scale or, for digital instruments, at one point per decade over the range that will be used. Portable radiation survey meters must be of a type that does not saturate and read zero at high radiation dose rates.

4. Water from the irradiator pool, other potentially contaminated liquids, and sediments from pool vacuuming must be monitored for radioactive contamination before release to unrestricted areas. Radioactive concentrations must not exceed those specified in Subchapter 4, Table 2, Column 2 or Table 3 of Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

5. Before releasing resins for unrestricted use, they must be monitored before release in an area with a background level less than 0.05 millirem (0.5 microsievert) per hour. The resins may be released only if the survey does not detect radiation levels above background radiation levels. The survey meter used must be capable of detecting radiation levels of 0.05 millirem (0.5 microsievert) per hour.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.22 **Detection of Leaking Sources.**

1. Each dry-source-storage sealed source must be tested for leakage at intervals not to exceed six months using a leak test kit or method approved by the Agency, an Agreement State, a Licensing State, or the U. S. Nuclear Regulatory Commission. In the absence of a certificate from a transferor that a test has been made within the six months before the transfer, the sealed source may not be used until tested. The test must be capable of detecting the presence of 0.005 microcurie (200 becquerels) of radioactive material and must be performed by a person approved by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission to perform the test.

2. For pool irradiators, sources may not be put into the pool unless the licensee tests the sources for leaks or has a certificate from a transferor that leak test has been done within the six months before the transfer. Water from the pool must be checked for contamination each day the irradiator operates. The check may be done either by using a radiation monitor on a pool water circulating system or by analysis of a sample of pool water. If a check for contamination is done by analysis of a sample of pool water, the results of the analysis must be available within 24 hours. If the licensee uses a radiation monitor on a pool water circulating system, the detection of above normal radiation levels must activate an alarm. The alarm set- point must be set as low as practical, but high enough to avoid false alarms. The licensee may reset the alarm set-point to a higher level if necessary to operate the pool water purification system to clear up contamination in the pool if specifically provided for in written emergency procedures.

3. If a leaking source is detected, the licensee shall arrange to remove the leaking source from service and have it decontaminated, repaired, or disposed of by the Agency, Agreement State, Licensing State, or the U.S. Nuclear Regulatory Commission licensee that is authorized to perform these

functions. The licensee shall promptly check its personnel, equipment, facilities, and irradiated product for radioactive contamination. No product may be shipped until the product has been checked and found free of contamination. If a product has been shipped that may have been inadvertently contaminated, the licensee shall arrange to locate and survey that product for contamination. If any personnel are found to be contaminated, decontamination must be performed promptly. If contaminated equipment, facilities, or products are found, the licensee shall arrange to have them decontaminated or disposed of by the Agency, Agreement State, Licensing State, or U.S. Regulatory Commission licensee that is authorized to perform these functions. If a pool is contaminated, the licensee shall arrange to clean the pool until the contamination levels do not exceed the appropriate concentration in Table 2, Column 2, Appendix B of Subchapter 4. (See 1.1.7 for reporting requirements.)

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.23 **Inspection and Maintenance.**

1. The licensee shall perform inspection and maintenance checks that include, as a minimum, each of the following at the frequency specified in the license or license application:

   a. Operability of each aspect of the access control system required by 1.12.8.

   b. Functioning of the source position indicator required by 1.12.12(2).

   c. Operability of the radiation monitor for radioactive contamination in pool water required by 1.12.22(2) using a radiation check source, if applicable.

   d. Operability of the over-pool radiation monitor at underwater irradiators as required by 1.12.11(2).

   e. Operability of the product exit monitor required by 1.12.11(1).

   f. Operability of the emergency source return control required by 1.12.12(3).

   g. Leak-tightness of systems through which pool water circulates (visual inspection).

   h. Operability of the heat and smoke detectors and extinguisher system required by 1.12.10 (but without turning extinguishers on).

   i. Operability of the means of pool water replenishment required by 1.12.13(3).

j. Operability of the indicators of high and low pool water levels required by 1.12.13(4).

k. Operability of the intrusion alarm required by 1.12.8(9), if applicable.

l. Functioning and wear of the system, mechanisms, and cables used to raise and lower sources.

m. Condition of the barrier to prevent products from hitting the sources or source mechanism as required by 1.12.14.

n. Amount of water added to the pool to determine if the pool is leaking.

o. Electrical wiring on required safety systems for radiation damage.

p. Pool water conductivity measurements and analysis as required by 1.12.24(2).

2. Malfunctions and defects found during inspection and maintenance checks must be repaired without undue delay.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.24 **Pool Water Purity.**

1. Pool water purification system must be run sufficiently to maintain the conductivity of the pool water below 20 microsiemens per centimeter under normal circumstances. If pool water conductivity rises above 20 microsiemens per centimeter, the licensee shall take prompt actions to lower the pool water conductivity and shall take corrective actions to prevent future recurrences.

2. The licensee shall measure the pool water conductivity frequently enough, but no less than weekly, to assure that the conductivity remains below 20 microsiemens per centimeter. Conductivity meters must be calibrated at least annually.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.25 **Attendance During Operation.**

1. Both an irradiator operator and at least one other individual, who is trained on how to respond and prepared to promptly render or summon assistance if the access control alarm sounds, shall be present onsite:

a. Whenever the irradiator is operated using an automatic product conveyor system; and

b. Whenever the product is moved into or out of the radiation room

when the irradiator is operated in a batch mode.

2. At a panoramic irradiator at which static irradiations (no movement of the product) are occurring, a person who has received the training on how to respond to alarms described in 1.12.18(7) must be onsite.

3. At an underwater irradiator, an irradiator operator must be present at the facility whenever the product is moved into or out of the pool. Individuals who move the product into or out of the pool of an underwater irradiator need not be qualified as irradiator operators; however, they must have received the training described in 1.12.18(6) and (7). Static irradiations may be performed without a person present at the facility.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.26 **Entering and Leaving the Radiation Room.**

1. Upon first entering the radiation room of a panoramic irradiator after an irradiation, the irradiator operator shall use a survey meter to determine that the source has returned to its fully shielded position. The operator shall check the functioning of the survey meter with a radiation check source prior to entry.

2. Before exiting from and locking the door to the radiation room of a panoramic irradiator prior to a planned irradiation, the irradiator operator shall:

   a. Visually inspect the entire radiation room to verify that no one else is in it; and

   b. Activate a control in the radiation room that permits the sources to be moved from the shielded position only if the door to the radiation room is locked within a preset time after setting the control.

3. During a power failure, the area around the pool of an underwater irradiator may not be entered without using an operable and calibrated radiation survey meter unless the over-the-pool monitor required by 1.12.11(2) is operating with backup power.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.27 **Irradiation of Explosive or Flammable Materials.**

1. Irradiation of explosive material is prohibited unless the licensee has received prior written authorization from the Agency. Authorization will not be granted unless the licensee can demonstrate that detonation of the explosive would not rupture the sealed sources, injure personnel, damage safety systems, or cause radiation overexposures of personnel.

2. Irradiation of more than small quantities of flammable material (flash point

below 140˚ (F) is prohibited in panoramic irradiators unless the licensee has received prior written authorization from the Agency. Authorization will not be granted unless the licensee can demonstrate that a fire in the radiation room could be controlled without damage to sealed sources or safety systems and without radiation overexposures of personnel.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.28 **Records and Retention Periods.** The licensee shall maintain the following records at the irradiator for the periods specified.

1. A copy of the license, license conditions, documents incorporated into a license by reference, and amendments thereto until superseded by new documents or until the Agency terminates the license for documents not superseded.

2. Records of each individual's training, tests, and safety reviews provided to meet the requirements of 1.12.18(1), (2), (3), (4), (6), and (7) until three years after the individual terminates work.

3. Records of the annual evaluations of the safety performance of irradiator operators required by 1.12.18(5) for three years after the evaluation.

4. A copy of the current operating and emergency procedures required by until superseded or the Agency terminates the license. Records of the radiation safety officer's review and approval of changes in procedures as required by 1.12.19(3)(c) retained for three years from the date of the change.

5. Personnel dosimeter results required by 1.12.20 until the Agency terminates the license.

6. Records of radiation surveys required by 1.12.21 for three years from the date of the survey.

7. Records of radiation survey meter calibrations required by 1.12.21 and pool water conductivity meter calibrations required by 1.12.24(2) until three years from the date of calibration.

8. Records of the results of leak tests required by 1.12.22(1) and the results of contamination checks required by 1.12.22(2) for three years from the date of each test.

9. Records of inspection and maintenance checks required by 1.12.23 for three years.

10. Records of major malfunctions, significant defects, operating difficulties or irregularities, and major operating problems that involve required radiation safety equipment for three years after repairs are completed.

11. Records of the receipt, transfer and disposal, of all licensed sealed sources as required by 1.1.04 and 1.3.24.

12. Records on the design checks required by 1.12.16 and the construction control checks as required by 1.12.17 until the license is terminated. The records must be signed and dated. The title or qualification of the person signing must be included.

13. Records related to decommissioning of the irradiator as required by 1.3.9(7).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.12.29 **Reports.**

1. In addition to the reporting requirements in other sections of these regulations, the licensee shall report the following events if not reported under other sections of these regulations:

   a. Source stuck in an unshielded position.

   b. Any fire or explosion in a radiation room.

   c. Damage to the source racks.

   d. Failure of the cable or drive mechanism

      used to move the source racks.

   e. Inoperability of the access control system.

   f. Detection of radiation source by the product exit monitor.

   g. Detection of radioactive contamination attributable to licensed radioactive material.

   h. Structural damage to the pool liner or walls.

   i. Abnormal water loss or leakage from the source storage pool.

   j. Pool water conductivity exceeding 100 microsiemens per centimeter.

2. The report must include a telephone report within 24 hours as described in 1.1.7(4)(a), and a written report within 30 days as described in 1.1.7(4)(b).

Subchapter 13 Transportation of Radioactive Materials

Rule 1.13.1 **Purpose and Scope.** The regulations in this section establish requirements for packaging, preparation for shipment, and transportation of radioactive material and apply to any licensee authorized by specific or general license issued by the Agency to receive, possess, use, or transfer licensed material, if the licensee delivers that material to a carrier for transport, transports the material outside the site of usage as specified in the Agency license, or transports that material on public highways. No provision of this section authorizes possession of licensed material.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.2 **Definitions.** As used in this section, the following definitions apply:

1. "Carrier" means a person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

2. “Certificate holder” means a person who has been issued a certificate of compliance or other package approval by the Nuclear Regulatory Commission.

3. “Certificate of Compliance (CoC)” means the certificate issued by the Nuclear Regulatory Commission which approves the design of a package for the transportation of radioactive material.

4. "Closed transport vehicle" means a transport vehicle equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the radioactive material. The enclosure may be either temporary or permanent but shall limit access from top, sides, and ends. In the case of packaged materials, it may be of the "see-through" type.

5. “Consignment” means each shipment of a package or groups of packages or load of radioactive material offered by a shipper for transport.

6. “Conveyance” means:

    a. For transport by public highway or rail any transport vehicle or large freight container;

    b. For transport by water any vessel, or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel; and

    c. For transport by any aircraft.

7. “Criticality Safety Index (CSI)” means the dimensionless number (rounded up to the next tenth) assigned to and placed on the label of a fissile material package, to designate the degree of control of accumulation of packages containing fissile material during transportation. Determination of the criticality safety index is described in 1.13.11, 1.13.12 and 10 CFR 71.59.

8. “Deuterium” means, for the purposes of 1.13.4(4) and 1.13.11, deuterium and any deuterium compounds, including heavy water, in which the ratio of deuterium atoms to hydrogen atoms exceeds 1:5000.

9. "Exclusive use" means the sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions, in writing, for maintenance of exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the consignor.

10. "Fissile material" means plutonium-239, plutonium-241, uranium-233, uranium-235, or any combination of these radionuclides. Fissile material means the fissile nuclides themselves, not material containing fissile nuclides. Unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in thermal reactors only, are not included in this definition.[47] Certain exclusions from fissile material controls are provided in 1.13.4(4).

11. "Fissile material package or Type AF package, Type BF package, Type B(U)F package, or Type B(M)F package " means a fissile material packaging together with its fissile material contents.

12. “Graphite” means, for the purposes of 1.13.4(4) and 1.13.11, graphite with a boron equivalent content less than 5 parts per million and density greater than 1.5 grams per cubic centimeter.

13. "Low specific activity (LSA) material" means radioactive material with limited specific activity which is nonfissile or is excepted under 1.13.4(4), and that satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

    a. LSA-I

    b. Uranium and thorium ores, concentrates of uranium or thorium ores and other ores containing naturally occurring radionuclides[48] which are not intended to be processed for the use of these radionuclides; or

    c. Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or

[47] Agency jurisdiction extends only to special nuclear material in quantities not sufficient to form a critical mass@ as defined in Section 100 of these regulations.

[48] For example, uranium or thorium decay series radionuclides

d. Radioactive material for which the A_2 value is unlimited; or

e. Other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the value for exempt material activity concentration determined in accordance with Appendix A.

14. LSA-II

a. Water with tritium concentration up to 0.8 terabecquerel per liter (20.0 Ci/L); or

b. Material in which the radioactive material is distributed throughout, and the average specific activity does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

15. LSA-III Solids, excluding powders, that satisfy the requirements of 10 CFR 71.77, in which: [49]

a. The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent;[50] and

b. The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of radioactive material per package by leaching, when placed in water for 7 days, would not exceed 0.1 A_2; and

c. The estimated average specific activity of the solid does not exceed 2 x 10^{-3} A_2/g.

16. "Low toxicity alpha emitters" means natural uranium, depleted uranium, natural thorium; uranium-235, uranium-238, thorium-232, thorium-228 or thorium-230 when contained in ores or physical or chemical concentrates or tailings; or alpha emitters with a half-life of less than 10 days.

17. "Natural thorium" means thorium isotopes with a naturally occurring distribution, which is essentially 100 weight percent thorium-232.

18. "Normal form radioactive material" means radioactive material which has not been demonstrated to qualify as special form radioactive material.

19. "Nuclear waste" means a quantity of source, byproduct or special nuclear material[51] required to be in Nuclear Regulatory Commission-approved

[49] For example, consolidated wastes, or activated materials.

[50] For example, concrete, bitumen, or ceramic.

[51] The definition of nuclear waste in this section is used in the same way as in 49 CFR 173.403.

specification packaging while transported to, through or across a state boundary to a disposal site, or to a collection point for transport to a disposal site.

20. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of 49 CFR Part 173, Subpart I. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

21. "Regulations of the U.S. Department of Transportation" means the regulations in 49 CFR Parts 100-189 and Parts 390-397.

22. "Regulations of the Nuclear Regulatory Commission" means the regulations in 10 CFR 71 for purposes of Subchapter 13.

23. "Special form radioactive material" means radioactive material that satisfies the following conditions:

    a. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

    b. The piece or capsule has at least one dimension not less than 5 millimeters (0.2 in.); and

    c. It satisfies the test requirements specified by the Nuclear Regulatory Commission. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998, may continue to be used. A special form encapsulation either designed or constructed after April 1, 1998, must meet requirements of this definition applicable at the time of its design or construction.

24. "Specific activity" of a radionuclide means the radioactivity per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radioactivity per unit mass of the material.

25. “Spent nuclear fuel” or “Spent fuel” means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least 1 year's decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.

26. "Surface contaminated object" (SCO) means a solid object that is not itself classed as radioactive material, but which has radioactive material distributed on any of its surfaces. An SCO must be in one of two groups with surface activity not exceeding the following limits:

27. SCO-I: A solid object on which:

    a. The non-fixed contamination on the accessible surface averaged over 300 cm^2, or the area of the surface if less than 300 cm^2, does not exceed 4 becquerel per cm^2 (10^{-4} μCi/cm^2) for beta and gamma and low toxicity alpha emitters, or 0.4 becquerel per cm^2 (10^{-5} μCi/cm^2) for all other alpha emitters;

    b. The fixed contamination on the accessible surface averaged over 300 cm^2, or the area of the surface if less than 300 cm^2, does not exceed $4x10^4$ becquerel per cm^2 (1.0 μCi/cm^2) for beta and gamma and low toxicity alpha emitters, or $4x10^3$ becquerel per cm^2 (0.1 μCi/cm^2) for all other alpha emitters; and

    c. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 , or the area of the surface if less than 300 cm^2, does not exceed $4x10^4$ becquerel per cm^2 (1 μCi/cm2) for beta and gamma and low toxicity alpha emitters, or $4x10^3$ becquerel per cm^2 (0.1 μCi/cm^2) for all other alpha emitters.

28. SCO-II: A solid object on which the limits for SCO-I are exceeded and on which:

    a. The non-fixed contamination on the accessible surface averaged over 300 cm^2, or the area of the surface if less than 300 cm^2, does not exceed 400 becquerel per cm^2 (10^{-2} μCi/cm^2) for beta and gamma and low toxicity alpha emitters or 40 becquerel per cm^2 (10^{-3} μCi/cm^2) for all other alpha emitters;

    b. The fixed contamination on the accessible surface averaged over 300 cm^2, or the area of the surface if less than 300 cm^2, does not exceed $8x10^5$ becquerel per cm^2 (20 μCi/cm^2) for beta and gamma and low toxicity alpha emitters, or $8x10^4$ becquerel per cm^2 (2 μCi/cm^2) for all other alpha emitters; and

    c. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2, or the area of the surface if less than 300 cm^2, does not exceed $8x10^5$ becquerel per cm^2 (20 μCi/cm^2) for beta and gamma and low toxicity alpha emitters, or $8x10^4$ becquerel per cm^2 (2 μCi/cm^2) for all other alpha emitters.

29. "Transport index" means the dimensionless number, rounded up to the next tenth, placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is the number expressing

the maximum radiation level at 1 meter (3.3 feet) from the external surface of the package in millisievert (mSv) per hour multiplied by 100, which is thus equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 feet).

30. "Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A_1 for special form radioactive material or A_2 for normal form radioactive material, where A_1 and A_2 are given in Table A-1 of this section or may be determined by procedures described in Appendix A of this section.

31. "Type A package" means a packaging that, together with its radioactive contents limited to A_1 or A_2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by Subchapter 13 under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

32. "Type B package" means a Type B packaging together with its radioactive contents. On approval, a Type B package design is designated by Nuclear Regulatory Commission as B(U) unless the package has a maximum normal operating pressure of more than 700 kPa (100 lbs/in^2) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 CFR 71.73 (hypothetical accident conditions), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval of international shipments. There is no distinction made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, see DOT regulations in 49 CFR Part 173. A Type B package approved before September 6, 1983, was designated only as Type B. Limitations on its use are specified in 1.13.8.

33. "Type B packaging" means a packaging designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

34. "Type B quantity" means a quantity of radioactive material greater than a Type A quantity.

35. “Unirradiated uranium” means uranium containing not more than 2×10^3 Bq of plutonium per gram of uranium-235, not more than 9×10^6 Bq of fission products per gram of uranium-235, and not more than 5×10^{-3} g of uranium-236 per gram of uranium-235.

36. "Uranium - natural, depleted, enriched"

    a. "Natural uranium" means uranium isotopes with the naturally occurring distribution of uranium, which is approximately 0.711 weight percent uranium-235, and the remainder by weight essentially uranium-238.

b. "Depleted uranium" means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

c. "Enriched uranium" means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.3 **Requirements for License.** No person shall transport radioactive material or deliver radioactive material to a carrier for transport except as authorized in a general or specific license issued by the Agency or as exempted in 1.13.4.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.4 **Exemptions.**

1. Common and contract carriers, freight forwarders, and warehouse workers which are subject to the requirements of the U.S. Department of Transportation in 49 CFR 170 through 189 or the U.S. Postal Service in the U.S. Postal Service Domestic Mail Manual (DMM), Section C-023.9.0, and the U.S. Postal Service, are exempt from the requirements of this section to the extent that they transport or store radioactive material in the regular course of their carriage for others or storage incident thereto. Common and contract carriers who are not subject to the requirements of the U.S. Department of Transportation or U.S. Postal Service are subject to 1.13.3 and other applicable requirements of these regulations.

2. A licensee is exempt from all the requirements of this section with respect to shipment or carriage of the following low-level materials:

   a. Natural material and ores containing naturally occurring radionuclides that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in Appendix A, Table A-2, of this section.

   b. Materials for which the activity concentration is not greater than the activity concentration values specified in Appendix A, Table A-2 of this section, or for which the consignment activity is not greater than the limit for an exempt consignment found in Appendix A, Table A-2, of this section.

3. **Exemptions for Physicians**. Any physician licensed by a State to dispense drugs in the practice of medicine is exempt from 1.13.5 with respect to transport by the physician of licensed material for use in the practice of medicine. However, any physician operating under this exemption must be licensed under Subchapter 7 of these regulations or an equivalent Agreement State or Nuclear Regulatory Commission regulations.

4. **Exemption from Classification as Fissile Material.** Fissile material meeting at least one of the requirements provided in 1.13.4(4)(a) through (f) of this section

are exempt from classification as fissile material and from the fissile material package standards of 10 CFR 71.55 and 71.59, but are subject to all other requirements of this section, except as noted.

a. Individual package containing 2 grams or less fissile material.

b. Individual or bulk packaging containing 15 grams or less of fissile material provided the package has at least 200 grams of solid nonfissile material for every gram of fissile material. Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass for solid nonfissile material.

c. Low concentrations of solid fissile material commingled with solid nonfissile material, provided that:

   i. There is at least 2000 grams of solid nonfissile material for every gram of fissile material, and

   ii. There is no more than 180 grams of fissile material distributed within 360 kg of contiguous nonfissile material.

   iii. Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass of solid nonfissile material.

d. Uranium enriched in uranium-235 to a maximum of 1 percent by weight, and with total plutonium and uranium-233 content of up to 1 percent of the mass of uranium-235, provided that the mass of any beryllium, graphite, and hydrogenous material enriched in deuterium constitutes less than 5 percent of the uranium mass.

e. Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2 percent by mass, with a total plutonium and uranium-233 content not exceeding 0.002 percent of the mass of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2. The material must be contained in at least a DOT Type A package.

f. Packages containing, individually, a total plutonium mass of not more than 1000 grams, of which not more than 20 percent by mass may consist of plutonium-239, plutonium-241, or any combination of these radionuclides.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.5 **Transportation of Licensed Material.**

1. Each licensee who transports licensed material outside the site of usage, as specified in the Agency license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall:

   a. comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the U.S. Department of Transportation; particularly the regulations of the U.S. Department of Transportation in the following areas:

      i. Packaging – 49 CFR Part 173: Subparts A and B and I.

      ii. Marking and labeling - 49 CFR Part 172: Subpart D; and 172.400 through 172.407 and 172.436 through 172.441 of Subpart E.

      iii. Placarding - 49 CFR Part 172: Subpart F, especially (172.500 through 172.519, 172.556, and Appendices B and C).

      iv. Accident reporting - 49 CFR Part 171: (171.15 and 171.16).

      v. Shipping papers and emergency information - 49 CFR Part 172: Subpart C and Subpart G.

      vi. Hazardous material employee training - 49 CFR Part 172: Subpart H.

      vii. Security plans--49 CFR Part 172: Subpart I.

      viii. Hazardous material shipper/carrier registration - 49 CFR Part 107: Subpart G.

   b. The licensee shall also comply with applicable U.S. Department of Transportation regulations pertaining to the following modes of transportation:

      i. Rail – 49 CFR Part 174: Sections 100 through 400 and K.

      ii. Air - 49 CFR Part 175.

      iii. Vessel - 49 CFR Part 176: Subparts A through F and M.

      iv. Public Highway - 49 CFR Part 177 and Parts 390 through 397.

   c. Before delivery of a package to a carrier for transport, assure that any special instructions needed to safely open the package are sent to or have been made available to the consignee in accordance with 1.4.34(5).

2. If for any reason, the regulations of the U.S. Department of Transportation are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of 49 CFR Parts 107, 171 through 180, and 390

through 397 appropriate to the mode of transport to the same extent as if the shipment was subject to the regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.6 **General Licenses for Carriers.**

1. A general license is hereby issued to any common or contract carrier not exempt under 1.13.4 to receive, possess, transport, and store radioactive material in the regular course of their carriage for others or storage incident thereto, provided the transportation and storage is in accordance with the applicable requirements, appropriate to the mode of transport, of the U.S. Department of Transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.

2. A general license is hereby issued to any private carrier to transport radioactive material, provided the transportation is in accordance with the applicable requirements, appropriate to the mode of transport, of the U.S. Department of Transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.[52]

3. Persons who transport radioactive material pursuant to the general licenses in 1.13.6(1) or 1.13.6(2) are exempt from the requirements of Subchapters 4 and 10 of these regulations to the extent that they transport radioactive material.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.7 **General License: Nuclear Regulatory Commission-Approved Packages.**

1. A general license is hereby issued to any licensee of the Agency to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, Certificate of Compliance, or other approval has been issued by the Nuclear Regulatory Commission.

2. This general license applies only to a licensee who:

   a. Has a copy of the specific license, certificate of compliance, or other approval by the Nuclear Regulatory Commission of the package and has the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;

   b. Complies with the terms and conditions of the license, certificate, or other approval by the. Nuclear Regulatory Commission, as applicable, and the applicable requirements of 10 CFR, Part 71, Subparts A, G, and H;

[52] Notification of an incident shall be filed with, or made to, the Agency as prescribed in 49 CFR, regardless of and in addition to notification made to the U.S. Department of Transportation or other agencies.

c. Prior to the licensee's first use of the package, has registered with the Nuclear Regulatory Commission; and

d. Has a quality assurance program required by 1.13.20

3. The general license in 1.13.7(1) applies only when the package approval authorizes use of the package under this general license.

4. For a Type B or fissile material packages, the design of which was approved by the U.S. Nuclear Regulatory Commission before April 1, 1996, the general license is subject to the additional restrictions of 1.13.8.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.8 **General License: Previously Approved Packages.**

1. A Type B(U) package, a Type B(M) package, or a fissile material package, previously approved by the Nuclear Regulatory Commission but without the designation "-85" in the identification number of the Nuclear Regulatory Commission Certificate of Compliance, may be used under the general license of 1.13.7 with the following additional conditions:

   a. Fabrication of the package is satisfactorily completed by April 1, 1999, as demonstrated by application of its model number in accordance with Nuclear Regulatory Commission regulations in 10 CFR 71.85(c);

   b. A package used for a shipment to a location outside the United States is subject to multilateral approval except approved under special arrangement in accordance with U.S. Department of Transportation regulations in 49 CFR 173.403; and

   c. A serial number which uniquely identifies each packaging which conforms to the approved design is assigned to and legibly and durably marked on the outside of each packaging.

2. A Type B(U) package, a Type B(M) package, or a fissile material package previously approved by the Nuclear Regulatory Commission with the designation "-85" in the identification number of the Nuclear Regulatory Commission CoC, may be used under the general license of 1.13.7 with the following additional conditions:

   a. Fabrication of the package must be satisfactorily completed by December 31, 2006, as demonstrated by application of its model number in accordance with Nuclear Regulatory Commission regulations in 10 CFR 71.85(c) ; and

   b. After December 31, 2003, a package used for a shipment to a location outside the United States is subject to multilateral approval as defined in DOT regulations at 49 CFR 173.403

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.9 **Reserved**

Rule 1.13.10 **General License: Use of Foreign Approved Package.**

1. A general license is issued to any licensee to transport, or to deliver to a carrier for transport, licensed material in a package, the design of which has been approved in a foreign national competent authority certificate which has been revalidated by the U.S. Department of Transportation as meeting the applicable requirements of 49 CFR 171.12.

2. Except as otherwise provided in this section, the general license applies only to a licensee who has a quality assurance program approved by the Nuclear Regulatory Commission as satisfying the applicable provisions of 10 CFR Part 71.

3. This general license applies only to shipments to or from locations outside the United States.

4. This general license applies only to a licensee who:

    a. Has a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;

    b. Complies with the terms and conditions of the certificate and revalidation, and with the applicable requirements of this section. With respect to the quality assurance provisions of 10 CFR Part 71, the licensee is exempt from design, construction, and fabrication considerations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.11 **General License: Fissile Material.**

1. A general license is hereby issued to any licensee to transport fissile material, or to deliver fissile material to a carrier for transport, if the material is shipped in accordance with this section. The fissile material need not be contained in a package which meets the standards of this section; however, the material must be contained in a Type A package. The Type A package must also meet the DOT requirements of 49 CFR 173.417(a).

2. The general license applies only to a licensee who has a quality assurance program approved by the Nuclear Regulatory Commission as satisfying the provisions of 10 CFR Part 71.

3. The general license applies only when a package's contents:

a. Contain no more than a Type A quantity of radioactive material; and

b. Contain less than 500 total grams of beryllium, graphite, or hydrogenous material enriched in deuterium.

4. The general license applies only to packages containing fissile material that are labeled with a CSI which:

a. Has been determined in accordance with 1.13.11(5) of this section;

b. Has a value less than or equal to 10; and

c. For a shipment of multiple packages containing fissile material, the sum of the CSIs must be less than or equal to 50 (for shipment on a nonexclusive use conveyance) and less than or equal to 100 (for shipment on an exclusive use conveyance).

5. The value for the CSI must be greater than or equal to the number calculated by the following equation:

$$CSI = 10\left[\frac{grams\ of\ ^{235}U}{X} + \frac{grams\ of\ ^{233}U}{Y} + \frac{grams\ of\ Pu}{Z}\right]$$

a. The calculated CSI must be rounded up to the first decimal place;

b. The values of X, Y, and Z used in the CSI equation must be taken from Tables I or II, as appropriate;

c. If Table II is used to obtain the value of X, then the values for the terms in the equation for uranium-233 and plutonium must be assumed to be zero; and

d. Table I values for X, Y, and Z must be used to determine the CSI if:

i. Uranium-233 is present in the package;

ii. The mass of plutonium exceeds 1 percent of the mass of uranium-235;

iii. The uranium is of unknown uranium-235 enrichment or greater than 24 weight percent enrichment; or

iv. Substances having a moderating effectiveness (i.e., an average hydrogen density greater than H_2O) (e.g., certain hydrocarbon oils or plastics) are present in any form, except as polyethylene used for packing or wrapping.

Table I

Mass Limits for General License Packages Containing Mixed Quantities of Fissile Material or Uranium-235 of Unknown Enrichment

Fissile material	Fissile material mass mixed with moderating substances having an average hydrogen density less than or equal to H_2O (grams)	Fissile material mass mixed with moderating substances having an average hydrogen density greater than H_2O[a] (grams)
^{235}U (X)	60	38
^{233}U (Y)	43	27
^{239}Pu or ^{241}Pu (Z)	37	24

[a] When mixtures of moderating substances are present, the lower mass limits shall be used if more than 15 percent of the moderating substance has an average hydrogen density greater than H_2O.

Table II

Mass Limits for General License Packages Containing Uranium-235 of Known Enrichment

Uranium enrichment in weight percent of ^{235}U not exceeding	Fissile material mass of ^{235}U (X) (grams)
24	60
20	63
15	67
11	72
10	76
9.5	78
9	81
8.5	82
8	85
7.5	88
7	90
6.5	93
6	97
5.5	102
5	108
4.5	114
4	120
3.5	132

3	150
2.5	180
2	246
1.5	408
1.35	480
1	1,020
0.92	1,800

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.12 **General license: Plutonium-Beryllium Special Form Material**

1. A general license is issued to any licensee of the Commission to transport fissile material in the form of plutonium-beryllium (Pu-Be) special form sealed sources, or to deliver Pu-Be sealed sources to a carrier for transport, if the material is shipped in accordance with this section. This material need not be contained in a package which meets the standards of 10 CFR Part 71; however, the material must be contained in a Type A package. The Type A package must also meet the DOT requirements of 49 CFR 173.417(a).

2. The general license applies only to a licensee who has a quality assurance program approved by the U. S. Nuclear Regulatory Commission as satisfying the provisions of 10 CFR 71.

3. The general license applies only when a package's contents:

   a. Contain no more than a Type A quantity of radioactive material; and

   b. Contain less than 1000 g of plutonium, provided that: plutonium-239, plutonium-241,or any combination of these radionuclides, constitutes less than 240 g of the total quantity of plutonium in the package.

4. The general license applies only to packages labeled with a CSI which:

   a. Has been determined in accordance with 1.13.12(5) of this section;

   b. Has a value less than or equal to 100; and

   c. For a shipment of multiple packages containing Pu-Be sealed sources, the sum of the CSIs must be less than or equal to 50 (for shipment on a nonexclusive use conveyance) and less than or equal to 100 (for shipment on an exclusive use conveyance).

5. The value for the CSI must be greater than or equal to the number calculated by the following equation:

$$CSI = 10\left[\frac{grams\ of\ ^{239}Pu + grams\ of\ ^{241}Pu}{24}\right]$$

a. The calculated CSI must be rounded up to the first decimal place.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.13 **Assumptions as to Unknown Properties of Fissile Material.** When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties have credible values that will cause the maximum neutron multiplication.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.14 **Preliminary Determinations.** Prior to the first use of any packaging for the shipment of radioactive material:

1. The licensee shall ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects which could significantly reduce the effectiveness of the packaging;

2. Where the maximum normal operating pressure will exceed 35 kilopascal (5 lb/in^2) gauge, the licensee shall test the containment system at an internal pressure at least 50 percent higher than the maximum normal operating pressure to verify the capability of that system to maintain its structural integrity at that pressure;

3. The licensee shall determine that the packaging has been fabricated in accordance with the design approved by the Nuclear Regulatory Commission; and

4. The licensee shall conspicuously and durably mark the packaging with its model number, serial number, gross weight, and a package identification number as assigned by the Nuclear Regulatory Commission.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.15 **Routine Determinations.** Prior to each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this section and of the license. The licensee shall determine that:

1. The package is proper for the contents to be shipped;

2. The package is in unimpaired physical condition except for superficial defects such as marks or dents;

3. Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;

4. Any system for containing liquid is adequately sealed and has adequate space or other specified provision for expansion of the liquid;

5. Any pressure relief device is operable and set in accordance with written procedures;

6. The package has been loaded and closed in accordance with written procedures;

7. For fissile material, any moderator or neutron absorber, if required, is present and in proper condition;

8. Any structural part of the package which could be used to lift or tie down the package during transport is rendered inoperable for that purpose unless it satisfies design requirements specified in 10 CFR 71.45;

9. The level of non-fixed radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable.

   a. The level of non-fixed radioactive contamination may be determined by wiping an area of 300 square centimeters of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the removable contamination levels. Except as provided in 1.13.15(9)(b), the amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, must not exceed the limits given in TABLE III at any time during transport. Other methods of assessment of equal or greater efficiency may be used. When other methods are used, the detection efficiency of the method used must be taken into account and in no case may the removable contamination on the external surfaces of the package exceed 10 times the limits listed in TABLE III.

   b. In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed radioactive contamination at any time during transport must not exceed 10 times the levels prescribed in 1.13.15(9)(a). The levels at the beginning of transport must not exceed the levels in 1.13.15(9)(a);

TABLE III
NON-FIXED (REMOVABLE) EXTERNAL RADIOACTIVE CONTAMINATION - WIPE LIMITS

	Bq/cm^2	$\mu Ci/cm^2$	dpm/cm^2
Beta and gamma emitters and low toxicity alpha emitters	0.4	10^{-5}	22
All other alpha emitting radionuclides	0.04	10^{-6}	2.2

10. Except as provided in 1.13.15(11), each package of radioactive material offered for transportation must be designed and prepared for shipment so that under conditions normally incident to transportation the radiation levels will not exceed 2 millisievert per hour (200 mrem/hr) at any point on the external surface of the package at any time during transportation. The transport index shall not exceed 10.0;

11. A package that exceeds the radiation level limits specified in 1.13.15(10) must be transported by exclusive use shipment only, and the radiation levels for such shipment must not exceed the following during transportation:

    a. 2 millisievert per hour (200 mrem/hr) on the accessible external surface of the package unless the following conditions are met, in which case the limit is 10 millisievert per hour (1000 mrem/hr);

        i. The shipment is made in a closed transport vehicle;

        ii. Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and

        iii. There are no loading or unloading operations between the beginning and end of the transportation.

    b. 2 millisievert per hour (200 mrem/hr) at any point on the outer surface of the vehicle, including the top and underside of the vehicle, or, in the case of a flat-bed style vehicle, with a personnel barrier, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load (or enclosure, if used), and on the lower external surface of the vehicle;

    c. 0.1 millisievert per hour (10 mrem/hr) at any point 2 meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of a flat-bed style vehicle, at any point 2 meters from the vertical planes projected from the outer edges of the vehicle; and

    d. 0.02 millisievert per hour (2 mrem/hr) in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in accordance with Subchapter 10 of these regulations.

    e. For shipments made under the provisions of 1.13.15(11) of this section, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

    f. The written instructions required for exclusive use shipments must be sufficient so that, when followed, they will cause the carrier to avoid

actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.

12. A package must be prepared for transport so that in still air at 38° Celsius (100° F) and in the shade, no accessible surface of a package would have a temperature exceeding 50° Celsius (122° F) in a nonexclusive use shipment or 85° Celsius (185° F) in an exclusive use shipment. Accessible package surface temperatures shall not exceed these limits at any time during transportation.

13. A package may not incorporate a feature intended to allow continuous venting during transport.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.16 **Air Transport of Plutonium.** Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this section or included indirectly by citation of the U.S. Department of Transportation regulations, as may be applicable, the licensee shall assure that plutonium in any form, whether for import, export, or domestic shipment, is not transported by air, or delivered to a carrier for air transport, unless:

1. The plutonium is contained in a medical device designed for individual human application; or

2. The plutonium is contained in a material in which the specific activity is less than or equal to the activity concentration values for plutonium specified in Appendix A, Table A-2, of this section, and in which the radioactivity is essentially uniformly distributed; or

3. The plutonium is shipped in a single package containing no more than an A_2 quantity of plutonium in any isotope or form and is shipped in accordance with 1.13.5; or

4. The plutonium is shipped in a package specifically authorized, in the Certificate of Compliance, issued by the Nuclear Regulatory Commission for the shipment of plutonium by air and the licensee requires, through special arrangement with the carrier, compliance with 49 CFR 175.704, the U.S. Department of Transportation regulations applicable to the air transport of plutonium.

5. Nothing in 1.13.16 is to be interpreted as removing or diminishing the requirements of 10 CFR 73.24.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.17 **Shipment Records.** Each licensee shall maintain for a period of 3 years after shipment a record of each shipment of licensed material not exempt under 1.13.4, showing, where applicable:

1. Identification of the packaging by model number and serial number;

2. Verification that the packaging, as shipped, had no significant defect;

3. Volume and identification of coolant;

4. Type and quantity of licensed material in each package, and the total quantity of each shipment;

5. Date of the shipment;

6. Name and address of the transferee;

7. Address to which the shipment was made; and

8. Results of the determinations required by 1.13.15 and by the conditions of the package approval.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.18 **Reports.** The licensee shall report to the Agency within 60 days:

1. Any instance in which there is significant reduction in the effectiveness of any packaging during use;

2. Details of any defects with safety significance in the packaging after first use, with the means employed to repair the defects and prevent their recurrence; or

3. Instances in which the conditions of approval in the Certificate of Compliance were not observed in making a shipment.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.19 **Advance Notification of Transport of Irradiated Reactor Fuel and Nuclear Waste.**

1. Prior to the transport of licensed material outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of licensed material to a carrier for transport, each licensee shall provide advance notification of such transport to the governor, or governor's designee,[53] of each state within or through which the waste will be transported.

2. Advance notification is required under this section for shipments of irradiated reactor fuel in quantities less than that subject to advance notification requirements of 10 CFR 73.37(f). Advance notification is also required under this

[53] A list of the mailing addresses of the governors and governors' designees is available upon request from the Director, Office of State Programs, U.S. Nuclear Regulatory Commission Washington, DC 20555. The list will be published annually in the Federal Register on or about June 30 to reflect any changes in information.

section for shipment of licensed material, other than irradiated fuel, meeting the following three conditions:

a. The licensed material is required to be in Type B packaging for transportation;

b. The licensed material is being transported into, within, or through a state enroute to a disposal facility or to a collection point for transport to a disposal facility; and

c. The quantity of licensed material in a single package exceeds:

i. 3000 times the A_1 value of the radionuclides as specified in Appendix A, Table A-1 for special form radioactive material;

ii. 3000 times the A_2 value of the radionuclides as specified in Appendix A, Table A-1 for normal form radioactive material; or

iii. 1000 terabecquerel (27,000 Ci).

3. Each advance notification of shipment of irradiated reactor fuel or nuclear waste required by 1.13.19(1) shall contain the following information:

a. The name, address, and telephone number of the shipper, carrier, and receiver of the shipment;

b. A description of the of irradiated reactor fuel or nuclear waste contained in the shipment as required by 49 CFR 172.202 and 172.203(d);

c. The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;

d. The 7-day period during which arrival of the shipment at state boundaries is estimated to occur;

e. The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and

f. A point of contact with a telephone number for current shipment information.

4. The notification required by 1.13.19(1) shall be made in writing to the office of each appropriate governor, or governor's designee, and to the Agency. A notification delivered by mail must be postmarked at least 7 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur. A notification delivered by any other means must reach the office of the governor, or governor's designee, at least 4 days before the beginning of the 7-day period during which departure of the shipment is

estimated to occur. A copy of the notification shall be retained by the licensee for 3 years.

5. The licensee shall notify each appropriate governor, or governor's designee, and the Agency of any changes to schedule information provided pursuant to 1.13.19(1). Such notification shall be by telephone to a responsible individual in the office of the governor, or governor's designee, of the appropriate state or states. The licensee shall maintain for 3 years a record of the name of the individual contacted.

6. Each licensee who cancels an irradiated reactor fuel or nuclear waste shipment, for which advance notification has been sent, shall send a cancellation notice, identifying the advance notification that is being canceled, to the governor, or governor's designee, of each appropriate state and to the Agency. A copy of the notice shall be retained by the licensee for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.20 **Quality Assurance Requirements.** This section describes quality assurance requirements applying to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. As used in this section, ‘‘quality assurance’’ comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements. The licensee, certificate holder, and applicant for a CoC are responsible for the quality assurance requirements as they apply to design, fabrication, testing, and modification of packaging. Each licensee is responsible for the quality assurance provision which applies to its use of a packaging for the shipment of licensed material subject to this section.

1. **Establishment of Program.** Each licensee, certificate holder, and applicant for a CoC shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of 10 CFR 71.101 through 71.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging. The licensee, certificate holder, and applicant for a CoC shall execute the applicable criteria in a graded approach to an extent that is commensurate with the quality assurance requirement's importance to safety.

2. **Approval of Program.** Before the use of any package for the shipment of licensed material subject to this section, each licensee shall obtain Agency approval of its quality assurance program and file a description of its quality assurance program, including a discussion of which requirements of this section are applicable and how they will be satisfied.

3. **Radiography Containers.** A program for transport container inspection and maintenance limited to radiographic exposure devices, source changers, or packages transporting these devices and meeting the requirements of 1.5.12(4) and (5) of these regulations or equivalent Nuclear Regulatory Commission, or Agreement State requirements, is deemed to satisfy the requirements of 1.13.7 and 1.13.20(1).

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.21 **Quality Assurance Organization**

1. The licensee,[54] certificate holder, and applicant for a CoC shall be responsible for the establishment and execution of the quality assurance program. The licensee, certificate holder, and applicant for a CoC may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part of the quality assurance program, but shall retain responsibility for the program. These activities include performing the functions associated with attaining quality objectives and the quality assurance functions.

2. The quality assurance functions are:

   a. Assuring that an appropriate quality assurance program is established and effectively executed; and

   b. Verifying, by procedures such as checking, auditing, and inspection, that activities affecting the functions that are important to safety have been correctly performed.

   c. The persons and organizations performing quality assurance functions must have sufficient authority and organizational freedom to:

      i. Identify quality problems;

      ii. Initiate, recommend, or provide solutions; and

      iii. Verify implementation of solutions.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.22 **Quality Assurance Program.**

1. The licensee, certificate holder, and applicant for a CoC shall establish, at the earliest practicable time consistent with the schedule for accomplishing the activities, a quality assurance program that complies with the requirements of 10 CFR 71.101 through 71.137. The licensee, certificate holder, and applicant for a

[54] While the term "licensee" is used in these criteria, the requirements are applicable to whatever design, fabrication, assembly, and testing of the package is accomplished with respect to a package before the time a package approval is issued.

CoC shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which the packaging is used. The licensee, certificate holder, and applicant for a CoC shall identify the material and components to be covered by the quality assurance program, the major organizations participating in the program, and the designated functions of these organizations.

2. The licensee, certificate holder, and applicant for a CoC, through its quality assurance program, shall provide control over activities affecting the quality of the identified materials and components to an extent consistent with their importance to safety, and as necessary to assure conformance to the approved design of each individual package used for the shipment of radioactive material. The licensee, certificate holder, and applicant for a CoC shall assure that activities affecting quality are accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment; suitable environmental conditions for accomplishing the activity, such as adequate cleanliness; and assurance that all prerequisites for the given activity have been satisfied. The licensee, certificate holder, and applicant for a CoC shall take into account the need for special controls, processes, test equipment, tools, and skills to attain the required quality, and the need for verification of quality by inspection and test.

3. The licensee, certificate holder, and applicant for a CoC shall base the requirements and procedures of its quality assurance program on the following considerations concerning the complexity and proposed use of the package and its components:

   a. The impact of malfunction or failure of the item to safety;

   b. The design and fabrication complexity or uniqueness of the item;

   c. The need for special controls and surveillance over processes and equipment;

   d. The degree to which functional compliance can be demonstrated by inspection or test; and

   e. The quality history and degree of standardization of the item.

4. The licensee, certificate holder, and applicant for a CoC shall provide for indoctrination and training of personnel performing activities affecting quality, as necessary to assure that suitable proficiency is achieved and maintained. The licensee, certificate holder, and applicant for a CoC shall review the status and adequacy of the quality assurance program at established intervals. Management of other organizations participating in the quality assurance program shall review regularly the status and adequacy of that part of the quality assurance program they are executing.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.23 **Handling, Storage, and Shipping Control.** The licensee, certificate holder, and applicant for a CoC shall establish measures to control, in accordance with instructions, the handling, storage, shipping, cleaning, and preservation of materials and equipment to be used in packaging to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, and specific moisture content and temperature levels must be specified and provided.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.24 **Inspection, Test, and Operating Status.**

1. The licensee, certificate holder, and applicant for a CoC shall establish measures to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests performed upon individual items of the packaging. These measures must provide for the identification of items that have satisfactorily passed required inspections and tests, where necessary to preclude inadvertent bypassing of the inspections and tests.

2. The licensee shall establish measures to identify the operating status of components of the packaging, such as tagging valves and switches, to prevent inadvertent operation.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.25 **Nonconforming Materials, Parts, or Components.** The licensee, certificate holder, and applicant for a CoC shall establish measures to control materials, parts, or components that do not conform to the licensee's requirements to prevent their inadvertent use or installation. These measures must include, as appropriate, procedures for identification, documentation, segregation, disposition, and notification to affected organizations. Nonconforming items must be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.26 **Corrective Action.** The licensee, certificate holder, and applicant for a CoC shall establish measures to assure that conditions adverse to quality, such as deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of a significant condition adverse to quality, the measures must assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken must be documented and reported to appropriate levels of management.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.27 **Quality Assurance Records.** The licensee, certificate holder, and applicant for a CoC shall maintain sufficient written records to describe the activities affecting quality. The records must include the instructions, procedures, and drawings required by 10 CFR 71.111 to prescribe quality assurance activities and must include closely related specifications such as required qualifications of personnel, procedures, and equipment. The records must include the instructions or procedures which establish a records retention program that is consistent with applicable regulations and designates factors such as duration, location, and assigned responsibility. The licensee, certificate holder, and applicant for a CoC shall retain these records for 3 years beyond the date when the licensee, certificate holder, and applicant for a CoC last engage in the activity for which the quality assurance program was developed. If any portion of the written procedures or instructions is superseded, the licensee, certificate holder, and applicant for a CoC shall retain the superseded material for 3 years after it is superseded.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.13.28 **Audits.** The licensee, certificate holder, and applicant for a CoC shall carry out a comprehensive system of planned and periodic audits to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. The audits must be performed in accordance with written procedures or checklists by appropriately trained personnel not having direct responsibilities in the areas being audited. Audited results must be documented and reviewed by management having responsibility in the area audited. Followup action, including reaudit of deficient areas, must be taken where indicated.

SOURCE: Miss. Code Ann. §45-14-11

APPENDIX A

Determination Of A_1 And A_2

1. Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations, are given in TABLE A-1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) figure. The curie values are expressed to three significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less. Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

2. For individual radionuclides whose identities are known, but which are not listed in Table A-1, the values of A_1 and A_2 in Table A-3 may be used. Otherwise, the licensee shall obtain prior Agency approval of the A_1 and A_2 values for radionuclides not listed in Table A-1, before shipping the material.

3. For individual radionuclides whose identities are known, but which are not listed in Table A-2, the exempt material activity concentration and exempt consignment activity values contained in Table A-3 may be used. Otherwise, the licensee shall obtain prior Agency approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in Table A-2, before shipping the material.

4. The licensee shall submit requests for prior approval, described in the paragraphs above to the Agency, in accordance with 1.1.14 of these regulations.

5. In the calculations of A_1 and A_2 for a radionuclide not in TABLE A-1, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days, or longer than that of the parent nuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days, or greater than that of the parent nuclide, the parent and those daughter nuclides shall be considered as mixtures of different nuclides.

6. For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

7. For special form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_i \frac{B(i)}{A_1(i)} \leq 1$$

8. For normal form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_i \frac{B(i)}{A_2(i)} \leq 1$$

where B(i) is the activity of radionuclide i and $A_1(i)$ and $A_2(i)$ are the A_1 and A_2 values for radionuclide i, respectively.

9. Alternatively, an A_1 value for mixtures of special form material may be determined as follows:

$$A_1 = \frac{1}{\sum_i \frac{f(i)}{A_1(i)}}$$

where f(i) is the fraction of activity of nuclide i in the mixture and $A_1(i)$ is the appropriate A_1 value for nuclide i.

10. An A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 = \frac{1}{\sum_i \frac{f(i)}{A_2(i)}}$$

where f(i) is the fraction of activity of nuclide i in the mixture and $A_2(i)$ is the appropriate A_2 value for nuclide i.

11. The exempt activity concentration for mixtures of nuclides may be determined as follows:

$$\text{Exempt activity concentration for mixture} = \frac{1}{\sum_I \frac{f(i)}{[A](i)}}$$

where f(i) is the fraction of activity concentration of radionuclide I in the mixture, and [A] is the activity concentration for exempt material containing radionuclide I.

12. The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

$$\text{Exempt consignment activity limit for mixture} = \frac{1}{\sum_{I} \frac{f(i)}{A(i)}}$$

where f(i) is the fraction of activity of radionuclide I in the mixture, and A is the activity limit for exempt consignments for radionuclide I.

13. When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph IV. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Ac-225 (a)	Actinium (89)	$8.0X10^{-1}$	$2.2X10^{1}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.1X10^{3}$	$5.8X10^{4}$
Ac-227 (a)		$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-5}$	$2.4X10^{-3}$	2.7	$7.2X10^{1}$
Ac-228		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$8.4X10^{4}$	$2.2X10^{6}$
Ag-105	Silver (47)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.1X10^{3}$	$3.0X10^{4}$
Ag-108m (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.7X10^{-1}$	$2.6X10^{1}$
Ag-110m (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.8X10^{2}$	$4.7X10^{3}$
Ag-111		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Al-26	Aluminum (13)	$1.0X10^{-1}$	2.7	$1.0X10^{-1}$	2.7	$7.0X10^{-4}$	$1.9X10^{-2}$
Am-241	Americium (95)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.3X10^{-1}$	3.4
Am-242m (a)		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.6X10^{-1}$	$1.0X10^{1}$
Am-243 (a)		5.0	$1.4X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.4X10^{-3}$	$2.0X10^{-1}$
Ar-37	Argon (18)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.7X10^{3}$	$9.9X10^{4}$
Ar-39		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	1.3	$3.4X10^{1}$
Ar-41		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.5X10^{6}$	$4.2X10^{7}$
As-72	Arsenic (33)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$6.2X10^{4}$	$1.7X10^{6}$
As-73		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$8.2X10^{2}$	$2.2X10^{4}$
As-74		1.0	$2.7X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$3.7X10^{3}$	$9.9X10^{4}$
As-76		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$5.8X10^{4}$	$1.6X10^{6}$
As-77		$2.0X10^{1}$	$5.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.9X10^{4}$	$1.0X10^{6}$
At-211 (a)	Astatine (85)	$2.0X10^{1}$	$5.4X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.6X10^{4}$	$2.1X10^{6}$
Au-193	Gold (79)	7.0	$1.9X10^{2}$	2.0	$5.4X10^{1}$	$3.4X10^{4}$	$9.2X10^{5}$
Au-194		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.5X10^{4}$	$4.1X10^{5}$
Au-195		$1.0X10^{1}$	$2.7X10^{2}$	6.0	$1.6X10^{2}$	$1.4X10^{2}$	$3.7X10^{3}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Au-198		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.0X10^{3}$	$2.4X10^{5}$
Au-199		$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$7.7X10^{3}$	$2.1X10^{5}$
Ba-131 (a)	Barium (56)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.1X10^{3}$	$8.4X10^{4}$
Ba-133		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	9.4	$2.6X10^{2}$
Ba-133m		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.2X10^{4}$	$6.1X10^{5}$
Ba-140 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{-1}$	8.1	$2.7X10^{3}$	$7.3X10^{4}$
Be-7	Beryllium (4)	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$1.3X10^{4}$	$3.5X10^{5}$
Be-10		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-1}$	$1.6X10^{1}$	$8.3X10^{-4}$	$2.2X10^{-2}$
Bi-205	Bismuth (83)	$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.5X10^{3}$	$4.2X10^{4}$
Bi-206		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$3.8X10^{3}$	$1.0X10^{5}$
Bi-207		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	1.9	$5.2X10^{1}$
Bi-210		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.6X10^{3}$	$1.2X10^{5}$
Bi-210m (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.1X10^{-5}$	$5.7X10^{-4}$
Bi-212 (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.4X10^{5}$	$1.5X10^{7}$
Bk-247	Berkelium (97)	8.0	$2.2X10^{2}$	$8.0X10^{-4}$	$2.2X10^{-2}$	$3.8X10^{-2}$	1.0
Bk-249 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{-1}$	8.1	$6.1X10^{1}$	$1.6X10^{3}$
Br-76	Bromine (35)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$9.4X10^{4}$	$2.5X10^{6}$
Br-77		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$2.6X10^{4}$	$7.1X10^{5}$
Br-82		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{4}$	$1.1X10^{6}$
C-11	Carbon (6)	1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.1X10^{7}$	$8.4X10^{8}$
C-14		$4.0X10^{1}$	$1.1X10^{3}$	3.0	$8.1X10^{1}$	$1.6X10^{-1}$	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	$3.1X10^{-3}$	$8.5X10^{-2}$
Ca-45		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Ca-47 (a)		3.0	$8.1X10^{1}$	$3.0X10^{-1}$	8.1	$2.3X10^{4}$	$6.1X10^{5}$
Cd-109	Cadmium (48)	$3.0X10^{1}$	$8.1X10^{2}$	2.0	$5.4X10^{1}$	$9.6X10^{1}$	$2.6X10^{3}$
Cd-113m		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	8.3	$2.2X10^{2}$
Cd-115 (a)		3.0	$8.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.9X10^{4}$	$5.1X10^{5}$
Cd-115m		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$9.4X10^{2}$	$2.5X10^{4}$
Ce-139	Cerium (58)	7.0	$1.9X10^{2}$	2.0	$5.4X10^{1}$	$2.5X10^{2}$	$6.8X10^{3}$
Ce-141		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.1X10^{3}$	$2.8X10^{4}$
Ce-143		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{4}$	$6.6X10^{5}$
Ce-144 (a)		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.2X10^{2}$	$3.2X10^{3}$
Cf-248	Californium (98)	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$5.8X10^{1}$	$1.6X10^{3}$
Cf-249		3.0	$8.1X10^{1}$	$8.0X10^{-4}$	$2.2X10^{-2}$	$1.5X10^{-1}$	4.1
Cf-250		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	4.0	$1.1X10^{2}$
Cf-251		7.0	$1.9X10^{2}$	$7.0X10^{-4}$	$1.9X10^{-2}$	$5.9X10^{-2}$	1.6

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Cf-252 (h)		$5.0X10^{-2}$	1.4	$3.0X10^{-3}$	$8.1X10^{-2}$	$2.0X10^{1}$	$5.4X10^{2}$
Cf-253 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{-2}$	1.1	$1.1X10^{3}$	$2.9X10^{4}$
Cf-254		$1.0X10^{-3}$	$2.7X10^{-2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.1X10^{2}$	$8.5X10^{3}$
Cl-36	Chlorine (17)	$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{-3}$	$3.3X10^{-2}$
Cl-38		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$4.9X10^{6}$	$1.3X10^{8}$
Cm-240	Curium (96)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$7.5X10^{2}$	$2.0X10^{4}$
Cm-241		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$6.1X10^{2}$	$1.7X10^{4}$
Cm-242		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$1.2X10^{2}$	$3.3X10^{3}$
Cm-243		9.0	$2.4X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.9X10^{-3}$	$5.2X10^{1}$
Cm-244		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	3.0	$8.1X10^{1}$
Cm-245		9.0	$2.4X10^{2}$	$9.0X10^{-4}$	$2.4X10^{-2}$	$6.4X10^{-3}$	$1.7X10^{-1}$
Cm-246		9.0	$2.4X10^{2}$	$9.0X10^{-4}$	$2.4X10^{-2}$	$1.1X10^{-2}$	$3.1X10^{-1}$
Cm-247 (a)		3.0	$8.1X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.4X10^{-6}$	$9.3X10^{-5}$
Cm-248		$2.0X10^{-2}$	$5.4X10^{-1}$	$3.0X10^{-4}$	$8.1X10^{-3}$	$1.6X10^{-4}$	$4.2X10^{-3}$
Co-55	Cobalt (27)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.1X10^{5}$	$3.1X10^{6}$
Co-56		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.1X10^{3}$	$3.0X10^{4}$
Co-57		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$3.1X10^{2}$	$8.4X10^{3}$
Co-58		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.2X10^{3}$	$3.2X10^{4}$
Co-58m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$2.2X10^{5}$	$5.9X10^{6}$
Co-60		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.2X10^{1}$	$1.1X10^{3}$
Cr-51	Chromium (24)	$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$3.4X10^{3}$	$9.2X10^{4}$
Cs-129	Cesium (55)	4.0	$1.1X10^{2}$	4.0	$1.1X10^{2}$	$2.8X10^{4}$	$7.6X10^{5}$
Cs-131		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$3.8X10^{3}$	$1.0X10^{5}$
Cs-132		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$5.7X10^{3}$	$1.5X10^{5}$
Cs-134		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.8X10^{1}$	$1.3X10^{3}$
Cs-134m		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{5}$	$8.0X10^{6}$
Cs-135		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$4.3X10^{-5}$	$1.2X10^{-3}$
Cs-136		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.7X10^{3}$	$7.3X10^{4}$
Cs-137 (a)		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	3.2	$8.7X10^{1}$
Cu-64	Copper (29)	6.0	$1.6X10^{2}$	1.0	$2.7X10^{1}$	$1.4X10^{5}$	$3.9X10^{6}$
Cu-67		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.8X10^{4}$	$7.6X10^{5}$
Dy-159	Dysprosium (66)	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$2.1X10^{2}$	$5.7X10^{3}$
Dy-165		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{5}$	$8.2X10^{6}$
Dy-166 (a)		$9.0X10^{-1}$	$2.4X10^{1}$	$3.0X10^{-1}$	8.1	$8.6X10^{3}$	$2.3X10^{5}$
Er-169	Erbium (68)	$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$3.1X10^{3}$	$8.3X10^{4}$
Er-171		$8.0X10^{-1}$	$2.2X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$9.0X10^{4}$	$2.4X10^{6}$

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Eu-147	Europium (63)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.4X10^{3}$	$3.7X10^{4}$
Eu-148		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.0X10^{2}$	$1.6X10^{4}$
Eu-149		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$3.5X10^{2}$	$9.4X10^{3}$
Eu-150 (short lived)		2.0	$5.4X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.1X10^{4}$	$1.6X10^{6}$
Eu-150 (long lived)		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.1X10^{4}$	$1.6X10^{6}$
Eu-152		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	6.5	$1.8X10^{2}$
Eu-152m		$8.0X10^{-1}$	$2.2X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$8.2X10^{4}$	$2.2X10^{6}$
Eu-154		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	9.8	$2.6X10^{2}$
Eu-155		$2.0X10^{1}$	$5.4X10^{2}$	3.0	$8.1X10^{1}$	$1.8X10^{1}$	$4.9X10^{2}$
Eu-156		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.0X10^{3}$	$5.5X10^{4}$
F-18	Fluorine (9)	1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.5X10^{6}$	$9.5X10^{7}$
Fe-52 (a)	Iron (26)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.7X10^{5}$	$7.3X10^{6}$
Fe-55		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$8.8X10^{1}$	$2.4X10^{3}$
Fe-59		$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$1.8X10^{3}$	$5.0X10^{4}$
Fe-60 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-1}$	5.4	$7.4X10^{-4}$	$2.0X10^{-2}$
Ga-67	Gallium (31)	7.0	$1.9X10^{2}$	3.0	$8.1X10^{1}$	$2.2X10^{4}$	$6.0X10^{5}$
Ga-68		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.5X10^{6}$	$4.1X10^{7}$
Ga-72		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.1X10^{5}$	$3.1X10^{6}$
Gd-146 (a)	Gadolinium (64)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.9X10^{2}$	$1.9X10^{4}$
Gd-148		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	1.2	$3.2X10^{1}$
Gd-153		$1.0X10^{1}$	$2.7X10^{2}$	9.0	$2.4X10^{2}$	$1.3X10^{2}$	$3.5X10^{3}$
Gd-159		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.9X10^{4}$	$1.1X10^{6}$
Ge-68 (a)	Germanium (32)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.6X10^{2}$	$7.1X10^{3}$
Ge-71		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.8X10^{3}$	$1.6X10^{5}$
Ge-77		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.3X10^{5}$	$3.6X10^{6}$
Hf-172 (a)	Hafnium (72)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.1X10^{1}$	$1.1X10^{3}$
Hf-175		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$3.9X10^{2}$	$1.1X10^{4}$
Hf-181		2.0	$5.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.3X10^{2}$	$1.7X10^{4}$
Hf-182		Unlimited	Unlimited	Unlimited	Unlimited	$8.1X10^{-6}$	$2.2X10^{-4}$
Hg-194 (a)	Mercury (80)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.3X10^{-1}$	3.5
Hg-195m (a)		3.0	$8.1X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Hg-197		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.2X10^{3}$	$2.5X10^{5}$
Hg-197m		$1.0X10^{1}$	$2.7X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.5X10^{4}$	$6.7X10^{5}$

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Hg-203		5.0	$1.4X10^{2}$	1.0	$2.7X10^{1}$	$5.1X10^{2}$	$1.4X10^{4}$
Ho-166	Holmium (67)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.6X10^{4}$	$7.0X10^{5}$
Ho-166m		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.6X10^{-2}$	1.8
I-123	Iodine (53)	6.0	$1.6X10^{2}$	3.0	$8.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$
I-124		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$9.3X10^{3}$	$2.5X10^{5}$
I-125		$2.0X10^{1}$	$5.4X10^{2}$	3.0	$8.1X10^{1}$	$6.4X10^{2}$	$1.7X10^{4}$
I-126		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$2.9X10^{3}$	$8.0X10^{4}$
I-129		Unlimited	Unlimited	Unlimited	Unlimited	$6.5X10^{-6}$	$1.8X10^{-4}$
I-131		3.0	$8.1X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.6X10^{3}$	$1.2X10^{5}$
I-132		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.8X10^{5}$	$1.0X10^{7}$
I-133		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{4}$	$1.1X10^{6}$
I-134		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$9.9X10^{5}$	$2.7X10^{7}$
I-135 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.3X10^{5}$	$3.5X10^{6}$
In-111	Indium (49)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$1.5X10^{4}$	$4.2X10^{5}$
In-113m		4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$6.2X10^{5}$	$1.7X10^{7}$
In-114m (a)		$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$8.6X10^{2}$	$2.3X10^{4}$
In-115m		7.0	$1.9X10^{2}$	1.0	$2.7X10^{1}$	$2.2X10^{5}$	$6.1X10^{6}$
Ir-189 (a)	Iridium (77)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$1.9X10^{3}$	$5.2X10^{4}$
Ir-190		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$2.3X10^{3}$	$6.2X10^{4}$
Ir-192 (c)		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.4X10^{2}$	$9.2X10^{3}$
Ir-194		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$3.1X10^{4}$	$8.4X10^{5}$
K-40	Potassium (19)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.4X10^{-7}$	$6.4X10^{-6}$
K-42		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$2.2X10^{5}$	$6.0X10^{6}$
K-43		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
Kr-81	Krypton (36)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$7.8X10^{-4}$	$2.1X10^{-2}$
Kr-85		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$1.5X10^{1}$	$3.9X10^{2}$
Kr-85m		8.0	$2.2X10^{2}$	3.0	$8.1X10^{1}$	$3.0X10^{5}$	$8.2X10^{6}$
Kr-87		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.0X10^{6}$	$2.8X10^{7}$
La-137	Lanthanum (57)	$3.0X10^{1}$	$8.1X10^{2}$	6.0	$1.6X10^{2}$	$1.6X10^{-3}$	$4.4X10^{-2}$
La-140		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$2.1X10^{4}$	$5.6X10^{5}$
Lu-172	Lutetium (71)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{3}$	$1.1X10^{5}$
Lu-173		8.0	$2.2X10^{2}$	8.0	$2.2X10^{2}$	$5.6X10^{1}$	$1.5X10^{3}$
Lu-174		9.0	$2.4X10^{2}$	9.0	$2.4X10^{2}$	$2.3X10^{1}$	$6.2X10^{2}$
Lu-174m		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$2.0X10^{2}$	$5.3X10^{3}$
Lu-177		$3.0X10^{1}$	$8.1X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.1X10^{3}$	$1.1X10^{5}$
Mg-28 (a)	Magnesium (12)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.0X10^{5}$	$5.4X10^{6}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Mn-52	Manganese (25)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.6X10^{4}$	$4.4X10^{5}$
Mn-53		Unlimited	Unlimited	Unlimited	Unlimited	$6.8X10^{-5}$	$1.8X10^{-3}$
Mn-54		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$2.9X10^{2}$	$7.7X10^{3}$
Mn-56		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$8.0X10^{5}$	$2.2X10^{7}$
Mo-93	Molybdenum (42)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	$4.1X10^{-2}$	1.1
Mo-99 (a) (i)		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{4}$	$4.8X10^{5}$
N-13	Nitrogen (7)	$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.4X10^{7}$	$1.5X10^{9}$
Na-22	Sodium (11)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.3X10^{2}$	$6.3X10^{3}$
Na-24		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$3.2X10^{5}$	$8.7X10^{6}$
Nb-93m	Niobium (41)	$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	8.8	$2.4X10^{2}$
Nb-94		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$6.9X10^{-3}$	$1.9X10^{-1}$
Nb-95		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.5X10^{3}$	$3.9X10^{4}$
Nb-97		$9.0X10^{-1}$	$2.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.9X10^{5}$	$2.7X10^{7}$
Nd-147	Neodymium (60)	6.0	$1.6X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{3}$	$8.1X10^{4}$
Nd-149		$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$4.5X10^{5}$	$1.2X10^{7}$
Ni-59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	$3.0X10^{-3}$	$8.0X10^{-2}$
Ni-63		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	2.1	$5.7X10^{1}$
Ni-65		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{5}$	$1.9X10^{7}$
Np-235	Neptunium (93)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.2X10^{1}$	$1.4X10^{3}$
Np-236 (short-lived)		$2.0X10^{1}$	$5.4X10^{2}$	2.0	$5.4X10^{1}$	$4.7X10^{-4}$	$1.3X10^{-2}$
Np-236 (long-lived)		$9.0X10^{0}$	$2.4X10^{2}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$4.7X10^{-4}$	$1.3X10^{-2}$
Np-237		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{-3}$	$5.4X10^{-2}$	$2.6X10^{-5}$	$7.1X10^{-4}$
Np-239		7.0	$1.9X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$8.6X10^{3}$	$2.3X10^{5}$
Os-185	Osmium (76)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$2.8X10^{2}$	$7.5X10^{3}$
Os-191		$1.0X10^{1}$	$2.7X10^{2}$	2.0	$5.4X10^{1}$	$1.6X10^{3}$	$4.4X10^{4}$
Os-191m		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	$4.6X10^{4}$	$1.3X10^{6}$
Os-193		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{4}$	$5.3X10^{5}$
Os-194 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.1X10^{1}$	$3.1X10^{2}$
P-32	Phosphorus (15)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.1X10^{4}$	$2.9X10^{5}$
P-33		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Pa-230 (a)	Protactinium (91)	2.0	$5.4X10^{1}$	$7.0X10^{-2}$	1.9	$1.2X10^{3}$	$3.3X10^{4}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Pa-231		4.0	$1.1X10^{2}$	$4.0X10^{-4}$	$1.1X10^{-2}$	$1.7X10^{-3}$	$4.7X10^{-2}$
Pa-233		5.0	$1.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$7.7X10^{2}$	$2.1X10^{4}$
Pb-201	Lead (82)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$6.2X10^{4}$	$1.7X10^{6}$
Pb-202		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	$1.2X10^{-4}$	$3.4X10^{-3}$
Pb-203		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$1.1X10^{4}$	$3.0X10^{5}$
Pb-205		Unlimited	Unlimited	Unlimited	Unlimited	$4.5X10^{-6}$	$1.2X10^{-4}$
Pb-210 (a)		1.0	$2.7X10^{1}$	$5.0X10^{-2}$	1.4	2.8	$7.6X10^{1}$
Pb-212 (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$2.0X10^{-1}$	5.4	$5.1X10^{4}$	$1.4X10^{6}$
Pd-103 (a)	Palladium (46)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$2.8X10^{3}$	$7.5X10^{4}$
Pd-107		Unlimited	Unlimited	Unlimited	Unlimited	$1.9X10^{-5}$	$5.1X10^{-4}$
Pd-109		2.0	$5.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.9X10^{4}$	$2.1X10^{6}$
Pm-143	Promethium (61)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$1.3X10^{2}$	$3.4X10^{3}$
Pm-144		$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.2X10^{1}$	$2.5X10^{3}$
Pm-145		$3.0X10^{1}$	$8.1X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	5.2	$1.4X10^{2}$
Pm-147		$4.0X10^{1}$	$1.1X10^{3}$	2.0	$5.4X10^{1}$	$3.4X10^{1}$	$9.3X10^{2}$
Pm-148m (a)		$8.0X10^{-1}$	$2.2X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Pm-149		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Pm-151		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.7X10^{4}$	$7.3X10^{5}$
Po-210	Polonium (84)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.7X10^{2}$	$4.5X10^{3}$
Pr-142	Praseodymium (59)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.3X10^{4}$	$1.2X10^{6}$
Pr-143		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{3}$	$6.7X10^{4}$
Pt-188 (a)	Platinum (78)	1.0	$2.7X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$2.5X10^{3}$	$6.8X10^{4}$
Pt-191		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$8.7X10^{3}$	$2.4X10^{5}$
Pt-193		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	1.4	$3.7X10^{1}$
Pt-193m		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Pt-195m		$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.2X10^{3}$	$1.7X10^{5}$
Pt-197		$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.2X10^{4}$	$8.7X10^{5}$
Pt-197m		$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.7X10^{5}$	$1.0X10^{7}$
Pu-236	Plutonium (94)	$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$2.0X10^{1}$	$5.3X10^{2}$
Pu-237		$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$4.5X10^{2}$	$1.2X10^{4}$
Pu-238		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.3X10^{-1}$	$1.7X10^{1}$
Pu-239		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$2.3X10^{-3}$	$6.2X10^{-2}$
Pu-240		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.4X10^{-3}$	$2.3X10^{-1}$
Pu-241 (a)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-2}$	1.6	3.8	$1.0X10^{2}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Pu-242		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.5X10^{-4}$	$3.9X10^{-3}$
Pu-244 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.7X10^{-7}$	$1.8X10^{-5}$
Ra-223 (a)	Radium (88)	$4.0X10^{-1}$	$1.1X10^{1}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$1.9X10^{3}$	$5.1X10^{4}$
Ra-224 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$5.9X10^{3}$	$1.6X10^{5}$
Ra-225 (a)		$2.0X10^{-1}$	5.4	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.5X10^{3}$	$3.9X10^{4}$
Ra-226 (a)		$2.0X10^{-1}$	5.4	$3.0X10^{-3}$	$8.1X10^{-2}$	$3.7X10^{-2}$	1.0
Ra-228 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.0X10^{1}$	$2.7X10^{2}$
Rb-81	Rubidium (37)	2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{5}$	$8.4X10^{6}$
Rb-83 (a)		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$6.8X10^{2}$	$1.8X10^{4}$
Rb-84		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.8X10^{3}$	$4.7X10^{4}$
Rb-86		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{3}$	$8.1X10^{4}$
Rb-87		Unlimited	Unlimited	Unlimited	Unlimited	$3.2X10^{-9}$	$8.6X10^{-8}$
Rb(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$6.7X10^{6}$	$1.8X10^{8}$
Re-184	Rhenium (75)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$6.9X10^{2}$	$1.9X10^{4}$
Re-184m		3.0	$8.1X10^{1}$	1.0	$2.7X10^{1}$	$1.6X10^{2}$	$4.3X10^{3}$
Re-186		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$6.9X10^{3}$	$1.9X10^{5}$
Re-187		Unlimited	Unlimited	Unlimited	Unlimited	$1.4X10^{-9}$	$3.8X10^{-8}$
Re-188		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.6X10^{4}$	$9.8X10^{5}$
Re-189 (a)		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{4}$	$6.8X10^{5}$
Re(nat)		Unlimited	Unlimited	Unlimited	Unlimited	0.0	$2.4X10^{-8}$
Rh-99	Rhodium (45)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{3}$	$8.2X10^{4}$
Rh-101		4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$4.1X10^{1}$	$1.1X10^{3}$
Rh-102		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$4.5X10^{1}$	$1.2X10^{3}$
Rh-102m		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.3X10^{2}$	$6.2X10^{3}$
Rh-103m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$1.2X10^{6}$	$3.3X10^{7}$
Rh-105		$1.0X10^{1}$	$2.7X10^{2}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{4}$	$8.4X10^{5}$
Rn-222 (a)	Radon (86)	$3.0X10^{-1}$	8.1	$4.0X10^{-3}$	$1.1X10^{-1}$	$5.7X10^{3}$	$1.5X10^{5}$
Ru-97	Ruthenium (44)	5.0	$1.4X10^{2}$	5.0	$1.4X10^{2}$	$1.7X10^{4}$	$4.6X10^{5}$
Ru-103 (a)		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.2X10^{3}$	$3.2X10^{4}$
Ru-105		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{5}$	$6.7X10^{6}$
Ru-106 (a)		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$1.2X10^{2}$	$3.3X10^{3}$
S-35	Sulphur (16)	$4.0X10^{1}$	$1.1X10^{3}$	3.0	$8.1X10^{1}$	$1.6X10^{3}$	$4.3X10^{4}$
Sb-122	Antimony (51)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Sb-124		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$6.5X10^{2}$	$1.7X10^{4}$
Sb-125		2.0	$5.4X10^{1}$	1.0	$2.7X10^{1}$	$3.9X10^{1}$	$1.0X10^{3}$
Sb-126		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.1X10^{3}$	$8.4X10^{4}$
Sc-44	Scandium (21)	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.7X10^{5}$	$1.8X10^{7}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Sc-46		$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$1.3X10^{3}$	$3.4X10^{4}$
Sc-47		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.1X10^{4}$	$8.3X10^{5}$
Sc-48		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$5.5X10^{4}$	$1.5X10^{6}$
Se-75	Selenium (34)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$5.4X10^{2}$	$1.5X10^{4}$
Se-79		$4.0X10^{1}$	$1.1X10^{3}$	2.0	$5.4X10^{1}$	$2.6X10^{-3}$	$7.0X10^{-2}$
Si-31	Silicon (14)	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.4X10^{6}$	$3.9X10^{7}$
Si-32		$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	3.9	$1.1X10^{2}$
Sm-145	Samarium (62)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.8X10^{1}$	$2.6X10^{3}$
Sm-147		Unlimited	Unlimited	Unlimited	Unlimited	$8.5X10^{-1}$	$2.3X10^{-8}$
Sm-151		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{1}$	$2.7X10^{2}$	$9.7X10^{-1}$	$2.6X10^{1}$
Sm-153		9.0	$2.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.6X10^{4}$	$4.4X10^{5}$
Sn-113 (a)	Tin (50)	4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$3.7X10^{2}$	$1.0X10^{4}$
Sn-117m		7.0	$1.9X10^{2}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.0X10^{3}$	$8.2X10^{4}$
Sn-119m		$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{1}$	$8.1X10^{2}$	$1.4X10^{2}$	$3.7X10^{3}$
Sn-121m (a)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-1}$	$2.4X10^{1}$	2.0	$5.4X10^{1}$
Sn-123		$8.0X10^{-1}$	$2.2X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Sn-125		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{3}$	$1.1X10^{5}$
Sn-126 (a)		$6.0X10^{-1}$	$1.6X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.0X10^{-3}$	$2.8X10^{-2}$
Sr-82 (a)	Strontium (38)	$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$2.3X10^{3}$	$6.2X10^{4}$
Sr-85		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$8.8X10^{2}$	$2.4X10^{4}$
Sr-85m		5.0	$1.4X10^{2}$	5.0	$1.4X10^{2}$	$1.2X10^{6}$	$3.3X10^{7}$
Sr-87m		3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$4.8X10^{5}$	$1.3X10^{7}$
Sr-89		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.1X10^{3}$	$2.9X10^{4}$
Sr-90 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	5.1	$1.4X10^{2}$
Sr-91 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.3X10^{5}$	$3.6X10^{6}$
Sr-92 (a)		1.0	$2.7X10^{1}$	$3.0X10^{-1}$	8.1	$4.7X10^{5}$	$1.3X10^{7}$
T(H-3)	Tritium (1)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.6X10^{2}$	$9.7X10^{3}$
Ta-178 (long-lived)	Tantalum (73)	1.0	$2.7X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$4.2X10^{6}$	$1.1X10^{8}$
Ta-179		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$4.1X10^{1}$	$1.1X10^{3}$
Ta-182		$9.0X10^{-1}$	$2.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$2.3X10^{2}$	$6.2X10^{3}$
Tb-157	Terbium (65)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$5.6X10^{-1}$	$1.5X10^{1}$
Tb-158		1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$5.6X10^{-1}$	$1.5X10^{1}$
Tb-160		1.0	$2.7X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$4.2X10^{2}$	$1.1X10^{4}$
Tc-95m (a)	Technetium (43)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$8.3X10^{2}$	$2.2X10^{4}$
Tc-96		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.2X10^{4}$	$3.2X10^{5}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Tc-96m (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.4X10^{6}$	$3.8X10^{7}$
Tc-97		Unlimited	Unlimited	Unlimited	Unlimited	$5.2X10^{-5}$	$1.4X10^{-3}$
Tc-97m		$4.0X10^{1}$	$1.1X10^{3}$	1.0	$2.7X10^{1}$	$5.6X10^{2}$	$1.5X10^{4}$
Tc-98		$8.0X10^{-1}$	$2.2X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.2X10^{-5}$	$8.7X10^{-4}$
Tc-99		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.3X10^{-4}$	$1.7X10^{-2}$
Tc-99m		$1.0X10^{1}$	$2.7X10^{2}$	4.0	$1.1X10^{2}$	$1.9X10^{5}$	$5.3X10^{6}$
Te-121	Tellurium (52)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.4X10^{3}$	$6.4X10^{4}$
Te-121m		5.0	$1.4X10^{2}$	3.0	$8.1X10^{1}$	$2.6X10^{2}$	$7.0X10^{3}$
Te-123m		8.0	$2.2X10^{2}$	1.0	$2.7X10^{1}$	$3.3X10^{2}$	$8.9X10^{3}$
Te-125m		$2.0X10^{1}$	$5.4X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.7X10^{2}$	$1.8X10^{4}$
Te-127		$2.0X10^{1}$	$5.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.8X10^{4}$	$2.6X10^{6}$
Te-127m (a)		$2.0X10^{1}$	$5.4X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.5X10^{2}$	$9.4X10^{3}$
Te-129		$7.0X10^{-1}$	$1.9X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$7.7X10^{5}$	$2.1X10^{7}$
Te-129m (a)		$8.0X10^{-1}$	$2.2X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.1X10^{3}$	$3.0X10^{4}$
Te-131m (a)		$7.0X10^{-1}$	$1.9X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{4}$	$8.0X10^{5}$
Te-132 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$3.1X10^{4}$	$3.0X10^{5}$
Th-227	Thorium (90)	$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-3}$	$1.4X10^{-1}$	$1.1X10^{3}$	$3.1X10^{4}$
Th-228 (a)		$5.0X10^{-1}$	$1.4X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.0X10^{1}$	$8.2X10^{2}$
Th-229		5.0	$1.4X10^{2}$	$5.0X10^{-4}$	$1.4X10^{-2}$	$7.9X10^{-3}$	$2.1X10^{-1}$
Th-230		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.6X10^{-4}$	$2.1X10^{-2}$
Th-231		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.0X10^{4}$	$5.3X10^{5}$
Th-232		Unlimited	Unlimited	Unlimited	Unlimited	$4.0X10^{-9}$	$1.1X10^{-7}$
Th-234 (a)		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$8.6X10^{2}$	$2.3X10^{4}$
Th(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$8.1X10^{-9}$	$2.2X10^{-7}$
Ti-44 (a)	Titanium (22)	$5.0X10^{-1}$	$1.4X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	6.4	$1.7X10^{2}$
Tl-200	Thallium (81)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.2X10^{4}$	$6.0X10^{5}$
Tl-201		$1.0X10^{1}$	$2.7X10^{2}$	4.0	$1.1X10^{2}$	$7.9X10^{3}$	$2.1X10^{5}$
Tl-202		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.0X10^{3}$	$5.3X10^{4}$
Tl-204		$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.7X10^{1}$	$4.6X10^{2}$
Tm-167	Thulium (69)	7.0	$1.9X10^{2}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{3}$	$8.5X10^{4}$
Tm-170		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.2X10^{2}$	$6.0X10^{3}$
Tm-171		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$
U-230 (fast lung absorption) (a)(d)	Uranium (92)	$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-1}$	2.7	$1.0X10^{3}$	$2.7X10^{4}$
U-230		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.0X10^{3}$	$2.7X10^{4}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
(medium lung absorption) (a)(e)							
U-230 (slow lung absorption) (a)(f)		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$1.0X10^{3}$	$2.7X10^{4}$
U-232 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-232 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-232 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-233 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$3.6X10^{-4}$	$9.7X10^{-3}$
U-233 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$
U-233 (slow lung absorption) (f)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$
U-234 (fast lung absorption) (d)		$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$2.3X10^{-4}$	$6.2X10^{-3}$
U-234 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$
U-234 (slow		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity (TBq/g)	Specific activity (Ci/g)
lung absorption) (f)							
U-235 (all lung absorption types) (a),(d),(e),(f)		Unlimited	Unlimited	Unlimited	Unlimited	$8.0X10^{-8}$	$2.2X10^{-6}$
U-236 (fast lung absorption) (d)		Unlimited	Unlimited	Unlimited	Unlimited	$2.4X10^{-6}$	$6.5X10^{-5}$
U-236 (medium lung absorption) (e)		$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$
U-236 (slow lung absorption) (f)		$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$
U-238 (all lung absorption types) (d),(e),(f)		Unlimited	Unlimited	Unlimited	Unlimited	$1.2X10^{-8}$	$3.4X10^{-7}$
U (nat)		Unlimited	Unlimited	Unlimited	Unlimited	$2.6X10^{-8}$	$7.1X10^{-7}$
U (enriched to 20% or less) (g)		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	See Table A-4
U (dep)		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	(See Table A-3)
V-48	Vanadium (23)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$6.3X10^{3}$	$1.7X10^{5}$
V-49		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.0X10^{2}$	$8.1X10^{3}$
W-178 (a)	Tungsten (74)	9.0	$2.4X10^{2}$	5.0	$1.4X10^{2}$	$1.3X10^{3}$	$3.4X10^{4}$
W-181		$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{1}$	$8.1X10^{2}$	$2.2X10^{2}$	$6.0X10^{3}$
W-185		$4.0X10^{1}$	$1.1X10^{3}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.5X10^{2}$	$9.4X10^{3}$
W-187		2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.6X10^{4}$	$7.0X10^{5}$
W-188 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$3.0X10^{-1}$	8.1	$3.7X10^{2}$	$1.0X10^{4}$
Xe-122 (a)	Xenon (54)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.8X10^{4}$	$1.3X10^{6}$
Xe-123		2.0	$5.4X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.4X10^{5}$	$1.2X10^{7}$
Xe-127		4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$1.0X10^{3}$	$2.8X10^{4}$

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
Xe-131m		$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.1X10^{3}$	$8.4X10^{4}$
Xe-133		$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$6.9X10^{3}$	$1.9X10^{5}$
Xe-135		3.0	$8.1X10^{1}$	2.0	$5.4X10^{1}$	$9.5X10^{4}$	$2.6X10^{6}$
Y-87 (a)	Yttrium (39)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.7X10^{4}$	$4.5X10^{5}$
Y-88		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$5.2X10^{2}$	$1.4X10^{4}$
Y-90		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.0X10^{4}$	$5.4X10^{5}$
Y-91		$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.1X10^{2}$	$2.5X10^{4}$
Y-91m		2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.5X10^{6}$	$4.2X10^{7}$
Y-92		$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$3.6X10^{5}$	$9.6X10^{6}$
Y-93		$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.2X10^{5}$	$3.3X10^{6}$
Yb-169	Ytterbium (70)	4.0	$1.1X10^{2}$	1.0	$2.7X10^{1}$	$8.9X10^{2}$	$2.4X10^{4}$
Yb-175		$3.0X10^{1}$	$8.1X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.6X10^{3}$	$1.8X10^{5}$
Zn-65	Zinc (30)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Zn-69		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{6}$	$4.9X10^{7}$
Zn-69m (a)		3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
Zr-88	Zirconium (40)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Zr-93		Unlimited	Unlimited	Unlimited	Unlimited	$9.3X10^{-5}$	$2.5X10^{-3}$
Zr-95 (a)		2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Zr-97 (a)		$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$

[a] A_1 and/or A_2 values include contributions from daughter nuclides with half-lives less than 10 days.
[b] The values of A_1 and A_2 in Curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq), (see Appendix A to Part 71 - Determination of A_1 and A_2, Section I.).
[c] The quantity may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.
[d] These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2 and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.
[e] These values apply only to compounds of uranium that take the chemical form of UO_3, UF_4, UCl_4 and hexavalent compounds in both normal and accident conditions of transport.
[f] These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.
[g] These values apply to unirradiated uranium only.
[h] A_1 = 0.1 TBq (2.7 Ci) and A_2 = 0.001 TBq (0.027 Ci) for Cf-252 for domestic use.
[i] A_2 = 0.74 TBq (20 Ci) for Mo-99 for domestic use.

TABLE A-2

EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac-225	Actinium (89)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ac-227		$1.0X10^{-1}$	$2.7X10^{-12}$	$1.0X10^{3}$	$2.7X10^{-8}$
Ac-228		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag-105	Silver (47)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag-108m (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag-110m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ag-111		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Al-26	Aluminum (13)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Am-241	Americium (95)	1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Am-242m (b)		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Am-243 (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Ar-37	Argon (18)	$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ar-39		$1.0X10^{7}$	$2.7X10^{-4}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ar-41		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
As-72	Arsenic (33)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
As-73		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
As-74		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
As-76		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
As-77		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
At-211	Astatine (85)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au-193	Gold (79)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au-194		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Au-195		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Au-198		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Au-199		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ba-131	Barium (56)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ba-133		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ba-133m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ba-140 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Be-7	Beryllium (4)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Be-10		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi-205	Bismuth (83)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi-206		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bi-207		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi-210		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Bi-210m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bi-212 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Bk-247	Berkelium (97)	1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Bk-249		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Br-76	Bromine (35)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Br-77		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Br-82		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
C-11	Carbon (6)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
C-14		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca-41	Calcium (20)	$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca-45		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ca-47		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd-109	Cadmium (48)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd-113m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd-115		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cd-115m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce-139	Cerium (58)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce-141		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ce-143		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ce-144 (b)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cf-248	Californium (98)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf-249		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cf-250		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf-251		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cf-252		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cf-253		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cf-254		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Cl-36	Chlorine (17)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cl-38		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm-240	Curium (96)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm-241		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cm-242		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cm-243		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm-244		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm-245		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cm-246		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Cm-247		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cm-248		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Co-55	Cobalt (27)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co-56		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Co-57		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co-58		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Co-58m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Co-60		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cr-51	Chromium (24)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Cs-129	Cesium (55)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs-131		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cs-132		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs-134		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cs-134m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs-135		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Cs-136		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Cs-137 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Cu-64	Copper (29)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Cu-67		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Dy-159	Dysprosium (66)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Dy-165		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Dy-166		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Er-169	Erbium (68)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Er-171		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Eu-147	Europium (63)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-148		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-149		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Eu-150 (short lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-150 (long lived)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-152		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-152m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-154		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Eu-155		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Eu-156		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
F-18	Fluorine (9)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe-52	Iron (26)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe-55		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe-59		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Fe-60		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ga-67	Gallium (31)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ga-68		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ga-72		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Gd-146	Gadolinium (64)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Gd-148		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Gd-153		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Gd-159		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ge-68	Germanium (32)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ge-71		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ge-77		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Hf-172	Hafnium (72)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf-175		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf-181		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hf-182		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg-194	Mercury (80)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg-195m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Hg-197		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Hg-197m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Hg-203		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ho-166	Holmium (67)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ho-166m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-123	Iodine (53)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
I-124		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-125		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-126		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-129		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
I-131		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-132		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
I-133		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
I-134		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
I-135		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
In-111	Indium (49)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In-113m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In-114m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
In-115m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ir-189	Iridium (77)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ir-190		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ir-192		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ir-194		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
K-40	Potassium (19)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
K-42		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
K-43		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Kr-81	Krypton (36)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Kr-85		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{4}$	$2.7X10^{-7}$
Kr-85m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{10}$	$2.7X10^{-1}$
Kr-87		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
La-137	Lanthanum (57)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
La-140		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Lu-172	Lutetium (71)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Lu-173		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Lu-174		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Lu-174m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Lu-177		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Mg-28	Magnesium (12)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mn-52	Manganese (25)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mn-53		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{9}$	$2.7X10^{-2}$
Mn-54		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Mn-56		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Mo-93	Molybdenum (42)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Mo-99		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
N-13	Nitrogen (7)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Na-22	Sodium (11)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Na-24		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Nb-93m	Niobium (41)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Nb-94		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nb-95		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nb-97		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nd-147	Neodymium (60)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Nd-149		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ni-59	Nickel (28)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ni-63		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ni-65		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Np-235	Neptunium (93)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Np-236 (short-lived)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Np-236 (long-lived)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Np-237 (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Np-239		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os-185	Osmium (76)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Os-191		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os-191m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Os-193		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Os-194		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
P-32	Phosphorus (15)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
P-33		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pa-230	Protactinium (91)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pa-231		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Pa-233		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pb-201	Lead (82)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb-202		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb-203		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pb-205		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pb-210 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pb-212 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pd-103	Palladium (46)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pd-107		$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Pd-109		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm-143	Promethium (61)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm-144		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm-145		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pm-147		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pm-148m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm-149		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pm-151		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Po-210	Polonium (84)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pr-142	Praseodymium (59)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pr-143		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt-188	Platinum (78)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt-191		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt-193		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pt-193m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pt-195m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt-197		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pt-197m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Pu-236	Plutonium (94)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu-237		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Pu-238		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Pu-239		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu-240		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Pu-241		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Pu-242		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Pu-244		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ra-223 (b)	Radium (88)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra-224 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra-225		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Ra-226 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Ra-228 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Rb-81	Rubidium (37)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rb-83		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rb-84		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rb-86		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Rb-87		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rb(nat)		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Re-184	Rhenium (75)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re-184m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re-186		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re-187		$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Re-188		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Re-189		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Re(nat)		$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Rh-99	Rhodium (45)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh-101		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rh-102		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh-102m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Rh-103m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Rh-105		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Rn-222 (b)	Radon (86)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{8}$	$2.7X10^{-3}$
Ru-97	Ruthenium (44)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ru-103		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ru-105		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ru-106 (b)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
S-35	Sulphur (16)	$1.0X10^{5}$	$2.7X10^{-6}$	$1.0X10^{8}$	$2.7X10^{-3}$
Sb-122	Antimony (51)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sb-124		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sb-125		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sb-126		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sc-44	Scandium (21)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sc-46		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sc-47		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sc-48		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Se-75	Selenium (34)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Se-79		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Si-31	Silicon (14)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Si-32		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sm-145	Samarium (62)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sm-147		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sm-151		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
Sm-153		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sn-113	Tin (50)	$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn-117m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sn-119m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn-121m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sn-123		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sn-125		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sn-126		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr-82	Strontium (38)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr-85		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr-85m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Sr-87m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr-89		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Sr-90 (b)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{4}$	$2.7X10^{-7}$
Sr-91		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Sr-92		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
T(H-3)	Tritium (1)	$1.0X10^{6}$	$2.7X10^{-5}$	$1.0X10^{9}$	$2.7X10^{-2}$
Ta-178 (long-lived)	Tantalum (73)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Ta-179		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Ta-182		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Tb-157	Terbium (65)	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tb-158		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tb-160		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc-95m	Technetium (43)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc-96		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc-96m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc-97		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{8}$	$2.7X10^{-3}$
Tc-97m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc-98		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tc-99		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
Tc-99m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te-121	Tellurium (52)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te-121m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Te-123m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te-125m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te-127		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te-127m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Te-129		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te-129m		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te-131m		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Te-132		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Th-227	Thorium (90)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th-228 (b)		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th-229 (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
Th-230		1.0	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th-231		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Th-232		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
Th-234 (b)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Th (nat) (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ti-44	Titanium (22)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
Tl-200	Thallium (81)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl-201		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl-202		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tl-204		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{4}$	$2.7X10^{-7}$
Tm-167	Thulium (69)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tm-170		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Tm-171		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{8}$	$2.7X10^{-3}$
U-230 (fast lung absorption) (b),(d)	Uranium (92)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-230 (medium lung absorption) (e)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-230 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-232 (fast lung absorption) (b),(d)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U-232 (medium lung absorption) (e)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-232 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-233 (fast lung absorption) (d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-233 (medium lung absorption) (e)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-233 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-234 (fast lung absorption) (d)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-234 (medium lung absorption) (e)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-234 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-235 (all lung absorption types) (b),(d),(e),(f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-236 (fast lung		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
absorption) (d)					
U-236 (medium lung absorption) (e)		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
U-236 (slow lung absorption) (f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U-238 (all lung absorption types) (b),(d),(e),(f)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
U (nat) (b)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U (enriched to 20% or less) (g)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
U (dep)		1.0	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$
V-48	Vanadium (23)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
V-49		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
W-178	Tungsten (74)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
W-181		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
W-185		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$
W-187		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
W-188		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Xe-122	Xenon (54)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Xe-123		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{9}$	$2.7X10^{-2}$
Xe-127		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Xe-131m		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{4}$	$2.7X10^{-7}$
Xe-133		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{4}$	$2.7X10^{-7}$
Xe-135		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{10}$	$2.7X10^{-1}$
Y-87	Yttrium (39)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y-88		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y-90		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{5}$	$2.7X10^{-6}$
Y-91		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y-91m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Y-92		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Y-93		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{5}$	$2.7X10^{-6}$
Yb-169	Ytterbium (70)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
Yb-175		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Zn-65	Zinc (30)	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zn-69		$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zn-69m		$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr-88	Zirconium (40)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr-93 (b)		$1.0X10^{3}$	$2.7X10^{-8}$	$1.0X10^{7}$	$2.7X10^{-4}$
Zr-95		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
Zr-97 (b)		$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

[a] [Reserved]

[b] Parent nuclides and their progeny included in secular equilibrium are listed in the following:
Sr-90 Y-90
Zr-93 Nb-93m
Zr-97 Nb-97
Ru-106 Rh-106
Cs-137 Ba-137m
Ce-134 La-134
Ce-144 Pr-144
Ba-140 La-140
Bi-212 Tl-208 (0.36), Po-212 (0.64)
Pb-210 Bi-210, Po-210
Pb-212 Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-220 Po-216
Rn-222 Po-218, Pb-214, Bi-214, Po-214
Ra-223 Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224 Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212 (0.64)
Ra-226 Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228 Ac-228
Th-226 Ra-222, Rn-218, Po-214
Th-228 Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-20
Th-nat Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 0.36), Po-212 (0.64)
Th-234 Pa-234m
U-230 Th-226, Ra-222, Rn-218, Po-214
U-232 Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235 Th-231
U-238 Th-234, Pa-234m
U-nat Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240 Np-240m
Np-237 Pa-233

Am-242m Am-242
§289.257(ff)(7)
257 - 79 (December 2007)
Am-243 Np-239

[c] [Reserved]

[d] These values apply only to compounds of uranium that take the chemical form of UF6, UO2F2 and UO2(NO3)2 in both normal and accident conditions of transport.

[e] These values apply only to compounds of uranium that take the chemical form of UO3, UF4, UCl4 and hexavalent compounds in both normal and accident conditions of transport.

[f] These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.

[g] These values apply to unirradiated uranium only.

TABLE A-3
GENERAL VALUES FOR A_1 AND A_2

Contents	A_1		A_2		Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limits for exempt consignments (Bq)	Activity limits for exempt consignments (Ci)
	(TBq)	(Ci)	(TBq)	(Ci)				
Only beta or gamma emitting radionuclides are known to be present	1×10^{-1}	2.7×10^{0}	2×10^{-2}	5.4×10^{-1}	1×10^{1}	2.7×10^{-10}	1×10^{4}	2.7×10^{-7}
Only alpha emitting radionuclides are known to be present	2×10^{-1}	5.4×10^{0}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}
No relevant data are available	1×10^{-3}	2.7×10^{-2}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}

TABLE A-4
ACTIVITY-MASS RELATIONSHIPS FOR URANIUM

Uranium Enrichment* weight % U-235 present	Specific Activity	
	TBq/g	Ci/g
0.45	1.8×10^{-8}	5.0×10^{-7}
0.72	2.6×10^{-8}	7.1×10^{-7}
1.0	2.8×10^{-8}	7.6×10^{-7}
1.5	3.7×10^{-8}	1.0×10^{-6}
5.0	1.0×10^{-7}	2.7×10^{-6}
10.0	1.8×10^{-7}	4.8×10^{-6}
20.0	3.7×10^{-7}	1.0×10^{-5}
35.0	7.4×10^{-7}	2.0×10^{-5}
50.0	9.3×10^{-7}	2.5×10^{-5}
90.0	2.2×10^{-6}	5.8×10^{-5}
93.0	2.6×10^{-6}	7.0×10^{-5}
95.0	3.4×10^{-6}	9.1×10^{-5}

* The figures for uranium include representative values for the activity of the uranium-234 which is concentrated during the enrichment process.

Subchapter 14 Radiation Safety Requirements For Wireline Service Operations And Subsurface Tracer Studies

Rule 1.14.1 **Purpose**. The regulations in this section establish radiation safety requirements for using sources of radiation for wireline service operations including mineral logging, radioactive markers, and subsurface tracer studies. The requirements of this section are in addition to, and not in substitution for, the requirements of Subchapters 1, 2, 3, 4, 10, and 13 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.2 **Scope.** The regulations in this section apply to all licensees or registrants who use sources of radiation for wireline service operations including mineral logging, radioactive markers, or subsurface tracer studies.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.3 **Definitions.** As used in this section, the following definitions apply:

1. "Energy compensation source (ECS)" means a small sealed source, with an activity not exceeding 3.7 megabecquerels (100 µCi), used within a logging tool, or other tool components, to provide a reference standard to maintain the tool's calibration when in use.

2. "Field station" means a facility where radioactive sources may be stored or used and from which equipment is dispatched to temporary jobsites.

3. "Injection tool" means a device used for controlled subsurface injection of radioactive tracer material.

4. "Logging assistant" means any individual who, under the personal supervision of a logging supervisor, handles sealed sources or tracers that are not in logging tools or shipping containers or who performs surveys required by 1.14.26

5. "Logging supervisor" means the individual who uses sources of radiation or provides personal supervision of the utilization of sources of radiation at a temporary jobsite and who is responsible to the licensee or the registrant for assuring compliance with the requirements of these regulations and all license and/or certificate of registration conditions.

6. "Logging tool" means a device used subsurface to perform well-logging.

7. "Mineral logging" means any logging performed for the purpose of mineral exploration other than oil or gas.

8. "Personal supervision" means guidance and instruction by the logging supervisor who is physically present at the jobsite in such proximity that visual contact can be maintained and immediate assistance given as required.

9. "Radioactive marker" means radioactive material placed subsurface or on a structure intended for subsurface use for the purpose of depth determination or direction orientation. This term includes radioactive collar markers and radioactive iron nails.

10. "Source holder" means a housing or assembly into which a radioactive source is placed for the purpose of facilitating the handling and use of the source in well-logging operations.

11. "Storage container" means a container designed to provide radiation safety and security when sources of radiation are being stored.

12. "Subsurface tracer study" means the release of a substance tagged with radioactive material for the purpose of tracing the movement or position of the tagged substance in the well-bore or adjacent formation.

13. "Temporary jobsite" means a location where radioactive materials are present for the purpose of performing wireline service operations or subsurface tracer studies.

14. "Transport container" means a container designed to provide radiation safety and security when sources of radiation are being transported.

15. "Tritium neutron generator target source" means a tritium source used within a neutron generator tube to produce neutrons for use in well-logging applications.

16. "Uranium sinker bar" means a weight containing depleted uranium used to pull a logging tool down toward the bottom of a well.

17. "Well-bore" means a drilled hole in which wireline service operations or subsurface tracer studies are performed.

18. "Well-logging" means all operations involving the lowering and raising of measuring devices or tools which may contain sources of radiation into well-bores or cavities for the purpose of obtaining information about the well or adjacent formations

19. "Wireline" means a cable containing one or more electrical conductors which is used to lower and raise logging tools in the well-bore.

20. "Wireline service operation" means any evaluation or mechanical service which is performed in the well-bore using devices on a wireline.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.4 **Prohibition.**

1. No licensee shall perform well-logging service operations with a sealed source(s) unless, prior to commencement of the operation, the licensee has a

written agreement with the well operator, well owner, drilling contractor, or land owner that specifies who will be responsible for ensuring the following requirements are met:

a. in the event a sealed source is lost or lodged downhole, a reasonable effort at recovery will be made;

b. a person may not attempt to recover a sealed source in a manner which, in the licensee's opinion, could result in its rupture;

c. if the environment, any equipment, or personnel are contaminated with radioactive material, they must be decontaminated before release from the site or release for unrestricted use; and

d. in the event a decision is made to abandon the sealed source downhole, the requirements of 1.14.29(2)(c) shall be met.

2. The licensee shall retain a copy of the written agreement for 3 years after the completion of the well-logging operation.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.5 **Limits on Levels of Radiation.** Sources of radiation shall be used, stored, and transported in such a manner that the transportation requirements of Subchapter 13 and the dose limitation requirements of Subchapter 4 of these regulations are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.6 **Storage Precautions.**

1. Each source of radiation, except accelerators, shall be provided with a storage or transport container. The container shall be provided with a lock, or tamper seal for calibration sources, to prevent unauthorized removal of, or exposure to, the source of radiation.

2. Sources of radiation shall be stored in a manner which will minimize danger from explosion or fire.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.7 **Transport Precautions.** Transport containers shall be physically secured to the transporting vehicle to prevent accidental loss, tampering, or unauthorized removal.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.8 **Radiation Survey Instruments.**

1. The licensee or registrant shall maintain a sufficient number of calibrated and operable radiation survey instruments at each field station and each temporary jobsite to make physical radiation surveys as required by this section and by 1.14.29(1) of these regulations. Instrumentation shall be capable of measuring 0 .001 millisievert (0.1 mrem) per hour through at least 0.5 millisievert (50 mrems) per hour.

2. Each radiation survey instrument shall be calibrated:

   a. at intervals not to exceed 6 months and after each instrument servicing;

   b. for linear scale instruments, at two points located approximately ⅓ and ⅔ of full-scale on each scale; for logarithmic scale instruments, at midrange of each decade, and at two points of at least one decade; and for digital instruments, at appropriate points; and

   c. so that accuracy within plus or minus 20 percent of the true radiation level can be demonstrated on each scale.

3. Calibration records shall be maintained for a period of 3 years for inspection by the Agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.9 **Leak Testing of Sealed Sources.**

1. **Requirements.** Each licensee using sealed sources of radioactive material shall have the sources tested for leakage. Records of leak test results shall be kept in units of becquerels (microcuries) and maintained for inspection by the Agency for 3 years after the next required leak test is performed or until transfer or disposal of the sealed source.

2. **Method of testing.** The wipe of a sealed source must be performed using a leak test kit or method approved by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State. The wipe sample must be taken from the nearest accessible point to the sealed source where contamination might accumulate. The wipe sample must be analyzed for radioactive contamination. The analysis must be capable of detecting the presence of 185 becquerel (0.005 µCi) of radioactive material on the test sample and must be performed by a person approved by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State to perform the analysis.

3. **Test frequency.**

   a. Each sealed source (except an energy compensation source (ECS)) must be tested at intervals not to exceed 6 months. In the absence of a

certificate from a transferor that a test has been made within the 6 months before the transfer, the sealed source may not be used until tested.

b. Each ECS that is not exempt from testing in accordance with 1.14.9(5) of this section must be tested at intervals not to exceed 3 years. In the absence of a certificate from a transferor that a test has been made within the 3 years before the transfer, the ECS may not be used until tested.

4. **Removal of leaking source from service.**

a. If the test conducted pursuant to 1.14.9(4)(a) and (b) of this section reveals the presence of 185 becquerel (0.005 µCi) or more of removable radioactive material, the licensee shall remove the sealed source from service immediately and have it decontaminated, repaired, or disposed of by an Agency, an U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State licensee that is authorized to perform these functions. The licensee shall check the equipment associated with the leaking source for radioactive contamination and, if contaminated, have it decontaminated or disposed of by an Agency, an U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State licensee that is authorized to perform these functions.

b. The licensee shall submit a report to the Agency within 5 days of receiving the test results. The report must describe the equipment involved in the leak, the test results, any contamination which resulted from the leaking source, and the corrective actions taken up to the time the report is made.

5. **Exemptions.** The following sources are exempted from the periodic leak test requirements of 1.14.9(1) through (4):

a. hydrogen-3 (tritium) sources;

b. sources of radioactive material with a half-life of 30 days or less;

c. sealed sources of radioactive material in gaseous form;

d. sources of beta- and/or gamma-emitting radioactive material with an activity of 3.7 megabecquerels (100 µCi)) or less; and

e. sources of alpha-emitting radioactive material with an activity of 0.370 megabecquerels (10 µCi)) or less.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.10 **Quarterly Inventory.** Each licensee or registrant shall conduct a quarterly

physical inventory to account for all sources of radiation. Records of inventories shall be maintained for 3 years from the date of the inventory for inspection by the Agency and shall include the quantities and kinds of sources of radiation, the location where sources of radiation are assigned, the date of the inventory, and the name of the individual conducting the inventory.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.11 **Utilization Records.** Each licensee or registrant shall maintain current records, which shall be kept available for inspection by the Agency for 3 years from the date of the recorded event, showing the following information for each source of radiation:

1. make, model number, and a serial number or a description of each source of radiation used;

2. the identity of the well-logging supervisor or field unit to whom assigned;

3. locations where used and dates of use; and

4. in the case of tracer materials and radioactive markers, the utilization record shall indicate the radionuclide and activity used in a particular well and the disposition of any unused tracer materials.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.12 **Design and Performance Criteria for Sealed Sources Used in Downhole Operations.**

1. A licensee may use a sealed source for use in well- logging applications if

   a. the sealed source is doubly encapsulated;

   b. the sealed source contains radioactive material whose chemical and physical forms are as insoluble and nondispersible as practical; and

   c. meets the requirements of 1.14.12(2), (3), or (4) of this section.

2. For a sealed source manufactured on or before July 14, 1989, a licensee may use the sealed source, for use in well-logging applications if it meets the requirements of USASI N5.10-1968, "Classification of Sealed Radioactive Sources," or the requirements in 1.14.12(3) or (4) of this section.

3. For a sealed source manufactured after July 14, 1989, a licensee may use the sealed source, for use in well-logging applications if it meets the oil-well-logging requirements of ANSI/HPS N43.6-1997, "Sealed Radioactive Sources-Classification."

4. For a sealed source manufactured after July 14, 1989, a licensee may use the sealed source, for use in well-logging applications, if the sealed source's prototype has been tested and found to maintain its integrity after each of the following tests:

   a. **Temperature.** The test source must be held at -40ºC for 20 minutes, 600ºC for 1 hour, and then be subject to a thermal shock test with a temperature drop from 600ºC to 20ºC within 15 seconds.

   b. **Impact Test.** A 5 kg steel hammer, 2.5 cm in diameter, must be dropped from a height of 1 m onto the test source.

   c. **Vibration test.** The test source must be subject to a vibration from 25 Hz to 500 Hz at 5 g amplitude for 30 minutes.

   d. **Puncture test.** A 1 gram hammer and pin, 0.3 cm pin diameter, must be dropped from a height of 1 m onto the test source.

   e. **Pressure test.** The test source must be subject to an external pressure of 1.695×10^7 pascals (24,600 pounds per square inch absolute).

5. The requirements in 1.14.12(1), (2), (3), and (4) of this section do not apply to sealed sources that contain radioactive material in gaseous form.

6. The requirements in 1.14.12(1), (2), (3), and (4) of this section do not apply to energy compensation sources (ECS). ECSs must be registered in accordance with 10 CFR 32.210 or equivalent Agreement State regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.13 **Labeling.**

1. Each source, source holder, or logging tool containing radioactive material shall bear a durable, legible, and clearly visible marking or label, which has, as a minimum, the standard radiation caution symbol, without the conventional color requirement, and the following wording:

   DANGER[55]

   RADIOACTIVE MATERIAL

   This labeling shall be on the smallest component transported as a separate piece of equipment.

2. Each storage and/or transport container shall have permanently attached to it a durable, legible, and clearly visible label which has, as a minimum, the standard radiation caution symbol in conventional colors and the following wording:

[55] or CAUTION

DANGER[56]

RADIOACTIVE MATERIAL

NOTIFY CIVIL AUTHORITIES (OR NAME OF COMPANY)

Source: MS. Code Ann. § 45-14-11

Rule 1.14.14 **Inspection and Maintenance.**

1. Each licensee or registrant shall visually inspect the source holders, logging tools, and source handling tools, for obvious defects before each use to ensure that the equipment is in good working condition and that required labeling is present.

2. Each licensee or registrant shall conduct, at intervals not to exceed six months, a program of inspection and maintenance of source holders, logging tools, source handling tools, storage containers, transport containers, and injection tools to assure proper labeling and physical condition. Records of inspection and maintenance shall be maintained for a period of 3 years for inspection by the Agency.

3. If any inspection conducted pursuant to 1.14.14(1) and (2) reveals damage to labeling or components critical to radiation safety, the device shall be removed from service until repairs have been made and a record must be made listing: the date of inspection, name of inspector, equipment involved, defects found, and repairs made. These records must be retained for 3 years after the defects are found for inspection by the Agency.

4. Removal of a sealed source from a source holder or logging tool, and maintenance on sealed sources or holders in which sealed sources are contained, may not be performed by the licensee unless a written procedure has been approved by the Agency as part of the license application.

5. If a sealed source is stuck in the source holder, the licensee shall not perform any operation, such as drilling, cutting, or chiseling, on the source holder unless the licensee is specifically approved by the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State to perform this operation.

6. The repair, opening, or modification of any sealed source shall be performed only by persons specifically authorized to do so by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State.

SOURCE: Miss. Code Ann. §45-14-11

[56] or CAUTION

Rule 1.14.15 **Training Requirements.**

1. No licensee or registrant shall permit any individual to act as a logging supervisor as defined in this section until such individual has:

   a. received, in a course recognized by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State, instruction in the subjects outlined in Appendix A of this section and demonstrated an understanding thereof;

   b. read and received instruction in the regulations contained in this section and the applicable rules of Subchapters 1, 4, and 10 of these regulations or their equivalent, conditions of appropriate license or certificate of registration, and the licensee's or registrant's operating and emergency procedures, and demonstrated an understanding thereof;

   c. demonstrated competence to use sources of radiation, related handling tools, and radiation survey instruments which will be used on the job; and

   d. has demonstrated an understanding of the requirements in 1.14.15(1)(a) and (b) by successfully completing a written test.

2. No licensee or registrant shall permit any individual to act as a logging assistant as defined in this section until such individual has:

   a. read and received instruction in applicable rules of Subchapters 1, 4, and 10 of these regulations or their equivalent;

   b. read and received instruction in the licensee's or registrant's operating and emergency procedures and demonstrated an understanding thereof;

   c. demonstrated competence to use, under the personal supervision of the logging supervisor, the sources of radiation, related handling tools, and radiation survey instruments which will be used on the job; and

   d. has demonstrated an understanding of the requirements in 1.14.15(2)(a) and (b) by successfully completing a written or oral test.

3. The licensee or registrant shall provide safety reviews for logging supervisors and logging assistants at least once during each calendar year.

4. The licensee or registrant shall maintain a record on each logging supervisor's and logging assistant's training and annual safety review. The training records must include copies of written tests and dates of oral tests given. The training records must be retained until 3 years following the termination of employment. Records of annual safety reviews must list the topics discussed and be retained for 3 years.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.16 **Operating and Emergency Procedures.** Each licensee or registrant shall develop and follow written operating and emergency procedures which include instructions in at least the following:

1. handling and use of sources of radiation to be employed so that no individual is likely to be exposed to radiation doses in excess of the standards established in Subchapter 4 of these regulations;

2. methods and occasions for conducting radiation surveys;

3. methods and occasions for locking and securing sources of radiation;

4. personnel monitoring and the use of personnel monitoring equipment;

5. transportation to temporary jobsites and field stations, including the packaging and placing of sources of radiation in vehicles, placarding of vehicles, and physically securing sources of radiation during transportation;

6. minimizing exposure of individuals including that from inhalation and ingestion of radioactive material, during well-logging operations and in the event of an accident;

7. notifying proper personnel in the event of an accident;

8. maintenance of records including records generated by logging personnel at temporary jobsites;

9. use, inspection and maintenance of source holders, logging tools, source handling tools, storage containers, transport containers, and injection tools;

10. procedure to be followed in the event a sealed source is lodged downhole;

11. procedures to be used for picking up, receiving, and opening packages containing radioactive material;

12. the use of tools for remote handling of sealed sources and radioactive tracer material, except low activity calibration sources;

13. actions to be taken if a sealed source is ruptured, including actions to prevent the spread of contamination and minimize inhalation and ingestion of radioactive material and actions to obtain suitable radiation survey instruments as required by 1.14.8; and

14. for the use of tracers, decontamination of the environment, equipment, and personnel.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.17 **Personnel Monitoring.**

1. No licensee or registrant shall permit any individual to act as a logging supervisor or logging assistant unless each such individual wears, at times during the handling of sources of radiation, a personnel dosimeter that is processed and evaluated by an accredited National Voluntary Laboratory Accreditation Program (NVLAP) processor. Each personnel dosimeter shall be assigned to and worn by only one individual. Film badges must be replaced at least monthly and other personnel dosimeters replaced at least quarterly. After replacement, each personnel dosimeter must be promptly processed.

2. The licensee or registrant shall keep reports received from the dosimetry processor and from the bioassay service laboratory for inspection until the Agency authorizes disposition.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.18 **Security.** During each logging or tracer application, the logging supervisor or other designated employee shall maintain direct surveillance of the operation to protect against unauthorized and/or unnecessary entry into a restricted area, as defined in Subchapter 1 of these regulations.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.19 **Handling Tools.** The licensee shall provide and require the use of tools that will assure remote handling of sealed sources other than low-activity calibration sources.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.20 **Subsurface Tracer Studies.**

1. Protective gloves and other appropriate protective clothing and equipment shall be used by all personnel handling radioactive tracer material. Precautions shall be taken to avoid ingestion or inhalation of radioactive material and to avoid contamination of field stations and temporary jobsites.

2. No licensee shall cause the injection of radioactive material into potable aquifers without prior written authorization from the Agency and any other appropriate state agency.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.21 **Particle Accelerators.** No licensee or registrant shall permit above-ground testing of particle accelerators, designed for use in well-logging, which results in the production of radiation, except in areas or facilities so controlled or shielded that the requirements of 1.4.5 of these regulations, as applicable, are met.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.22 **Radioactive Markers.** The licensee may use radioactive markers in wells, only if the individual markers contain quantities of radioactive material not exceeding the specified exempt quantities in Subchapter 3. Appendix B. The use of radioactive markers in wells containing such exempt quantities of radioactive material is not subject to the other requirements of Subchapter 14.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.23 **Uranium Sinker Bars.** The licensee may use a uranium sinker bar in well- logging operations, only if it is legibly impressed with the words "CAUTION-RADIOACTIVE-DEPLETED URANIUM" and "NOTIFY CIVIL AUTHORITIES (or COMPANY NAME) IF FOUND."

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.24 **Energy Compensation Source.** The licensee may use an energy compensation source (ECS) which is contained within a logging tool, or other tool components, only if the ECS contains quantities of radioactive material not exceeding 3.7 megabecquerels (100 µCi).

1. For well-logging applications with a surface casing for protecting fresh water aquifers, use of the ECS is only subject to the requirements of 1.14.4, and 1.14.9 through 1.14.11.

2. For well-logging applications without a surface casing for protecting fresh water aquifers, use of the ECS is only subject to the requirements of 1.14.4, 1.14.9 through 1.14.11, and 1.14.29.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.25 **Tritium Neutron Generator Target Source.**

1. Use of a tritium neutron generator target source, containing quantities not exceeding 1,110 gigabecquerels (30 Ci) and in a well with a surface casing to protect fresh water aquifers, is subject to the requirements of this section except 1.14.4, 1.14.12, and 1.14.29.

2. Use of a tritium neutron generator target source, containing quantities exceeding 1,110 gigabecquerels (30 Ci) or in a well without a surface casing to protect fresh water aquifers, is subject to the requirements of this except 1.14.29.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.26 **Radiation Surveys.**

1. Radiation surveys shall be made and recorded for each area where radioactive materials are used and stored.

2. Radiation surveys shall be made and recorded for the radiation levels in occupied positions and on the exterior of each vehicle used to transport radioactive material. Such surveys shall include each source of radiation or combination of sources to be transported in the vehicle.

3. If the sealed source assembly is removed from the logging tool before departing the temporary jobsite, the logging tool detector shall be energized, or a survey meter used, to assure that the logging tool is free of contamination.

4. If the licensee has reason to believe that, as a result of any operation involving a sealed source, the encapsulation of the sealed source could be damaged by the operation, the licensee shall conduct a radiation survey, including a contamination survey, during and after the operation.

5. Radiation surveys shall be made and recorded at the temporary jobsite or well-head for each subsurface tracer study. These surveys shall include measurements of radiation levels before and after each subsurface tracer study.

6. Records required pursuant to 1.14.26(1) through (5) shall include the dates, the identification of individual(s) making the survey, the identification of survey instrument(s) used, and an exact description of the location of the survey. Records of these surveys shall be maintained for inspection by the Agency for 3 years after completion of the survey.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.27 **Documents and Records Required at Field Stations.** Each licensee or registrant shall maintain, for inspection by the Agency, the following documents and records for the specific devices and sources used at the field station:

1. appropriate license, certificate of registration, or equivalent document(s);

2. operating and emergency procedures;

3. applicable regulations;

4. records of the latest radiation survey instrument calibrations pursuant to 1.14.8;

5. records of the latest leak test results pursuant to 1.14.9;

6. quarterly inventories required pursuant to 1.14.10;

7. utilization records required pursuant to 1.14.11;

8. records of inspection and maintenance required pursuant to 1.14.14;

9. survey records required pursuant to 1.14.26;

10. training records required pursuant to 1.14.15; and

11. records of personnel monitoring required pursuant to 1.14.17.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.28 **Documents and Records Required at Temporary Jobsites.** Each licensee or registrant conducting operations at a temporary jobsite shall have the following documents and records available at that site for inspection by the Agency:

1. operating and emergency procedures;

2. survey records required pursuant to 1.14.26 for the period of operation at the site;

3. evidence of current calibration for the radiation survey instruments in use at the site;

4. when operating in the State under reciprocity, a copy of the appropriate license, certificate of registration, or equivalent document(s); and

5. shipping papers for the transportation of radioactive material.

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.14.29 **Notification of Incidents, Abandonment, and Lost Sources.**

1. Notification of incidents and sources lost in other than downhole logging operations shall be made in accordance with appropriate provisions of Subchapter 4 of these regulations.

2. Whenever a sealed source or device containing radioactive material is lodged downhole, the licensee shall:

   a. continuously monitor at the surface for the presence of radioactive contamination with an appropriate radiation survey instrument or logging tool with a radiation detector, the circulating fluids from the well, if any, during logging tool recovery operations;

   b. notify the Agency immediately by telephone and subsequently, within 30 days, by confirmatory letter if the licensee knows or has reason to believe that a sealed source has been ruptured. This letter shall identify the well or other location, describe the magnitude and extent of the escape of radioactive material, assess the consequences of the rupture,

and explain efforts planned or being taken to mitigate these consequences; and

c. initiate the emergency procedures required by 1.14.16.

3. When it becomes apparent that efforts to recover the radioactive source will not be successful, the licensee shall:

a. notify the Agency by telephone, of the circumstances that resulted in the inability to retrieve the source and

i. obtain Agency approval to implement abandonment procedures; or

ii. that the licensee implemented abandonment before receiving Agency approval because the licensee believed there was an immediate threat to public health and safety; and

b. advise the well-operator and the Mississippi Oil and Gas Board regarding abandonment and an appropriate method of abandonment, which shall include:

i. the immobilization and sealing in place of the radioactive source with a cement plug,

ii. the setting of a whipstock or other deflection device, and

iii. the mounting of a permanent identification plaque at the surface of the well, containing the appropriate information required by 1.14.29(4); and

c. file a written report with the Agency within 30 days of the abandonment. The licensee shall send a copy of the report to the Mississippi Oil and Gas Board that issued permits or otherwise approved the drilling operation. The report shall contain the following information:

i. date of occurrence;

ii. a description of the well- logging source involved, including the radionuclide and its quantity, chemical, and physical form;

iii. surface location and identification of the well;

iv. results of efforts to immobilize and seal the source in place;

v. a brief description of the attempted recovery effort;

vi. depth of the source;

vii. depth of the top of the cement plug;

viii. depth of the well;

ix. the immediate threat to public health and safety justification for implementing abandonment if prior Agency approval was not obtained in accordance with 1.14.29(3)(a)(ii);

x. any other information, such as a warning statement, contained on the permanent identification plaque; and

xi. the names of state agencies receiving a copy of this report.

4. Whenever a sealed source containing radioactive material is abandoned downhole, the licensee shall provide a permanent plaque[57], constructed of long lasting material such as stainless steel, brass, bronze, or monel, must be mounted at the surface of the well, unless the mounting of the plaque is not practical The size of the plaque must be at least 17 cm (7 inches) square and 3 mm (1/8-inch) thick. The plaque must contain the following information:

   a. the word "CAUTION";

   b. the radiation symbol without the conventional color requirement;

   c. the date the source was abandoned;

   d. the name of the well operator or well owner;

   e. the well name and well identification number(s) or other designation;

   f. the sealed source(s) by radionuclide and activity;

   g. the source depth and the depth to the top of the plug; and

   h. an appropriate warning, depending on the specific circumstances of each abandonment.[58]

5. The licensee shall immediately notify the Agency by telephone and subsequently by confirming letter if the licensee knows or has reason to believe that radioactive material has been lost in or to an underground potable water aquifer. Such notice shall designate the well location and shall describe the magnitude and extent of loss of radioactive material, assess the consequences of such loss, and explain efforts planned or being taken to mitigate these consequences.

SOURCE: Miss. Code Ann. §45-14-11

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[57] An example of a suggested plaque is shown in Appendix B of this section.

[58] Appropriate warnings may include: (a) "Do not drill below plug-back depth"; (b) "Do not enlarge casing"; or (c) "Do not re-enter the hole", followed by the words, "before contacting the Division of Radiological Health, Mississippi State Department of Health.

APPENDIX A

Subjects To Be Included In Training Courses For Logging Supervisors

I. Fundamentals of Radiation Safety

- A. Characteristics of radiation
- B. Units of radiation dose and quantity of radioactivity
- C. Significance of radiation dose
  - 1. Radiation protection standards
  - 2. Biological effects of radiation dose
- D. Levels of radiation from sources of radiation
- E. Methods of minimizing radiation dose
  - 1. Working time
  - 2. Working distances
  - 3. Shielding
- F. Radiation safety practices, including prevention of contamination, and methods of decontamination

II. Radiation Detection Instrumentation to be Used

- A. Use of radiation survey instruments
  - 1. Operation
  - 2. Calibration
  - 3. Limitations
- B. Survey techniques
- C. Use of personnel monitoring equipment

III. Equipment to be Used

- A. Handling equipment
- B. Sources of radiation

C. Storage, control, and disposal of radioactive material

D. Operation and maintenance of equipment

IV. The Requirements of Pertinent Federal and State Regulations

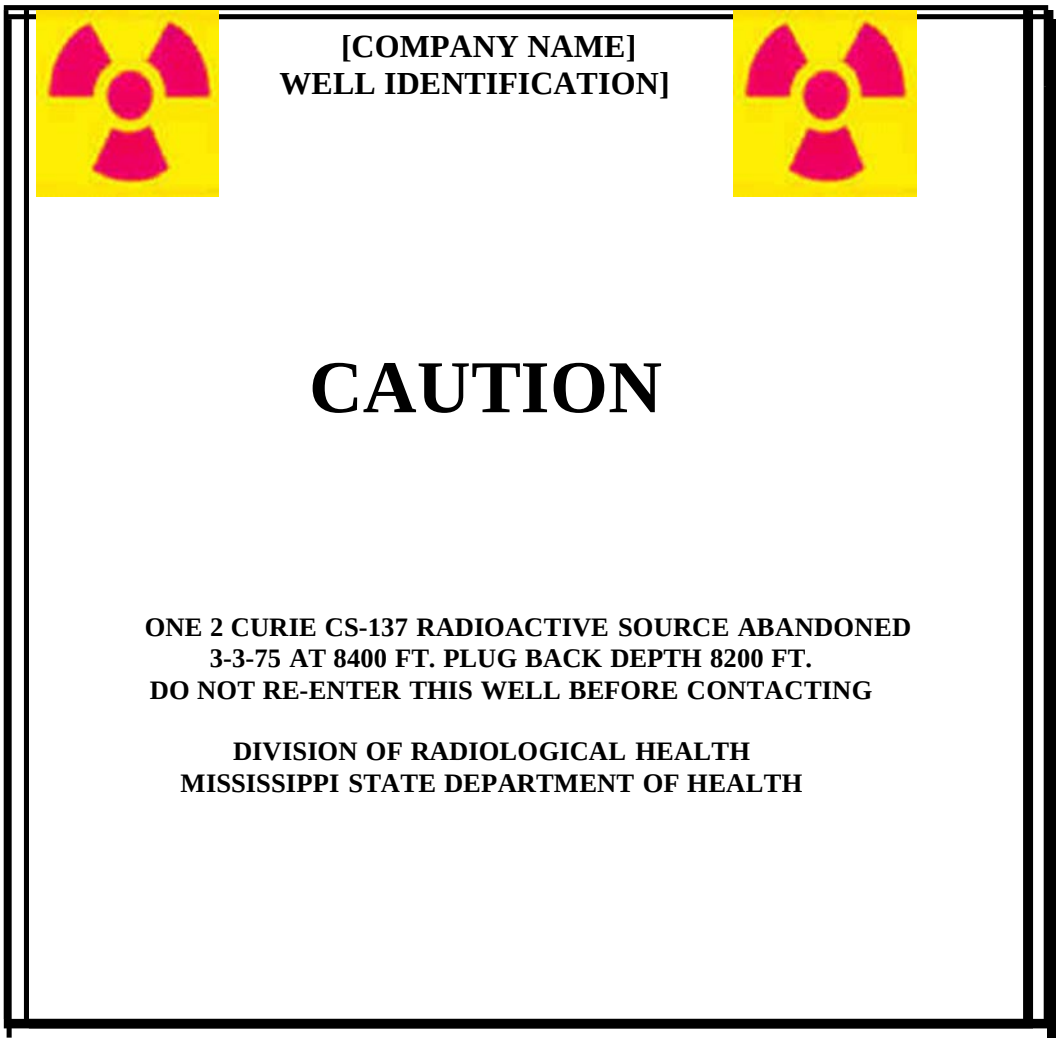
V. The Licensee's or Registrant's Written Operating and Emergency Procedures

VI. The Licensee's or Registrant's Record Keeping Procedures

VII. Case histories and potential consequences of accidents in well-logging operations

APPENDIX B

Example of Plaque for Identifying Wells Containing Sealed Sources of Radioactive Material Abandoned Downhole



Letter size of the word "CAUTION" should be approximately twice the letter size of the rest of the information, e.g., 1/2-inch and 1/4-inch letter size, respectively.

Subchapter 15 Therapeutic Radiation Machines

Rule 1.15.1 **Scope and Applicability.**

1. This section establishes requirements, for which the registrant is responsible, for use of therapeutic radiation machines. The provisions of this section are in addition to, and not in substitution for, other applicable provisions of these regulations.

2. The use of therapeutic radiation machines shall be by, or under the supervision of, a licensed practitioner of the healing arts who meets the training/experience criteria established by 1.15.3.(3)

SOURCE: Miss. Code Ann. §45-14-11

Rule 1.15.2 **Definitions.** As used in this section, the following definitions apply:

1. "Absorbed dose" is the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The special unit of absorbed dose is the rad (see "Rad").

2. "Absorbed dose rate" means absorbed dose per unit time, for machines with timers, or dose monitor unit per unit time for linear accelerators.

3. "Accessible surface" means the external surface of the enclosure or housing provided by the manufacturer.

4. "Added filtration" means any filtration which is in addition to the inherent filtration.

5. "Air kerma (K)" means the kinetic energy released in air by ionizing radiation. Kerma is determined as the quotient of dE by dM, where dE is the sum of the initial kinetic energies of all the charged ionizing particles liberated by uncharged ionizing particles in air of mass dM. Kerma is measured in the same unit as absorbed dose.

6. "Barrier" (See "Protective barrier").

7. "Beam axis" means the central ray of the useful radiation beam that passes through the isocenter and the source of radiation.

8. "Beam-limiting device" means a field defining collimator which provides a means to restrict the dimensions of the useful beam.

9. "Beam monitoring system" means a system designed and installed in the radiation head to detect and measure the radiation present in the useful beam.

10. "Beam scattering foil" means a thin piece of material (usually metallic) placed in the beam to scatter a beam of electrons in order to provide a more uniform electron distribution in the useful beam.

11. "Bent beam linear accelerator" means a linear accelerator geometry in which the accelerated electron beam must change direction by passing through a bending magnet.

12. "Changeable filters" means any filter, exclusive of inherent filtration, which can be removed from the useful beam through any electronic, mechanical, or physical process.

13. "Contact therapy system" means a therapeutic radiation machine with a short source to skin distance (SSD), usually less than 5 centimeters.

14. "Detector" (See "Radiation detector").

15. "Dose monitor unit (DMU)" means a unit response from the beam monitoring system from which the absorbed dose can be calculated.

16. "External beam radiation therapy" means therapeutic irradiation in which the source of radiation is at a distance from the body.

17. "Field-flattening filter" means a filter used to homogenize the absorbed dose rate over the radiation field.

18. "Filter" means material placed in the useful beam to change beam quality in therapeutic radiation machines subject to1.15.6.

19. "Gantry" means that part of a system supporting and allowing movements of the radiation head about a center of rotation.

20. "Gray (Gy)" means the special name for the SI unit of absorbed dose, kerma, and specific energy imparted equal to 1 joule per kilogram. The previous unit of absorbed dose (rad) is being replaced by the gray. [1 Gy=100 rad].

21. "Half-value layer (HVL)" means the thickness of a specified material which attenuates under narrow beam conditions, x-radiation or gamma radiation to an extent such that the air kerma rate, exposure rate or absorbed dose rate is reduced to one-half of the value measured without the material.

22. "Interlock" means a device preventing the start or continued operation of equipment unless certain predetermined conditions prevail.

23. "Interruption of irradiation" means the stopping of irradiation with the possibility of continuing irradiation without resetting of operating conditions at the control panel.

24. "Irradiation" means the exposure of a living being or matter to ionizing radiation.

25. "Isocenter" means the center of the smallest sphere through which the useful beam axis passes.

26. "Kilovolt (kV) [kilo electron volt (keV)]" means the energy equal to that acquired by a particle with one electron charge in passing through a potential difference of one thousand volts in a vacuum. [Note: current convention is to use kV for photons and keV for electrons.]

27. "Lead equivalent" means the thickness of the material in question affording the same attenuation, under specified conditions, as lead.

28. "Leakage radiation" means radiation emanating from the therapeutic source assembly except for the useful beam.

29. "Light field" means the area illuminated by light, being the locus of points at which the illumination exceeds a specific or specified level, simulating the radiation field.

30. "mA" means milliampere.

31. "Megavolt (MV) [mega electron volt (MeV)]" means the energy equal to that acquired by a particle with one electron charge in passing through a potential difference of one million volts in a vacuum. [Note: current convention is to use MV for photons and MeV for electrons.]

32. "Monitor unit (MU)" (See "Dose monitor unit").

33. "Moving beam radiation therapy" means radiation therapy with continuous displacement of the radiation source relative to the patient during irradiation. It includes arc therapy, skip therapy, conformal therapy and rotational therapy.

34. "Nominal treatment distance" means:

    a. For electron irradiation, the distance from the scattering foil, virtual source, or exit window of the electron beam to the entrance surface of the irradiated object along the central axis of the useful beam.

    b. For x-ray irradiation, the virtual source or target to isocenter distance along the central axis of the useful beam. For non-isocentric equipment, this distance shall be that specified by the manufacturer.

35. "Patient" means an individual subjected to machine produced external beam radiation for the purposes of medical therapy.

36. "Peak tube potential" means the maximum value of the potential difference across the x-ray tube during an exposure.

37. "Periodic quality assurance check" means a procedure which is performed to ensure that a previous calibration continues to be valid.

38. "Phantom" means an object behaving in essentially the same manner as tissue, with respect to absorption or scattering of the ionizing radiation in question.

39. "Practical range of electrons" corresponds to classical electron range where the only contribution to dose is from bremsstrahlung x-rays. Precise definition may be found in "Clinical Electron Beam Dosimetry: Report of AAPM Radiation Therapy Committee Task Group 25" [Medical Physics 18(1): 73-109, Jan/Feb 1991] and ICRU Report 35, "Radiation Dosimetry: Electron Beams with Energies Between 1 and 50 MeV", International Commission on Radiation Units and Measurements, September 15, 1984.

40. “Primary dose monitoring system" means a system which will monitor the useful beam during irradiation and which will terminate irradiation when a preselected number of dose monitor units have been acquired.

41. "Primary protective barrier" (See "Protective barrier").

42. "Protective barrier" means a barrier of radiation absorbing material(s) used to reduce radiation exposure. The types of protective barriers are as follows:

    a. "Primary protective barrier" means the material, excluding filters, placed in the useful beam, to protect anyone other than the patient from radiation exposure.

    b. "Secondary protective barrier" means a barrier sufficient to attenuate the stray radiation to the required degree.

43. "Radiation detector" means a device which, in the presence of radiation provides, by either direct or indirect means a signal or other indication suitable for use in measuring one or more quantities of incident radiation.

44. "Radiation head" means the structure from which the useful beam emerges.

45. "Radiation Therapy Physicist" means an individual qualified in accordance with 1.15.3(4).

46. "Redundant dose monitoring combination" means a combination of two dose monitoring systems in which both systems are arranged to terminate irradiation in accordance with a preselected number of dose monitor units.

47. "Response time" means the time required for an instrument system to reach 90 percent of its final reading when the radiation-sensitive volume of the instrument system is exposed to a step change in radiation flux from zero sufficient to provide a steady state midscale reading.

48. "Scattered radiation" means ionizing radiation emitted by interaction of ionizing radiation with matter, the interaction being accompanied by a change in direction

of the radiation. Scattered primary radiation means that scattered radiation which has been deviated in direction only by materials irradiated by the useful beam.

49. "Secondary dose monitoring system" means a system which will terminate irradiation in the event of failure of the primary dose monitoring system.

50. "Secondary protective barrier" (See "Protective barrier").

51. "Shadow tray" means a device attached to the radiation head to support auxiliary beam blocking material.

52. "Shutter" means a device attached to the tube housing assembly which can totally intercept the useful beam and which has a lead equivalency not less than that of the tube housing assembly.

53. "Sievert (Sv)" means the special name for the SI unit of dose equivalent. The unit of dose equivalent is the joule per kilogram. The previous unit of dose equivalent (rem) is being replaced by the sievert [1 Sv=100 rem].

54. "Simulator (radiation therapy simulation system)" means a radiographic or fluoroscopic x-ray system intended for localizing the volume to be exposed during radiation therapy and confirming the position and size of the therapeutic irradiation field.

55. "Source" means the region and/or material from which the radiation emanates.

56. "Source-skin distance (SSD)" means the distance measured along the central ray from the center of the front surface of the radiation source to the surface of the irradiated object or patient. [See also Target-skin distance]

57. "Stationary beam radiation therapy" means radiation therapy without displacement of the radiation source relative to the patient during irradiation.

58. "Stray radiation" means the sum of leakage and scattered radiation.

59. "Target" means that part of an x-ray tube or particle accelerator onto which is directed a beam of accelerated particles to produce ionizing radiation or other particles.

60. "Target-skin distance (TSD)" means the distance measured along the central ray from the center of the front surface of the x-ray target to the surface of the irradiated object or patient. [See also Source-skin distance]

61. "Tenth-value layer (TVL)" means the thickness of a specified material which attenuates under broad beam conditions, x-radiation or gamma radiation to an extent such that the air kerma rate, exposure rate or absorbed dose rate is reduced to one-tenth of the value measured without the material.

62. "Termination of irradiation" means the stopping of irradiation in a fashion which will not permit continuance of irradiation without the resetting of operating conditions at the control panel.

63. "Therapeutic radiation machine" means x-ray or electron-producing equipment designed and used for external beam radiation therapy.

64. "Tube" means an x-ray tube, unless otherwise specified.

65. "Tube housing assembly" means the tube housing with tube installed. It includes high-voltage and/or filament transformers and other appropriate elements when such are contained within the tube housing.

66. "Useful beam" means the radiation emanating from the tube housing port or the radiation head and passing through the aperture of the beam-limiting device when the exposure controls are in a mode to cause the therapeutic radiation machine to produce radiation.

67. "Virtual source" means a point from which radiation appears to originate.

68. "Wedge filter" means a filter which effects continuous change in transmission over all or a part of the radiation field.

69. "X-ray tube" means any electron tube which is designed to be used primarily for the production of x-rays.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.3 **General Administrative Requirements for Facilities Using Therapeutic Radiation Machines.**

1. **Administrative Controls.** The registrant shall be responsible for directing the operation of the therapeutic radiation machines which have been registered with the Agency. The registrant or the registrant's agent shall ensure that the requirements of Subchapter 15 are met in the operation of the therapeutic radiation machine(s).

2. A therapeutic radiation machine which does not meet the provisions of these regulations shall not be used for irradiation of patients.

3. **Training for External Beam Radiation Therapy Authorized User.** The registrant for any therapeutic radiation machine subject to 1.15.6 or 1.15.7 shall require the authorized user to be a physician who:

   a. Is certified in:

      i. Radiology or therapeutic radiology by the American Board of Radiology;

ii. Radiation oncology by the American Osteopathic Board of Radiology;

iii. Radiology, with specialization in radiotherapy, as a British "Fellow of the Faculty of Radiology" or "Fellow of the Royal College of Radiology"; or

iv. Therapeutic Radiology by the Canadian Royal College of Physicians and Surgeons; or

b. Is in the active practice of therapeutic radiology, and has completed 200 hours of instruction in basic radiation techniques applicable to the use of an external beam radiation therapy unit, 500 hours of supervised work experience, and a minimum of 3 years of supervised clinical experience.To satisfy the requirement for instruction, the classroom and laboratory training shall include:

i. Radiation physics and instrumentation;

i Radiation protection;

ii Mathematics pertaining to the use and measurement of radioactivity; and

iii Radiation biology.

ii. To satisfy the requirement for supervised work experience, training shall be under the supervision of an authorized user and shall include:

i. Review of the full calibration measurements and periodic quality assurance checks;

ii. Preparing treatment plans and calculating treatment times;

iii. Using administrative controls to prevent misadministrations;

iv. Implementing emergency procedures to be followed in the event of the abnormal operation of an external beam radiation therapy unit or console; and

v. Checking and using survey meters.

iii. To satisfy the requirement for a period of supervised clinical experience, training shall include 1 year in a formal training program approved by the Residency Review Committee for Radiology of the Accreditation Council for Graduate Medical

Education or the Committee on Postdoctoral Training of the American Osteopathic Association and an additional 2 years of clinical experience in therapeutic radiology under the supervision of an authorized user. The supervised clinical experience shall include:

i. Examining individuals and reviewing their case histories to determine their suitability for external beam radiation therapy treatment, and any limitations/contraindications;

ii. Selecting proper dose and how it is to be administered;

iii. Calculating the external beam radiation therapy doses and collaborating with the authorized user in the review of patients' progress and consideration of the need to modify originally prescribed doses as warranted by patients' reaction to radiation; and

iv. Post administration follow-up and review of case histories.

c. Notwithstanding the requirements of 1.15.3(3)(a) and 1.15.3(3)(b), the registrant for any therapeutic radiation machine subject to 1.15.6 may also submit the training of the prospective authorized user physician for Agency review on a case-by-case basis.

d. A physician shall not act as an authorized user for any therapeutic radiation machine until such time as said physician's training has been reviewed and approved by the Agency.

4. **Training for Radiation Therapy Physicist.** The registrant for any therapeutic radiation machine subject to 1.15.6 or 1.15.7 shall require the Radiation Therapy Physicist to:

a. Be registered with the Agency, under the provisions of Subchapter 2 of these regulations, as a provider of radiation services in the area of calibration and compliance surveys of external beam radiation therapy units.

b. Be certified by the American Board of Radiology in:

i. Therapeutic radiological physics;

ii. Roentgen-ray and gamma-ray physics;

iii. X-ray and radium physics; or

iv. Radiological physics; or

c. Be certified by the American Board of Medical Physics in Radiation Oncology Physics; or

d. Be certified by the Canadian College of Medical Physics; or

e. Hold a master's or doctor's degree in physics, biophysics, radiological physics, or health physics, and have completed 1 year of full-time training in therapeutic radiological physics and also 1 year of full-time work experience under the supervision of a Radiation Therapy Physicist at a medical institution. To meet this requirement, the individual shall have performed the tasks listed in 1.15.4(1), 1.15.6(16), 1.15.6(17), 1.15.7(20), and 1.15.7(21) under the supervision of a Radiation Therapy Physicist during the year of work experience; or

f. Hold a bachelor's degree in a physical science and have completed 1 additional year of full-time training in therapeutic radiological physics and also 2 years of full-time work experience under the supervision of a Radiation Therapy Physicist at a medical institution. To meet this requirement, the individual shall have performed the tasks listed in 1.15.4(1), 1.15.6(16), 1.15.6(17), 1.15.7(20), and 1.15.7(21) under the supervision of a Radiation Therapy Physicist during the 2 years of work experience.

Agency review of applicants in this category will only be on a case-by-case basis and additional information may be required for the Agency to determine if the applicant is qualified to function as a Radiation Therapy Physicist.

5. **Qualifications of Operators**

a. Individuals who will be operating a therapeutic radiation machine for medical use shall be American Registry of Radiologic Technologists (ARRT) Registered Radiation Therapy Technologists. Individuals who are not ARRT Registered Radiation Therapy Technologists shall submit evidence that they have satisfactorily completed a radiation therapy technologist training program that complies with the requirements of the Joint Review Committee on Education in Radiologic Technology. ARRT Registered Radiologic Technologists, who have been working for two years or more in radiation therapy, will be allowed three years from the effective date of these regulations to fulfill the above listed requirements.[59]

b. The names and training of all personnel currently operating a therapeutic radiation machine shall be kept on file at the facility. Information on former operators shall be retained for a period of 2 years beyond the last

[59] "Essentials and Guidelines of an Accredited Educational Program for the Radiation Therapy Technologist", Joint Review Committee on Education in Radiologic Technology, 1988.

date they were authorized to operate a therapeutic radiation machine at that facility.

6. Written safety procedures and rules shall be developed by a Radiation Therapy Physicist and shall be provided to each individual operating a therapeutic radiation machine, including any restrictions of the operating technique required for the safe operation of the particular therapeutic radiation machine. The operator shall be able to demonstrate familiarity with these rules.

7. Individuals shall not be exposed to the useful beam except for medical therapy purposes and unless such exposure has been ordered in writing by a licensed practitioner of the healing arts who is specifically identified on the Certificate of Registration. This provision specifically prohibits deliberate exposure of an individual for training, demonstration or other non-healing-arts purposes.

8. All individuals associated with the operation of a therapeutic radiation machine shall be instructed in and shall comply with the provisions of the registrant's quality management program. In addition to the requirements of Subchapter 15, these individuals are also subject to the requirements of 1.4.5, 1.4.10, and 1.4.18.

9. **Information and Maintenance Record and Associated Information.** The registrant shall maintain the following information in a separate file or package for each therapeutic radiation machine, for inspection by the Agency:

   a. Report of acceptance testing;

   b. Records of surveys, calibrations, and periodic quality assurance checks of the therapeutic radiation machine required by Subchapter 15, as well as the name(s) of person(s) who performed such activities;

   c. Records of major maintenance and modifications performed on the therapeutic radiation machine after the effective date of these regulations, as well as the name(s) of person(s) who performed such services; and

   d. Signature of person authorizing the return of therapeutic radiation machine to clinical use after service, repair, or upgrade.

10. **Records Retention.** All records required by Subchapter 15 shall be retained until disposal is authorized by the Agency unless another retention period is specifically authorized in Subchapter 15. All required records shall be retained in an active file from at least the time of generation until the next Agency inspection. Any required record generated prior to the last Agency inspection may be microfilmed or otherwise archived as long as a complete copy of said record can be retrieved until such time as the Agency authorizes final disposal.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.4 **General Technical Requirements for Facilities Using Therapeutic Radiation Machines.**

1. **Protection Surveys.**

a. The registrant shall ensure that radiation protection surveys of all new facilities, and existing facilities not previously surveyed are performed with an operable radiation measurement survey instrument calibrated in accordance with1.15.8. The radiation protection survey shall be performed by, or under the direction of, a Radiation Therapy Physicist or a Certified Health Physicist and shall verify that, with the therapeutic radiation machine in a "BEAM-ON" condition, with the largest clinically available treatment field and with a scattering phantom in the primary beam of radiation:

i. Radiation levels in restricted areas are not likely to cause personnel exposures in excess of the limits specified in 1.4.6(1); and

ii. Radiation levels in unrestricted areas do not exceed the limits specified in 1.4.14(1) and 1.4.14(2).

b. In addition to the requirements of 1.15.4(1)(a), a radiation protection survey shall also be performed prior to any subsequent medical use and:

i. After making any change in the treatment room shielding;

ii. After making any change in the location of the therapeutic radiation machine within the treatment room;

iii. After relocating the therapeutic radiation machine; or

iv. Before using the therapeutic radiation machine in a manner that could result in increased radiation levels in areas outside the external beam radiation therapy treatment room.

c. The survey record shall indicate all instances where the facility, in the opinion of the Radiation Therapy Physicist or a Certified Health Physicist, is in violation of applicable regulations. The survey record shall also include the date of the measurements, the reason the survey is required, the manufacturer's name, model number and serial number of the therapeutic radiation machine, the instrument(s) used to measure radiation levels, a plan of the areas surrounding the treatment room that were surveyed, the measured dose rate at several points in each area expressed in millirems (microsieverts) per hour, the calculated maximum level of radiation over a period of 1 week for each restricted and unrestricted area, and the signature of the individual responsible for conducting the survey;

d. If the results of the surveys required by 1.15.4(1)(a) or 1.15.4(1)(b) indicate any radiation levels in excess of the respective limit specified in1.15.4(1)(a), the registrant shall lock the control in the "OFF" position and not use the unit:

i. Except as may be necessary to repair, replace, or test the therapeutic radiation machine, the therapeutic radiation machine shielding, or the treatment room shielding; or

ii. Until the registrant has received a specific exemption from the Agency.

2. **Modification of Radiation Therapy Unit or Room Before Beginning a Treatment Program.** If the survey required by 1.15.4(1) indicates that an individual in an unrestricted area may be exposed to levels of radiation greater than those permitted by 1.4.14(1) of these regulations, before beginning the treatment program the registrant shall:

a. Either equip the unit with beam direction interlocks or add additional radiation shielding to ensure compliance with 1.4.14(1) of these regulations;

b. Perform the survey required by 1.15.4(1) again; and

c. Include in the report required by 1.15.4(4) the results of the initial survey, a description of the modification made to comply with 1.15.4(2)(a), and the results of the second survey; or

d. Request and receive a registration amendment under 1.4.14(3) of these regulations that authorizes radiation levels in unrestricted areas greater than those permitted by 1.4.14(1) of these regulations.

3. **Dosimetry Equipment.**

a. The registrant shall have a calibrated dosimetry system available for use. The system shall have been calibrated for Cobalt-60 by the National Institute for Standards and Technology (NIST) or by an American Association of Physicists in Medicine (AAPM) Accredited Dosimetry Calibration Laboratory (ADCL). The calibration shall have been performed within the previous 24 months and after any servicing that may have affected system calibration;

b. The registrant shall have available for use a dosimetry system for quality assurance check measurements. To meet this requirement, the system may be compared with a system that has been calibrated in accordance with 1.15.4(3)(a). This comparison shall have been performed within the previous 12 months (6 months if the dosimetry system is an ionization chamber) and after each servicing that may have affected system

calibration. The quality assurance check system may be the same system used to meet the requirement in 1.15.4(3)(a); and

c. The registrant shall maintain a record of each dosimetry system calibration, intercomparison, and comparison for the duration of the license and/or registration. For each calibration, intercomparison, or comparison, the record shall include the date, the model numbers and serial numbers of the instruments that were calibrated, intercompared, or compared as required by 1.15.4(3)(a) and 1.15.4(3)(b), the correction factors that were determined, the names of the individuals who performed the calibration, intercomparison, or comparison, and evidence that the intercomparison was performed by, or under the direct supervision of, a Radiation Therapy Physicist.

4. **Reports of External Beam Radiation Therapy Surveys and Measurements.** The registrant for any therapeutic radiation machine subject to 1.15.6 or 1.15.7 shall furnish a copy of the records required in 1.15.4(1) and 1.15.4(2) to the Agency within 30 days following completion of the action that initiated the record requirement.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.5 **Quality Management Program.**

1. In addition to the definitions in 1.15.2, the following definitions are applicable to a quality management program:

a. "Prescribed dose" means the total dose and dose per fraction as documented in the written directive.

b. "Misadministration" means the administration of an external beam radiation therapy dose:

i. Involving the wrong patient, wrong treatment modality, or wrong treatment site;

ii. When the treatment consists of three (3) or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than 10 percent of the total prescribed dose;

iii. When the calculated weekly administered dose is 30 percent greater than the weekly prescribed dose; or

iv. When the calculated total administered dose differs from the total prescribed dose by more than 20 percent of the total prescribed dose.

c. "Recordable event" means the administration of an external beam radiation therapy dose when the calculated weekly administered dose is 15 percent greater than the weekly prescribed dose.

d. "Written directive" means an order in writing for a specific patient, dated and signed by an authorized user prior to the administration of radiation, containing the following information: total dose, dose per fraction, treatment site and overall treatment period.

2. **Scope and Applicability.** Each applicant or registrant subject to 1.15.6 or 1.15.7 shall establish and maintain a written quality management program to provide high confidence that radiation will be administered as directed by the authorized user. The quality management program shall include written policies and procedures to meet the following specific objectives:

a. Prior to administration, a written directive is prepared for any external beam radiation therapy dose;

i. Notwithstanding 1.15.5(2)(a), a written revision to an existing written directive may be made provided that the revision is dated and signed by an authorized user prior to administration of the external beam radiation therapy dose or the next external beam radiation therapy fractional dose;

ii. Notwithstanding 1.15.5(2)(a), if, because of the patient's condition, a delay in order to provide a written revision to an existing written directive would jeopardize the patient's health, an oral revision to an existing written directive shall be acceptable, provided that the oral revision is documented immediately in the patient's record and a revised written directive is signed by an authorized user within 48 hours of the oral revision; or

iii. Notwithstanding 1.15.5(2)(a), if, because of the emergent nature of the patient's condition, a delay in order to provide a written directive would jeopardize the patient's health, an oral directive shall be acceptable, provided that the information contained in the oral directive is documented immediately in the patient's record and a written directive is prepared and signed by an authorized user within 24 hours of the oral directive.

b. Prior to each administration, the patient's identity is verified, by more than one method, as the individual named in the written directive;

c. External beam radiation therapy final plans of treatment and related calculations are in accordance with the respective written directives;

d. Each administration is in accordance with the written directive; and

e. Any unintended deviation from the written directive is identified and evaluated, and appropriate action is taken.

3. **Submission of Quality Management Program**

a. Each applicant subject to 1.15.6 or 1.15.7 shall submit a quality management program to the Agency as part of the application required by Subchapter 2 of these regulations. The registrant shall implement the program upon issuance of a Certificate of Registration by the Agency.

b. Each existing registrant subject to 1.15.6 or 1.15.7 shall, within 30 days of the effective date of these regulations, submit to the Agency a written certification that a quality management program has been implemented, as well as a copy of said program.

4. As a part of the quality management program, the registrant shall:

a. Develop procedures for, and conduct a review of, the quality management program including, since the last review, an evaluation of a representative sample of patient administrations, all recordable events, and all misadministrations to verify compliance with all aspects of the quality management program;

b. Conduct these reviews at intervals not to exceed 12 months;

c. Evaluate each of these reviews to determine the effectiveness of the quality management program and, if required, make modifications to meet the requirements of 1.15.5(2); and

d. Maintain records of each review, including the evaluations and findings of the review, in an auditable form, for 3 years.

5. The registrant shall evaluate and respond, within 30 days after discovery of the recordable event, to each recordable event by:

a. Assembling the relevant facts including the cause;

b. Identifying what, if any, corrective action is required to prevent recurrence; and

c. Retaining a record, in an auditable form, for 3 years, of the relevant facts and what corrective action, if any, was taken.

6. The registrant shall retain:

a. Each written directive; and

b. A record of each administered radiation dose, in an auditable form, for 3 years after the date of administration.

7. The registrant may make modifications to the quality management program to increase the program's efficiency provided the program's effectiveness is not decreased. The registrant shall furnish the modifications to the Agency within 30 days after the modification has been made.

8. The registrant shall evaluate each misadministration and shall take the following actions in response to a misadministration:

a. Notify the Agency by telephone no later than the next calendar day after discovery of the misadministration;

b. Submit a written report to the Agency within 15 days after discovery of the misadministration. The written report shall include: the registrant's name; the prescribing physician's name; a brief description of the event; why the event occurred; the effect on the patient; what improvements are needed to prevent recurrence; actions taken to prevent recurrence; whether the registrant notified the patient or the patient's responsible relative or guardian (this person will subsequently be referred to as "the patient"), and if not, why not, and if the patient was notified, what information was provided to the patient. The report shall not include the patient's name or other information that could lead to identification of the patient;

c. Notify the referring physician and also notify the patient of the misadministration no later than 24 hours after its discovery, unless the referring physician personally informs the registrant either that he/she will inform the patient or that, based on medical judgment, telling the patient would be harmful. The registrant is not required to notify the patient without first consulting the referring physician. If the referring physician or patient cannot be reached within 24 hours, the registrant shall notify the patient as soon as possible thereafter. The registrant shall not delay any appropriate medical care for the patient, including any necessary remedial care as a result of the misadministration, because of any delay in notification;

d. Retain a record of each misadministration for 5 years. The record shall contain the names of all individuals involved (including the prescribing physician, allied health personnel, the patient, and the patient's referring physician), the patient's social security number or identification number if one has been assigned, a brief description of the event, why it occurred, the effect on the patient, what improvements are needed to prevent recurrence, and the actions taken to prevent recurrence; and

e. If the patient was notified, furnish, within 15 days after discovery of the misadministration, a written report to the patient by sending either a copy

of the report that was submitted to the Agency, or a brief description of both the event and the consequences as they may effect the patient, provided a statement is included that the report submitted to the Agency can be obtained from the registrant.

9. Aside from the notification requirement, nothing in 1.15.5(8) affects any rights or duties of registrants and physicians in relation to each other, patients, or the patient's responsible relatives or guardians.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.6 **Therapeutic Radiation Machines of Less Than 500 kV.**

1. **Leakage Radiation.** When the x-ray tube is operated at its maximum rated tube current for the maximum kV, the leakage kerma rate shall not exceed the value specified at the distance specified for that classification of therapeutic radiation machine:

   a. 5-50 kV Systems. The leakage air kerma rate measured at any position 5 centimeters from the tube housing assembly shall not exceed 100 mrad (1 mGy) in any one hour.

   b. >50 and <500 kV Systems. The leakage air kerma rate measured at a distance of 1 meter from the source in any direction shall not exceed 1 rad (1 cGy) in any one hour. This air kerma rate measurement may be averaged over areas no larger than 100 square centimeters. In addition, the air kerma rate at a distance of 5 centimeters from the surface of the tube housing assembly shall not exceed 30 rad (3O cGy) per hour.

2. **Permanent Beam-Limiting Devices.** Permanent diaphragms or cones used for limiting the useful beam shall provide at least the same degree of attenuation as required for the tube housing assembly.

3. **Adjustable or Removable Beam-Limiting Devices.**

   a. All adjustable or removable beam-limiting devices, diaphragms, cones or blocks shall not transmit more than 5 percent of the useful beam for the most penetrating beam used.

   b. When adjustable beam-limiting devices are used, the position and shape of the radiation field shall be indicated by a light beam.

4. **Filter System.** The filter system shall be so designed that:

   a. Filters cannot be accidentally displaced at any possible tube orientation;

   b. For equipment installed after the effective date of these regulations, an interlock system prevents irradiation if the proper filter is not in place;

c. The air kerma rate escaping from the filter slot shall not exceed 1 rad (1 cGy) per hour under any operating conditions; and

d. Each filter shall be marked as to its material of construction and its thickness.

5. **Tube Immobilization.**

a. The x-ray tube shall be so mounted that it cannot accidentally turn or slide with respect to the housing aperture; and

b. The tube housing assembly shall be capable of being immobilized for stationary portal treatments.

6. **Source Marking.** The tube housing assembly shall be so marked that it is possible to determine the location of the source to within 5 millimeters, and such marking shall be readily accessible for use during calibration procedures.

7. **Beam Block.** Contact therapy tube housing assemblies shall have a removable shield of material, equivalent in attenuation to 0.5 millimeters of lead at 100 kV, which can be positioned over the entire useful beam exit port during periods when the beam is not in use.

8. **Timer.** A suitable irradiation control device shall be provided to terminate the irradiation after a preset time interval.

a. A timer which has a display shall be provided at the treatment control panel. The timer shall have a preset time selector and an elapsed time indicator;

b. The timer shall be a cumulative timer which activates with an indication of "BEAM-ON" and retains its reading after irradiation is interrupted or terminated. After irradiation is terminated and before irradiation can be reinitiated, it shall be necessary to reset the elapsed time indicator;

c. The timer shall terminate irradiation when a preselected time has elapsed, if any dose monitoring system present has not previously terminated irradiation;

d. The timer shall permit accurate presetting and determination of exposure times as short as 1 second;

e. The timer shall not permit an exposure if set at zero;

f. The timer shall not activate until the shutter is opened when irradiation is controlled by a shutter mechanism unless calibration includes a timer error correction to compensate for mechanical lag; and

g. The timer shall be accurate to within 1 percent of the selected value or 1 second, whichever is greater.

9. **Control Panel Functions.** The control panel, in addition to the displays required by other provisions in 1.15.6 shall have:

a. An indication of whether electrical power is available at the control panel and if activation of the x-ray tube is possible;

b. An indication of whether x-rays are being produced;

c. Means for indicating x-ray tube potential and current;

d. The means for terminating an exposure at any time;

e. A locking device which will prevent unauthorized use of the therapeutic radiation machine; and

f. For therapeutic radiation machines manufactured after the effective date of these regulations, a positive display of specific filter(s) in the beam.

10. **Multiple Tubes.** When a control panel may energize more than one x-ray tube:

a. It shall be possible to activate only one x-ray tube at any time;

b. There shall be an indication at the control panel identifying which x-ray tube is activated; and

c. There shall be an indication at the tube housing assembly when that tube is energized.

11. **Source-to-Skin Distance (SSD).** There shall be a means of determining the central axis SSD to within 1 centimeter and of reproducing this measurement to within 2 millimeters thereafter.

12. **Shutters.** Unless it is possible to bring the x-ray output to the prescribed exposure parameters within 5 seconds after the x-ray "ON" switch is energized, the beam shall be attenuated by a shutter having a lead equivalency not less than that of the tube housing assembly. In addition, after the unit is at operating parameters, the shutter shall be controlled electrically by the operator from the control panel. An indication of shutter position shall appear at the control panel.

13. **Low Filtration X-ray Tubes.** Each therapeutic radiation machine equipped with a beryllium or other low-filtration window shall be clearly labeled as such upon the tube housing assembly and shall be provided with a permanent warning device on the control panel that is activated when no additional filtration is present to indicate that the dose rate is very high.

14. **Facility Design Requirements for Therapeutic Radiation Machines Capable of Operating in the Range 50 kV to 500 kV.** In addition to shielding adequate to meet requirements of 1.15.9, the treatment room shall meet the following design requirements:

a. Aural Communication. Provision shall be made for continuous two-way aural communication between the patient and the operator at the control panel.

b. Viewing Systems. Provision shall be made to permit continuous observation of the patient during irradiation and shall be so located that the operator can observe the patient from the control panel. The therapeutic radiation machine shall not be used for patient irradiation unless at least one viewing system is operational.

15. **Additional Requirements.** Treatment rooms which contain a therapeutic radiation machine capable of operating above 150 kV shall meet the following additional requirements:

a. All protective barriers shall be fixed except for entrance doors or beam interceptors;

b. The control panel shall be located outside the treatment room or in a totally enclosed booth, which has a ceiling, inside the room;

c. Interlocks shall be provided such that all entrance doors, including doors to any interior booths, shall be closed before treatment can be initiated or continued. If the radiation beam is interrupted by any door opening, it shall not be possible to restore the machine to operation without closing the door and reinitiating irradiation by manual action at the control panel; and

d. When any door referred to in 1.15.6(15)(c) is opened while the x-ray tube is activated, the air kerma rate at a distance of 1 meter from the source shall be reduced to less than 100 mrad (1 mGy) per hour.

16. **Full Calibration Measurements.**

a. Full calibration of a therapeutic radiation machine subject to 1.15.6 shall be performed by, or under the direct supervision of, a Radiation Therapy Physicist:

i. Before the first medical use following installation or reinstallation of the therapeutic radiation machine;

ii. At intervals not exceeding 1 year; and

iii. Before medical use under the following conditions:

i. Whenever quality assurance check measurements indicate that the radiation output differs by more than 5 percent from the value obtained at the last full calibration and the difference cannot be easily discerned; and

ii. Following any component replacement, major repair, or modification of components that could significantly affect the characteristics of the radiation beam.

b. To satisfy the requirement of 1.15.6(16)(a), full calibration shall include all measurements recommended for annual calibration by NCRP Report 69, "Dosimetry of X-Ray and Gamma Ray Beams for Radiation Therapy in the Energy Range 10 keV to 50 MeV" (1981).

c. A registrant shall maintain a record of each calibration for the duration of the registration. The record shall include the date of the calibration, the manufacturer's name, model number, and serial number for both the therapeutic radiation machine and the x-ray tube, the model numbers and serial numbers of the instruments used to calibrate the therapeutic radiation machine, and the signature of the Radiation Therapy Physicist responsible for performing the calibration.

17. **Periodic Quality Assurance Checks.**

a. Periodic quality assurance checks shall be performed on therapeutic radiation machines subject to 1.15.6, which are capable of operation at greater than 150 kV.

b. To satisfy the requirement of 1.15.6(17)(a), quality assurance checks shall meet the following requirements:

i. The registrant shall perform quality assurance checks in accordance with written procedures established by the Radiation Therapy Physicist; and

ii. The quality assurance check procedures shall specify the frequency at which tests or measurements are to be performed. The quality assurance check procedures shall specify that the quality assurance check shall be performed during the calibration specified 1.15.6(16)(a). The acceptable tolerance for each parameter measured in the quality assurance check, when compared to the value for that parameter determined in the calibration specified in 1.15.6(16)(a) shall be stated.

c. The cause for a parameter exceeding a tolerance set by the Radiation Therapy Physicist shall be investigated and corrected before the system is used for patient irradiation.

d. Whenever a quality assurance check indicates a significant change in the operating characteristics of a system, as specified in the Radiation Therapy Physicist's quality assurance check procedures, the system shall be recalibrated as required in 1.15.6(16)(a).

e. The registrant shall use the dosimetry system described in 1.15.4(3) to make the quality assurance check required in 1.15.6(17)(b).

f. The registrant shall have the Radiation Therapy Physicist review and sign the results of each radiation output quality assurance check at intervals not to exceed 1 month. The Radiation Therapy Physicist shall promptly notify the registrant in writing of the results of each radiation output quality assurance check. The registrant shall keep a copy of each written notification for 3 years.

g. Therapeutic radiation machines subject to 1.15.6 shall have safety quality assurance checks of each external beam radiation therapy facility performed at intervals not to exceed 1 month.

h. To satisfy the requirement of 1.15.6(17)(g), safety quality assurance checks shall ensure proper operation of:

i. Electrical interlocks at each external beam radiation therapy room entrance;

ii. Proper operation of the "BEAM-ON" and termination switches;

iii. Beam condition indicator lights on the access door(s), control console, and in the radiation therapy room;

iv. Viewing systems; and

v. Electrically operated treatment room doors from inside and outside the treatment room.

i. The registrant shall promptly repair any system identified in 1.15.6(17)(h) that is not operating properly.

j. The registrant shall maintain a record of each quality assurance check required by 1.15.6(17)(a) and 1.15.6(17)(g) for 3 years. The record shall include the date of the quality assurance check, the manufacturer's name, model number, and serial number for the therapeutic radiation machine, the manufacturer's name, model number and serial number of the instrument(s) used to measure the radiation output of the therapeutic radiation machine, and the signature of the individual who performed the periodic quality assurance check.

18. **Operating Procedures.**

a. The therapeutic radiation machine shall not be used for irradiation of patients unless the requirements of 1.15.6(16) and 1.15.6(17) have been met;

b. Therapeutic radiation machines shall not be left unattended unless it is secured pursuant to 1.15.6(9)(e);

c. When a patient must be held in position for radiation therapy, mechanical supporting or restraining devices shall be used;

d. The tube housing assembly shall not be held by an individual during operation unless the assembly is designed to require such holding and the peak tube potential of the system does not exceed 50 kV. In such cases, the holder shall wear protective gloves and apron of not less than 0.5 millimeters lead equivalency at 100 kV;

e. A copy of the current operating and emergency procedures shall be maintained at the therapeutic radiation machine control console; and

f. No individual other than the patient shall be in the treatment room during exposures from therapeutic radiation machines operating above 150 kV. At energies less than or equal to 150 kV, any individual, other than the patient, in the treatment room shall be protected by a barrier sufficient to meet the requirements of 1.4.6 of these regulations.

19. **Possession of Survey Instrument(s).** The registrant authorized to use a therapeutic radiation machine in accordance with 1.15.6 shall possess appropriately calibrated portable monitoring equipment. As a minimum, such equipment shall include a portable radiation measurement survey instrument capable of measuring dose rates over the range 1 mrem (10 μSv) per hour to 1000 mrem (10 mSv) per hour. The survey instrument(s) shall be operable and calibrated in accordance with 1.15.8.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.7 **Therapeutic Radiation Machines - Photon Therapy Systems (500 kV and Above) and Electron Therapy Systems (500 keV and Above).**

1. **Possession of Survey Instrument(s).** A registrant authorized to use a therapeutic radiation machine in accordance with 1.15.7 shall possess appropriately calibrated portable monitoring equipment. As a minimum, such equipment shall include a portable radiation measurement survey instrument capable of measuring dose rates over the range 1 mrem (10 μSv) per hour to 1000 mrem (10 mSv) per hour. The survey instrument(s) shall be operable and calibrated in accordance with 1.15.8.

2. **Leakage Radiation Outside the Maximum Useful Beam in Photon and Electron Modes.**

a. The absorbed dose rate due to leakage radiation (excluding neutrons) at any point outside the maximum sized useful beam, but within a circular plane of radius 2 meters which is perpendicular to and centered on the central axis of the useful beam at the nominal treatment distance (i.e., patient plane), shall not exceed a maximum of 0.2 percent and an average of 0.1 percent of the absorbed dose rate on the central axis of the beam at the nominal treatment distance. Measurements shall be averaged over an area up to but not exceeding 100 square centimeters at the positions specified;

b. Except for the area defined in 1.15.7(2)(a), the absorbed dose rate in tissue (excluding that from neutrons) at I meter from the electron path between the source and the target or electron window shall not exceed 0.5 percent of the absorbed dose rate in tissue on the central axis of the beam at the nominal treatment distance. Measurements shall be averaged over an area up to but not exceeding 100 square centimeters at the positions specified;

c. The neutron absorbed dose rate outside the useful beam shall be kept as low as practicable. Measurements of the portion of the leakage radiation dose contributed by neutrons shall be averaged over an area up to but not exceeding 800 square centimeters; and

d. For each therapeutic radiation machine, the registrant shall determine, or obtain from the manufacturer, the leakage radiation existing at the positions specified in 1.15.7(2)(a) through 1.15.7(2)(c) for the specified operating conditions. Records on leakage radiation measurements shall be maintained at the installation for inspection by the Agency.

3. **Leakage Radiation Through Beam-Limiting Devices.**

a. Photon Radiation. All adjustable or interchangeable beam-limiting devices shall attenuate the useful beam such that:

i. At the nominal treatment distance, the maximum absorbed dose anywhere in the area shielded by the beam-limiting device(s) shall not exceed 2 percent of the maximum absorbed dose on the central axis of the useful beam measured in a 10 centimeters by 10 centimeters radiation field.

ii. For fields of any size in which the maximum area shielded by the beam-limiting devices exceeds 500 square centimeters, the product of the average absorbed dose due to leakage radiation through the beam-limiting devices and the maximum area protectable by the beam-limiting devices shall not exceed one tenth (0.1) of the product of the maximum absorbed dose on the central axis of the useful beam and the area of the useful beam for a radiation field of

10 centimeters by 10 centimeters. All values of absorbed dose and area are referred to the nominal treatment distance.

b. **Electron Radiation.** All adjustable or interchangeable electron applicators shall attenuate the radiation, including but not limited to photon radiation generated by electrons incident on the beam-limiting device and electron applicator and other parts of the radiation head, such that the following limits apply:

i. The absorbed dose in a plane perpendicular to the central axis of the useful beam at the nominal treatment distance shall not exceed:

i. An average of 2 percent of the absorbed dose on the central axis of the useful beam at the nominal treatment distance. This limit shall apply in the area between a line 4 centimeters outside the periphery of the geometrical radiation field and the border of the maximum area protectable by the electron applicator; and

ii. A maximum of 10 percent of the absorbed dose on the central axis of the useful beam at the nominal treatment distance. This limit shall apply in the area between a line 2 centimeters outside the periphery of the geometrical radiation field and the border of the maximum area protectable by the electron applicator.

ii. For fields of any size in which the maximum area shielded by the electron applicator exceeds 1000 square centimeters, the product of the average absorbed dose due to leakage radiation through the electron applicators and the maximum area protectable by the electron applicators shall not exceed two tenths (0.2) of the product of the maximum absorbed dose on the central axis of the useful beam and the area of the useful beam for a radiation field of 10 centimeters by 10 centimeters. All values of absorbed dose and area are referred to the nominal treatment distance.

c. Measurement of Leakage Radiation.

i. **Photon Radiation.** Measurements of leakage radiation through the beam-limiting devices shall be made with the beam-limiting devices closed and any residual aperture blocked by at least two (2) tenth value layers of suitable absorbing material. In the case of overlapping beam-limiting devices, the leakage radiation through each set shall be measured independently, and the leakage radiation from each set shall not exceed a maximum of 2 percent anywhere in the area protectable by that beam-limiting device.

ii. **Electron Radiation.** Measurements of leakage radiation through the electron applicators shall be made with the electron beam directed into the air and using a radiation detector of area up to but not exceeding 1 square centimeter suitably protected against radiation which has been scattered from material beyond the radiation detector. Measurements shall be made using 1 centimeter of tissue equivalent build up material.

d. When adjustable beam-limiting devices are used, the position and shape of the radiation field shall be indicated by a light field.

4. **Filters/Wedges.**

a. Each filter and/or wedge which is removable from the system shall be clearly marked with an identification number. For removable wedge filters, the nominal wedge angle shall appear on the wedge or wedge tray (if permanently mounted to the tray). If the wedge or wedge tray is damaged, the wedge transmission factor shall be redetermined;

b. If the absorbed dose rate information required by 1.15.7(9) relates exclusively to operation with a field flattening or beam scattering filter in place, such filter shall be removable only by the use of tools;

c. For equipment manufactured after the effective date of these regulations which utilize a system of wedge filters, interchangeable field flattening filters, or interchangeable beam scattering foils:

i. Irradiation shall not be possible until a selection of a filter or a positive selection to use "no filter" has been made at the treatment control panel, either manually or automatically;

ii. An interlock system shall be provided to prevent irradiation if the filter selected is not in the correct position;

iii. A display shall be provided at the treatment control panel showing the wedge filter(s), interchangeable field flattening filter(s), and/or interchangeable beam scattering foil(s) in use; and

iv. An interlock shall be provided to prevent irradiation if any filter and/or beam scattering foil selection operation carried out in the treatment room does not agree with the filter and/or beam scattering foil selection operation carried out at the treatment control panel.

5. **X-Ray Stray Radiation in the Useful Electron Beam.** For equipment manufactured after the effective date of these regulations, the registrant shall determine during acceptance testing, or obtain from the manufacturer, data sufficient to ensure that x-ray stray radiation in the useful electron beam, absorbed

dose at the surface during x-ray irradiation and stray neutron radiation in the useful x-ray beam are in compliance with International Electrotechnical Commission (IEC) Document 601-2-1 (most current revision).

6. **Beam Monitors.** All therapeutic radiation machines subject to 1.15.7 shall be provided with beam monitoring devices. The sensors for this device shall be fixed in the useful beam during treatment, (or interlocked) to indicate the air kerma rate or dose rate.

   a. Equipment manufactured after the effective date of these regulations shall be provided with at least two independently powered integrating dose meters. Alternatively, a common power supply may be used if the production of radiation is terminated upon failure of any common element.

   b. Equipment manufactured on or before the effective date of these regulations shall be provided with at least one radiation detector. This detector shall be incorporated into a primary beam monitoring system;

   c. The detector and the system into which that detector is incorporated shall meet the following requirements:

      i. Each detector shall be removable only with tools and, if movable, shall be interlocked to prevent incorrect positioning;

      ii. Each detector shall form part of a beam monitoring system from whose readings in dose monitor units the absorbed dose at a reference point in the treatment volume can be calculated;

      iii. Each beam monitoring system shall be capable of independently monitoring, interrupting, and terminating irradiation; and

      iv. For equipment manufactured after the effective date of these regulations, the design of the beam monitoring systems shall ensure that the:

         i. Malfunctioning of one system shall not affect the correct functioning of the secondary system; and

         ii. Failure of any element common to both systems which could affect the correct function of both systems shall terminate irradiation or prevent the initiation of radiation.

      v. Each beam monitoring system shall have a legible display at the treatment control panel. For equipment manufactured after the effective date of these regulations, each display shall:

         i. maintain a reading until intentionally reset;

ii. have only one scale and no electrical or mechanical scale multiplying factors;

iii. utilize a design such that increasing dose is displayed by increasing numbers; and

iv. In the event of power failure, the beam monitoring information required in 1.15.7(6)(c)(v)(iii) displayed at the control panel at the time of failure shall be retrievable in at least one system for a 20 minute period of time.

7. **Beam Symmetry.**

a. Bent-beam linear accelerators subject to 1.15.7 shall be provided with auxiliary device(s) to monitor beam symmetry;

b. The device(s) referenced in 1.15.7(7)(a) shall be able to detect field asymmetry greater than 10 percent; and

c. The device(s) referenced in 1.15.7(7)(a) shall be configured to terminate irradiation if the specifications in 1.15.7(7)(b) cannot be maintained.

8. **Selection and Display of Dose Monitor Units.**

a. Irradiation shall not be possible until a selection of a number of dose monitor units has been made at the treatment control panel;

b. The preselected number of dose monitor units shall be displayed at the treatment control panel until reset manually for the next irradiation;

c. After termination of irradiation, it shall be necessary to reset the dosimeter display before subsequent treatment can be initiated; and

d. For equipment manufactured after the effective date of these regulations, after termination of irradiation, it shall be necessary for the operator to reset the preselected dose monitor units before irradiation can be initiated.

9. **Air Kerma Rate/Absorbed Dose Rate.** For equipment manufactured after the effective date of these regulations, a system shall be provided whose readings the air kerma rate or absorbed dose rate at a reference point in the treatment volume can be calculated. [The radiation detectors specified in 1.15.7(6) may form part of this system.] In addition:

a. The dose monitor unit dose rate shall be displayed at the treatment control panel;

b. If the equipment can deliver under any conditions, an air kerma rate or absorbed dose rate at the nominal treatment distance more than twice the

maximum value specified by the manufacturer, a device shall be provided which terminates irradiation when the air kerma rate or absorbed dose rate exceeds a value twice the specified maximum. The dose rate at which the irradiation will be terminated shall be a record maintained by the registrant; and

c. For equipment manufactured after the effective date of these regulations, if the equipment can deliver under any conditions an air kerma rate or absorbed dose rate at the nominal treatment distance more than ten (10) times the maximum value specified by the manufacturer, a device shall be provided to prevent the air kerma rate or absorbed dose rate anywhere in the radiation field from exceeding twice the specified maximum value and to terminate irradiation if the excess absorbed dose at the nominal treatment distance exceeds 400 rad (4 Gy).

10. **Termination of Irradiation by the Beam Monitoring System or Systems During Stationary Beam Radiation Therapy.**

a. Each primary system shall terminate irradiation when the preselected number of dose monitor units has been detected by the system;

b. If original design of the equipment included a secondary dose monitoring system, that system shall be capable of terminating irradiation when not more than 15 percent or 40 dose monitor units above the preselected number of dose monitor units set at the control panel has been detected by the secondary dose monitoring system; and

c. For equipment manufactured after the effective date of these regulations, an indicator on the control panel shall show which monitoring system has terminated irradiation.

11. **Termination Switches.** It shall be possible to terminate irradiation and equipment movement or go from an interruption condition to termination condition at any time from the operator's position at the treatment control panel.

12. **Interruption Switches.** If a therapeutic radiation machine has an interrupt mode, it shall be possible to interrupt irradiation and equipment movements at any time from the treatment control panel. Following an interruption, it shall be possible to restart irradiation by operator action without any reselection of operating conditions. If any change is made of a preselected value during an interruption, irradiation and equipment movements shall be automatically terminated.

13. **Timer.** A suitable irradiation control device shall be provided to terminate the irradiation after a preset time interval.

a. A timer shall be provided which has a display at the treatment control panel. The timer shall have a preset time selector and an elapsed time indicator;

b. The timer shall be a cumulative timer which activates with an indication of "BEAM-ON" and retains its reading after irradiation is interrupted or terminated. After irradiation is terminated and before irradiation can be reinitiated, it shall be necessary to reset the elapsed time indicator;

c. For equipment manufactured after the effective date of these regulations, after termination of irradiation and before irradiation can be reinitiated, it shall be necessary for the operator to reset the preset time selector; and

d. The timer shall terminate irradiation when a preselected time has elapsed, if the dose monitoring systems have not previously terminated irradiation.

14. **Selection of Radiation Type.** Equipment capable of both x-ray therapy and electron therapy shall meet the following additional requirements:

a. Irradiation shall not be possible until a selection of radiation type (x-rays or electrons) has been made at the treatment control panel;

b. The radiation type selected shall be displayed at the treatment control panel before and during irradiation;

c. An interlock system shall be provided to ensure that the equipment can principally emit only the radiation type which has been selected;

d. An interlock system shall be provided to prevent irradiation with x-rays except to obtain a verification film, when electron applicators are fitted;

e. An interlock system shall be provided to prevent irradiation with electrons when accessories specific for x-ray therapy are fitted; and

f. An interlock system shall be provided to prevent irradiation if any selected operations carried out in the treatment room do not agree with the selected operations carried out at the treatment control panel.

15. **Selection of Energy.** Equipment capable of generating radiation beams of different energies shall meet the following requirements:

a. Irradiation shall not be possible until a selection of energy has been made at the treatment control panel;

b. The measured energy value selected shall be displayed (MV for photons and MeV for electrons) at the treatment control panel before and during irradiation; and

c. Irradiation shall not be possible until the appropriate flattening filter or scattering foil for the selected energy is in its proper location.

16. **Selection of Stationary Beam Radiation Therapy or Rotational Arc Radiation Therapy.** Therapeutic radiation machines capable of both stationary beam radiation therapy and rotational arc radiation therapy shall meet the following requirement:

a. Irradiation shall not be possible until a selection of stationary beam radiation therapy or rotational arc radiation therapy has been made at the treatment control panel;

b. The mode of operation shall be displayed at the treatment control panel;

c. An interlock system shall be provided to ensure that the equipment can operate only in the mode which has been selected;

d. An interlock system shall be provided to prevent irradiation if any selected parameter in the treatment room does not agree with the selected parameter at the treatment control panel;

e. Rotational arc radiation therapy shall be controlled to obtain the selected relationships between incremental dose monitor units and incremental angle of movement:

i. For equipment manufactured after the effective date of these regulations, an interlock system shall be provided to terminate irradiation if the number of dose monitor units delivered in any 15 degrees of arc differs by more than 20 percent from the selected value;

ii. For equipment manufactured after the effective date of these regulations, where gantry angle terminates the irradiation in rotational arc radiation therapy, the dose monitor units shall differ by less than 5 percent from the value calculated from the absorbed dose per unit angle and total angle relationship;

iii. For equipment manufactured after the effective date of these regulations, an interlock shall be provided to prevent the gantry moving more than 5 degrees beyond the selected angular limits during rotational arc radiation therapy; and

iv. For equipment manufactured after the effective date of these regulations, an interlock shall be provided to require that a selection of direction be made at the treatment control panel in all units which are capable of both clockwise and counter-clockwise rotational arc radiation therapy.

f. Where the beam monitor system terminates the irradiation in rotational arc radiation therapy, the termination of irradiation shall be as required by 1.15.7(10); and

g. For equipment manufactured after the effective date of these regulations, an interlock system shall be provided to terminate irradiation if movement of the gantry:

i. occurs during stationary beam radiation therapy; or

ii. stops during rotational arc radiation therapy unless such stoppage is a preplanned function.

17. **Facility Design Requirements for Therapeutic Radiation Machines Operating above 500 kV.** In addition to shielding adequate to meet requirements of 1.15.9, the following design requirements are made:

a. **Protective Barriers.** All protective barriers shall be fixed, except for access doors to the treatment room or movable beam interceptors;

b. **Control Panel.** In addition to other requirements specified in Subchapter 15, the control panel shall also:

i. Be located outside the treatment room;

ii. Provide an indication of whether electrical power is available at the control panel and if activation of the radiation is possible;

iii. Provide an indication of whether radiation is being produced; and

iv. Include an access control (locking) device which will prevent unauthorized use of the therapeutic radiation machine;

c. **Viewing Systems.** Windows, mirrors, closed-circuit television or an equivalent viewing system shall be provided to permit continuous observation of the patient following positioning and during irradiation and shall be so located that the operator may observe the patient from the treatment control panel. The therapeutic radiation machine shall not be used for patient irradiation unless at least one viewing system is operational;

d. **Aural Communications.** Provision shall be made for continuous two-way aural communication between the patient and the operator at the control panel. The therapeutic radiation machine shall not be used for irradiation of patients unless continuous two-way aural communication is possible;

e. **Room Entrances.** Treatment room entrances shall be provided with warning lights in a readily observable position near the outside of all access doors, which will indicate when the useful beam is "ON" and when it is "OFF";

f. **Entrance Interlocks.** Interlocks shall be provided such that all entrance doors must be closed before treatment can be initiated or continued. If the radiation beam is interrupted by any door opening, it shall not be possible to restore the machine to operation without closing the door and reinitiating irradiation by manual action at the control panel;

g. **Beam Interceptor Interlocks.** If the shielding material in any protective barrier requires the presence of a beam interceptor to ensure compliance with 1.4.14(1), and 1.4.14(2) of these regulations, interlocks shall be provided to prevent the production of radiation, unless the beam interceptor is in place, whenever the useful beam is directed at the designated barrier(s);

h. **Emergency Cutoff Switches.** At least one (1) "scram button" or other emergency power cutoff switch shall be located in the radiation therapy room and shall terminate all equipment electrical power including radiation and mechanical motion. This switch is in addition to the termination switch required by 1.15.7(11). All emergency power cutoff switches shall include a manual reset so that the therapeutic radiation machine cannot be restarted from the unit's control console without resetting the emergency cutoff switch;

i. **Safety Interlocks.** All safety interlocks shall be designed so that any defect or component failure in the safety interlock system prevents or terminates operation of the therapeutic radiation machine; and

j. **Surveys for Residual Radiation.** Surveys for residual activity, shall be conducted on all therapeutic radiation machines capable of generating photon and electron energies above 10 MV prior to machining, removing, or working on therapeutic radiation machine components which may have become activated due to photo-neutron production.

18. **Radiation Therapy Physicist Support.**

a. The services of a Radiation Therapy Physicist shall be utilized in facilities having therapeutic radiation machines with energies of 500 kV and above. The Radiation Therapy Physicist shall be responsible for:

i. Full calibration(s) required by 1.15.7(20) and protection surveys required by 1.15.4(1);

ii. Supervision and review of dosimetry;

iii. Beam data acquisition and storage for computerized dosimetry, and supervision of its use;

iv. Quality assurance, including quality assurance check review required by 1.15.7(21)(e) of these regulations;

v. Consultation with the authorized user in treatment planning, as needed; and

vi. Perform calculations/assessments regarding misadministrations.

b. If the Radiation Therapy Physicist is not a full-time employee of the registrant, the operating procedures required by 1.15.7(19) shall also specifically address how the Radiation Therapy Physicist is to be contacted for problems or emergencies, as well as the specific actions, if any, to be taken until the Radiation Therapy Physicist can be contacted.

19. **Operating Procedures.**

a. No individual other than the patient shall be in the treatment room during treatment of a patient or during any irradiation for testing or calibration purposes;

b. Therapeutic radiation machines shall not be made available for medical use unless the requirements of 1.15.4(1), 1.15.7(20), and 1.15.7(21) have been met;

c. Therapeutic radiation machines, when not in operation, shall be secured to prevent unauthorized use;

d. If a patient must be held in position during treatment, mechanical supporting or restraining devices shall be used; and

e. A copy of the current operating and emergency procedures shall be maintained at the therapeutic radiation machine control console.

20. **Full Calibration Measurements.**

a. Full calibration of a therapeutic radiation machine subject to 1.15.7 shall be performed by, or under the direct supervision of, a Radiation Therapy Physicist:

i. Before the first medical use following installation or reinstallation of the therapeutic radiation machine;

ii. At intervals not exceeding 1 year; and

iii. Before medical use under the following conditions:

i. Whenever quality assurance check measurements indicate that the radiation output differs by more than 5 percent from the value obtained at the last full calibration and the difference cannot be easily discerned; and

ii. Following any component replacement, major repair, or modification of components that could significantly affect the characteristics of the radiation beam.

iv. Notwithstanding the requirements of 1.15.7(20)(a)(iii):

i. Full calibration of therapeutic radiation machines with multi-energy and/or multi-mode capabilities is required only for those modes and/or energies that are not within their acceptable range; and

ii. If the repair, replacement or modification does not affect all modes and/or energies, full calibration shall be performed on the affected mode/energy that is in most frequent clinical use at the facility. The remaining energies/modes may be validated with quality assurance check procedures against the criteria in 1.15.7(20)(a)(iii)(i).

b. To satisfy the requirement of 1.15.7(1)(a), full calibration shall include all measurements required for annual calibration by American Association of Physicists in Medicine (AAPM) Report 13, "Physical Aspects of Quality Assurance in Radiation Therapy";

c. The registrant shall use the dosimetry system described in 1.15.4(3) to measure the radiation output for one set of exposure conditions. The remaining radiation measurements required in 1.15.7(20)(b) may then be made using a dosimetry system that indicates relative dose rates; and

d. The registrant shall maintain a record of each calibration for the duration of the registration. The record shall include the date of the calibration, the manufacturer's name, model number, and serial number for the therapeutic radiation machine, the model numbers and serial numbers of the instruments used to calibrate the therapeutic radiation machine, and the signature of the Radiation Therapy Physicist responsible for performing the calibration.

21. **Periodic Quality Assurance Checks.**

a. Periodic quality assurance checks shall be performed on all therapeutic radiation machines subject to 1.15.7 at intervals not to exceed 1 week;

b. To satisfy the requirement of 1.15.7(21)(a), quality assurance checks shall include determination of all parameters for periodic quality assurance checks contained in American Association of Physicists in Medicine (AAPM) Report 13, "Physical Aspects of Quality Assurance in Radiation Therapy";

c. The registrant shall use a dosimetry system which has been intercompared within the previous 6 months with the dosimetry system described in 1.15.4(3) to make the periodic quality assurance checks required in 1.15.7(21)(b);

d. The registrant shall perform periodic quality assurance checks required by 1.15.7(21)(a) in accordance with procedures established by the Radiation Therapy Physicist;

e. The registrant shall review the results of each periodic radiation output check according to the following procedures:

   i. The authorized user and Radiation Therapy Physicist shall be immediately notified if any parameter is not within its acceptable range. The therapeutic radiation machine shall not be made available for subsequent medical use until the Radiation Therapy Physicist has determined that all parameters are within their acceptable range;

   ii. If all quality assurance check parameters appear to be within their acceptable range, the quality assurance check shall be reviewed and signed by either the authorized user or Radiation Therapy Physicist within 3 treatment days; and

   iii. The Radiation Therapy Physicist shall review and sign the results of each radiation output quality assurance check at intervals not to exceed 1 month;

f. Therapeutic radiation machines subject to 1.15.7 shall have safety quality assurance checks of each radiation therapy facility performed at intervals not to exceed 1 week;

g. To satisfy the requirement of 1.15.7(21)(f), safety quality assurance checks shall ensure proper operation of:

   i. Electrical interlocks at each external beam radiation therapy room entrance;

   ii. Proper operation of the "BEAM-ON", interrupt and termination switches;

   iii. Beam condition indicator lights on the access doors, control console, and in the radiation therapy room;

   iv. Viewing systems;

   v. Electrically operated treatment room door(s) from inside and outside the treatment room; and

vi. At least one emergency power cutoff switch. If more than one emergency power cutoff switch is installed and not all switches are tested at once, each switch shall be tested on a rotating basis. Safety quality assurance checks of the emergency power cutoff switches may be conducted at the end of the treatment day in order to minimize possible stability problems with the therapeutic radiation machine.

h. The registrant shall promptly repair any system identified in 1.15.7(21)(g) that is not operating properly; and

i. A registrant shall maintain a record of each quality assurance check required by 1.15.7(21)(a) and 1.15.7(21)(g) for 3 years. The record shall include the date of the quality assurance check, the manufacturer's name, model number, and serial number for the therapeutic radiation machine, the manufacturer's name, model number and serial number of the instrument(s) used to measure the radiation output of the therapeutic radiation machine, and the signature of the individual who performed the periodic quality assurance check.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.8 **Calibration and Check of Survey Instruments.**

1. A registrant shall ensure that the survey instruments used to show compliance with this Subchapter have been calibrated before first use, annually, and following repair.

2. To satisfy the requirements of 1.15.8(1), the registrant shall:

   a. Calibrate all required scale readings up to 1000 mrem (10 mSv) per hour with an appropriate radiation source;

   b. Calibrate at least two points on each scale to be calibrated. These points should be at approximately 1/3 and 2/3 of scale rating; and

   c. Conspicuously note on the instrument the apparent dose rate from a dedicated check source as determined at the time of calibration, and the date of calibration.

3. To satisfy the requirements of 1.15.8(2), the registrant shall:

   a. Consider a point as calibrated if the indicated dose rate differs from the calculated dose rate by not more than 10 percent; and

   b. Consider a point as calibrated if the indicated dose rate differs from the calculated dose rate by not more than 20 percent if a correction factor or graph is conspicuously attached to the instrument.

4. A registrant shall check each survey instrument for proper operation with the dedicated check source each day of use. The registrant is not required to keep records of these checks.

5. The registrant shall retain a record of each calibration required in 1.15.8(1) for 3 years. The record shall include:

   a. A description of the calibration procedure; and

   b. A description of the source used and the certified dose rates from the source, and the rates indicated by the instrument being calibrated, the correction factors deduced from the calibration data, the signature of the individual who performed the calibration, and the date of calibration.

6. The registrant may obtain the services of individuals licensed by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State to perform calibrations of survey instruments. Records of calibrations which contain information required by 1.15.8(5) shall be maintained by the registrant.

Source: Miss. Code Ann. §45-14-11

Rule 1.15.9 **Shielding and Safety Design Requirements.**

1. Each therapeutic radiation machine subject to 1.15.6 or 1.15.7 shall be provided with such primary and/or secondary barriers as are necessary to ensure compliance with 1.4.6 and 1.4.14 of these regulations.

2. Facility design information for all new installations of a therapeutic radiation machine or installations of a therapeutic radiation machine of higher energy into a room not previously approved for that energy shall be submitted for Agency approval prior to actual installation of the therapeutic radiation machine. The minimum facility design information that must be submitted is contained in Appendix A.

Source: Miss. Code Ann. §45-14-11

APPENDIX A

INFORMATION ON RADIATION SHIELDING REQUIRED FOR PLAN REVIEWS

I. ALL THERAPEUTIC RADIATION MACHINES

A. Basic facility information including: name, telephone number and Agency registration number of the individual responsible for preparation of the shielding plan; name and telephone number of the facility supervisor; and the street address [including room number] of the external beam radiation therapy facility. The plan should also indicate whether this is a new structure or a modification to existing structure(s).

B. All wall, floor, and ceiling areas struck by the useful beam shall have primary barriers.

C. Secondary barriers shall be provided in all wall, floor, and ceiling areas not having primary barriers.

II. THERAPEUTIC RADIATION MACHINES UP TO 150 kV (PHOTONS ONLY)

In addition to the requirements listed in Section I. above, therapeutic radiation machine facilities which produce only photons with a maximum energy less than or equal to 150 kV shall submit shielding plans which contain, as a minimum, the following additional information:

A. Equipment specifications, including the make, model and serial number of the therapeutic radiation machine, as well as the maximum technique factors.

B. The maximum design workload for the facility, including the total anticipated number of exposures/films per day and/or week, as well as the type of treatment(s) or examination(s) which will be performed with the therapeutic radiation machine.

C. A facility blueprint/drawing indicating: scale [0.25 inch = 1 foot is typical]; direction of North; normal location of the therapeutic radiation machine's radiation port(s); the port's travel and traverse limits; general direction(s) of the useful beam; locations of any windows and doors; and the location of the therapeutic radiation machine control panel. If the control panel is located inside the external beam radiation therapy treatment room, the location of the operator's booth shall be noted on the plan and the operator's station at the control panel shall be behind a protective barrier sufficient to ensure compliance with 400.06 of these regulations.

D. The structural composition and thickness or lead/concrete equivalent of all walls, doors, partitions, floor, and ceiling of the room(s) concerned.

E. The type of occupancy of all adjacent areas inclusive of space above and below the room(s) concerned. If there is an exterior wall, show distance to the closest area(s) where it is likely that individuals may be present.

F. At least one example calculation which shows the methodology used to determine the amount of shielding required for each physical condition [i.e., primary and secondary/leakage barriers, restricted and unrestricted areas, entry door(s) and shielding material in the facility.]

(1) If commercial software is used to generate shielding requirements, identify the software used and the version/revision date.

(2) If the software used to generate shielding requir. ements is not in the open literature, submit quality control sample calculations to verify the result obtained with the software.

III. THERAPEUTIC RADIATION MACHINES OVER 150 kV

In addition to the requirements listed in Section I. above, therapeutic radiation machine facilities which produce photons with a maximum energy in excess of 150 kV and/or electrons and/or protons or other subatomic particles shall submit shielding plans which contain, as a minimum, the following additional information:

A. Equipment specifications including manufacturer, model number, and serial number of the therapeutic radiation machine, rad/gray or rem/sievert per minute at the isocenter and the energy(s) and type(s) of radiation produced [i.e., photon, electron]. The source to isocenter distance shall be specified.

B. Maximum design workload for the facility including total weekly radiation output, [expressed in rad/gray or rem/sievert per minute at 1 meter], total beam-on time per day or week, the average treatment time per patient, along with the anticipated number of patients to be treated per day or week.

C. Facility blueprint/drawing [including both floor plan and elevation views] indicating relative orientation of the therapeutic radiation machine, scale [0.25 inch = 1 foot is typical], type(s) and thickness of shielding material(s), direction of North, the locations and size of all penetrations through each shielding barrier [ceiling, walls and floor], as well as details of the door(s) and maze.

D. The structural composition and thickness or concrete equivalent of all walls, doors, partitions, floor, and ceiling of the room(s) concerned

E. The type of occupancy of all adjacent areas inclusive of space above and below the room(s) concerned. If there is an exterior wall, show distance to the closest area(s) where it is likely that individuals may be present.

F. Description of all assumptions that were in shielding calculations including, but not limited to, design energy [i.e., room may be designed for 6 MV unit although

only a 4 MV unit is currently proposed], workload, presence of integral beam-stop in unit, occupancy and use(s) of adjacent areas, fraction of time that primary beam will intercept each permanent barrier [walls, floor and ceiling] and "allowed" radiation exposure in both restricted and unrestricted areas.

G. At least one example calculation which shows the methodology used to determine the amount of shielding required for each physical condition [i.e., primary and secondary/leakage barriers, restricted and unrestricted areas, small angle scatter, entry door(s) and maze] and shielding material in the facility.

(1) If commercial software is used to generate shielding requirements, identify the software used and the version/revision date.

(2) If the software used to generate shielding requirements is not in the open literature, submit quality control sample calculations to verify the result obtained with the software.

IV. NEUTRON SHIELDING

In addition to the requirements listed in Section III above, therapeutic radiation machine facilities which are capable of operating above 10 MV shall submit shielding plans which contain, as a minimum, the following additional information:

A. The structural composition, thickness and location of all neutron shielding material.

B. Description of all assumptions that were used in neutron shielding calculations including, but not limited to, neutron spectra as a function of energy, neutron fluence rate, absorbed dose and dose equivalent (due to neutrons) in both restricted and unrestricted areas.

C. At least one example calculation which shows the methodology used to determine the amount of neutron shielding required for each physical condition [i.e. restricted and unrestricted areas, entry door(s) and maze] and neutron shielding material utilized in the facility.

(1) If commercial software is used to generate shielding requirements, identify the software used and the version/revision date.

(2) If the software used to generate shielding requirements is not in the open literature, submit quality control sample calculations to verify the result obtained with the software.

D. The method(s) and instrumentation which will be used to verify the adequacy of all neutron shielding installed in the facility.

V. REFERENCES

A. NCRP Report 49, "Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies Up to 10 MeV" (1976).

B. NCRP Report 51, "Radiation Protection Design Guidelines for 0.1-100 MeV Particle Accelerator Facilities" (1977).

C. NCRP Report 79, "Neutron Contamination from Medical Electron Accelerators" (1984).

Chapter 2 REGULATIONS FOR TANNING FACILITIES

Subchapter 1 Regulations of Tanning Equipment & Facilities

Rule 2.1.1 **Purpose and Scope.**

1. This Chapter provides for the registration of tanning equipment and tanning facilities and regulation of the maintenance and operation of tanning facilities.

2. In addition to the requirements of this Chapter, all registrants are subject to the applicable provision of other Chapters of these regulations.

3. Nothing in this Chapter shall be interpreted as limiting the intentional exposure of patients to ultraviolet radiation for the purpose of treatment or use commensurate with the licensed practitioner's use of a healing art.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.2 **Definitions.** The following terms are defined for purposes of this Chapter.

1. "Act" means the Mississippi Radiation Protection Law of 1976.

2. "Agency" means the Mississippi Department of Health.

3. "CFR" means Code of Federal Regulations.

4. "Consumer" means any member of the public who is provided access to a tanning facility in exchange for a fee or other compensation, or any individual who, in exchange for a fee or other compensation, is afforded use of a tanning facility as a condition or benefit of membership or access.

5. "FDA" means U.S. Food and Drug Administration.

6. "Healing arts" means the professional disciplines authorized by the laws of this state to use sources of radiation in the diagnosis or treatment of human or animal diseases.

7. "Individual" means any human being.

8. "Inspection" means an official examination or observation including but not limited to tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements, and conditions of the Agency.

9. "Operator" means an individual designated by the Registrant to control operation of the tanning facility and to instruct and assist the consumer in the proper operation of the tanning equipment.

10. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing.

11. "Radiation" means ultraviolet radiation in these regulations.

12. "Radiation machine" means any device capable of producing radiation.

13. “Registrant" means any person who is registered with the Agency and is legally obligated to register with the Agency pursuant to these regulations and the Act.

14. “Registration" means registration with the Agency in accordance with regulations adopted by the Agency.

15. "Tanning equipment" means ultraviolet lamps and equipment containing ultraviolet lamps intended to induce skin tanning through the irradiation of any part of the living human body.

16. "Tanning facility" means any location, place, area, structure or business which provides consumers access to tanning equipment.

17. "These regulations" means all chapters of the Mississippi State Board of Health Environmental Regulations Division 800-Radiological Health, Subpart 78-Radiation, Chapter 2, Regulations For Tanning Facilities.

18. "Ultraviolet radiation" means electromagnetic radiation with wavelengths in air between two hundred (200) nanometers and four hundred (400) nanometers.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.3 **Exemptions.**

1. **General:** The Agency may, upon application therefore or upon its own initiative, grant such exemptions or exceptions from the requirements of these regulations as it determines are authorized by law and will not result in undue hazard to public health and safety.

2. Equipment intended for purposes other than the deliberate exposure of parts of the living body to ultraviolet radiation, and which produce or emit ultraviolet radiation incidental to its proper operation are exempt from the provisions of this Chapter.

3. Radiation machines while in transit or storage incidental thereto are exempt from the provisions of this Chapter.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.4 **Application for Registration of Tanning Facilities.**

1. Each person having a tanning facility shall apply for registration of such facility with the Agency within thirty (30) days following the effective date of these regulations or thereafter prior to the operation of a tanning facility. Application for registration shall be completed on forms furnished by the Agency and shall contain all the information required by the form and the accompanying instructions.

2. The Agency shall require at least the following information on the Application for Registration of Tanning Facilities form:

   a. Name, address and telephone number of the following:

      i. the tanning facility;

      ii. the owner(s) of the tanning facility.

   b. The manufacturer, model number, and type of each ultraviolet lamp or tanning equipment located within the facility.

   c. The geographic areas within the State to be covered, if the facility is mobile.

   d. Name of the tanning equipment supplier, installer, and service agent.

   e. A signed and dated certification that the applicant has read and understands the requirements of these regulations.

   f. A copy of operating and safety procedures unique to facility operation.

3. Each applicant shall provide such additional information as the Agency may reasonably require.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.5 **Issuance of Certificate of Registration.**

1. Upon determination that an applicant meets the requirements of these regulations, the Agency shall issue a certificate of registration.

2. The Agency may incorporate in the certificate of registration at the time of issuance or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the registrant's receipt, possession, use, and transfer of tanning equipment and tanning facilities as it deems appropriate or necessary.

3. No person shall operate a tanning facility until the Agency has issued the certificate of registration.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.6 **Expiration of Certificate of Registration**. Except as provided in 2.1.7 (2), each certificate of registration shall expire at the end of the specified day in the month and year stated therein.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.7 **Renewal of Certificate of Registration.**

1. Application for renewal of registration shall be filed in accordance with 2.1.4.

2. In any case in which a registrant, not less than 30 days prior to the expiration of his existing certificate of registration, has filed an application in proper form for renewal, such existing certificate of registration shall not expire until the application status has been finally determined by the Agency.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.8 **Report of Changes.** The registrant shall notify the Agency in writing before making any change which would render the information reported pursuant to 2.1.4 (2) (a), (b), (c) and (g), contained in the application for registration and/or the certificate of registration, no longer accurate. This requirement shall not apply to changes involving replacement of designated original equipment lamp types with lamps which have been certified with the FDA as "equivalent (lamps under the FDA regulations and policies applicable at the time of replacement of the lamps. The facility owner shall maintain manufacturer's literature demonstrating the equivalency of any replacement lamps.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.9 **Transfer of Certificate of Registration.** No certificate of registration shall be transferable from one person to another or from one tanning facility to another.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.10 **Approval Not Implied.** No person, in any advertisement, shall refer to the fact that he or his facility is registered with the Agency pursuant to the provisions of 2.1.4, and no person shall state or imply that any activity under such registration has been approved by the Agency.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.11 **Denial, Suspension, or Revocation of Certificate of Registration.** The Agency may, for good cause shown, deny, suspend or revoke a certificate of registration sought or issued pursuant to these regulations for any of the following reasons:

1. Failure of reports, plans or specifications to show that the tanning facility will be constructed, operated or maintained in accordance with the requirements of these regulations;

2. Submission of incorrect, false or misleading information in the application, reports, plans, or specifications;

3. Failure to construct, operate or maintain the tanning facility in accordance with the application, plans and specifications approved by the Agency except as such maintenance may involve the replacement of lamps by "equivalent" lamps which have been defined in 2.1. 8;

4. Operation of the tanning facility in a way that causes or created a nuisance or hazard to the public health or safety;

5. Violation of any rules, regulations, standards, or requirements adopted by the Agency;

6. Violation of any condition upon which the certificate of registration was issued;

7. Failure to allow duly authorized agents of the Agency to conduct inspections at reasonable hours and in a reasonable manner;

8. Failure to pay any registration or inspection fees.

9. Failure of the tanning equipment to comply with the Federal Performance Standard for Sunlamp Products and Ultraviolet Lamps intended for use in Sunlamp Products 21 CFR 1040.20.

Rule 2.1.12 **Hearing:** If any certificate of registration is denied, suspended, or revoked, the applicant or registrant may request a hearing in accordance with Chapter 45-14-21, Mississippi Code of 1972, Annotated.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.13 **Construction and Operation of Tanning Facilities.** Unless otherwise ordered or approved by the Agency, each tanning facility shall be constructed, operated, and maintained to meet the following minimum requirements:

1. **Physical facilities**

   a. The following warning sign shall be posted in the immediate proximity (within 1 meter) of each piece of tanning equipment and it shall be readily legible, clearly visible, and not obstructed by any barrier, equipment, or

other item present so that the user can easily view the warning sign before energizing the ultraviolet light generating equipment:

DANGER - ULTRAVIOLET RADIATION

b. Follow instructions.

c. Avoid overexposure. As with natural sunlight, overexposure can cause eye and skin injury and allergic reactions. Repeated exposure may cause premature aging of the skin and skin cancer.

d. Wear protective eyewear.

e. **FAILURE TO USE PROTECTIVE EYEWEAR MAY RESULT IN SEVERE BURNS OR LONG-TERM INJURY TO THE EYES.**

f. Medications or cosmetics may increase your sensitivity to the ultraviolet radiation. Consult a physician before using sunlamp if you are using medications or have a history of skin problems or believe yourself especially sensitive to sunlight.

g. If you do not tan in the sun, you are unlikely to tan from the use of this product.

h. The lettering on each warning sign shall be at least ten (10) millimeters high for all words showing in capital letters and at least five (5) millimeters high for all lowercase letters.

i. Only tanning equipment manufactured and certified to comply with 21 CFR Part 1040, Chapter

j. 1040.20, "Sunlamp products and ultraviolet lamps intended for use in sunlamp products", shall be used in tanning facilities. Compliance shall be based on the standard in effect at the time of manufacture as shown on the device identification label required by 21 CFR Part 1010, Chapter 1010.3.

k. Each tanning equipment shall have a timer which complies with the requirements of 21 CFR Part 1040, Chapter 1040.20(c) (2). The maximum timer interval shall not exceed the manufacturer's maximum recommended exposure time. No timer interval shall have an error greater than ± 10% of the maximum timer interval for the product.

l. Tanning equipment shall meet the National Fire Protection Association's National Electrical Code.

m. There shall be physical barriers to protect consumers from injury induced by touching or breaking the lamps.

n. Additional requirements for stand-up booths:

i. there shall be physical barriers or other means such as handrails or floor markings to indicate the proper exposure distance between ultraviolet lamps and the consumer's skin.

ii. the construction of the booth shall be such that it will withstand the stress of use and the impact of a falling person.

iii. access to the booth shall be of rigid construction. Doors shall open outwardly. Handrails and nonslip floors shall be provided.

o. Tanning equipment electrical circuit shall be approved by the Underwriter Laboratories (UL) or Electrical Testing Laboratories (ETL).

2. **Protective goggles**

a. Each consumer shall be provided with protective goggles and instructions for the use.

b. Protective goggles shall meet the requirements of 21 CFR Part 1040, Section 1040.20 (c) (5).

c. Protective goggles shall be properly sanitized before each use. Exposure to the ultraviolet radiation produced by the tanning equipment itself is not considered a sanitizing agent.

d. Each consumer shall wear the protective goggles as instructed.

3. **Operation**

a. An operator must be present when tanning equipment is operated.

b. Prior to initial exposure each consumer shall be provided the opportunity to read a copy of the warning specified in 2.1.12 (1) (a). The operator shall then request that the consumer sign a statement that the information has been read and understood. For illiterate or visually handicapped persons, the warning statement shall be read by the operator in the presence of a witness. Both the witness and the operator shall sign the statement.

c. A record shall be kept by the facility operator of each consumer's total number of tanning visits and tanning times.

d. A written report of any tanning injury shall be forwarded to the Agency within five [5] working days of the occurrence or knowledge thereof. The report shall include:

i. the name of the affected individual;

ii. the name and location of the tanning facility involved;

iii. the nature of the injury; and

iv. name and address of health care provider, if any;

v. any other information considered relevant to the situation.

e. No consumer under sixteen years of age shall be allowed to use the tanning facility unless he or she provides a consent form signed by the parent or legal guardian. The parent or guardian shall have been provided with the basic information required under 2.1.12.

f. Defective or burned-out lamps or filters shall be replaced with a type intended for use in that device as specified on the product label on the tanning equipment, or, with lamps or filters that are "equivalent" under the FDA regulations and policies applicable at the time of lamp manufacture.

g. Each operator must be adequately trained. Proof of training must be maintained in the facility and available for inspection. Training shall include:

i. the requirements of these regulations;

ii. procedures for correct operation of the facility;

iii. recognition of injury or overexposure;

iv. manufacturer's procedures for operation and maintenance of tanning equipment;

v. emergency procedures in case of injury.

vi. A list of operators trained in accordance with 2.1.12 (3) (g) shall be maintained and available at the facility.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.14 **Enforcement and Penalties.** An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or any regulation or order issued there under. Any person who willfully violates any provisions of the Act, or any regulation, or order issued there under, may be guilty of a misdemeanor and, upon conviction, may be punished by fine or imprisonment or both, as provided by Section 45-14-37 of the Act.

Source: Miss. Code Ann. §45-14-11

Rule 2.1.15 **Communications.** All communications and reports concerning these regulations, and applications filed there under, should be addressed to the Division of Radiological Health at its office located at 3150 Lawson Street, P. 0. Box 1700, Jackson, Mississippi, 39215-1700.

Source: Miss. Code Ann. §45-14-11