

EFFECTIVE
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NEBRASKA DEPARTMENT OF
HEALTH AND HUMAN SERVICES

180 NAC 1

TITLE 180 CONTROL OF RADIATION

CHAPTER 1 GENERAL PROVISIONS

001. SCOPE AND AUTHORITY. Title 180 applies to all persons who receive, possess, use, transfer, own, or acquire: any radiation generating equipment and; any naturally occurring or accelerator produced radioactive material, including special nuclear material in quantities not sufficient to form a critical mass. The regulations are authorized by and implement the Radiation Control Act, Nebraska Revised Statute (Neb. Rev. Stat.) §§ 71-3501 to 71-3520. 10 Code of Federal Regulations (CFR), as published on January 1, 2013; 40 CFR as published on July 1, 2013 and 49 CFR as published on October 1, 2013 and referred throughout this Title are incorporated by reference and available for viewing at the Nebraska Department of Health and Human Services, Radiological Health, 301 Centennial Mall South, 3rd Floor, Lincoln, Nebraska 68509 or from the U.S. Government Printing Office Bookstore, 710 North Capitol Street NW, Washington D.C., 20401.

002. DEFINITIONS. The definitions in the Radiation Control Act and the following definitions apply to all chapters within Title 180 of the Nebraska Administrative Code (NAC).

002.01 A1. The term A1 is the maximum activity of special form radioactive material permitted in a Type A package. This value is either listed in Appendix A of 180 NAC 13, Table A-1, or may be derived as specified in Appendix A of 180 Nebraska Administrative Code (NAC) 013.

002.02 A2. The term A2 is the maximum activity of radioactive material, other than special form, Low Specific Activity (LSA) and Surface Contaminated Object (SCO) material, permitted in a Type A package. These values are either listed in Appendix A of 180 NAC 13, Table A-1, or may be derived as prescribed in Appendix A of 180 NAC 013.

002.03 ABSORBED DOSE (D). The energy imparted by ionizing radiation to matter is described by the term absorbed dose. Absorbed dose is determined as the quotient of dE by dM, where dE is the mean energy imparted by ionizing radiation to matter of mass dM. The International System of Units (SI) unit of absorbed dose is joule per kilogram and the special name of the unit of absorbed dose is the gray (Gy). The previously used special unit of absorbed dose (rad) is being replaced by the gray.

002.04 ACCELERATOR. An accelerator is 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 megaelectron volt. Particle accelerator is an equivalent term.

002.05 ACCELERATOR PRODUCED MATERIAL. Accelerator produced material is any material made radioactive by a particle accelerator.

002.06 ACTIVITY. Activity is the rate of disintegration or transformation or decay of radioactive material. The units of activity are the becquerel (Bq) and the curie (Ci).

002.07 ADULT. An adult is an individual 18 or more years of age.

002.08 AGREEMENT STATE. An agreement state is any state with which the United States Nuclear Regulatory Commission (NRC) or the United States Atomic Energy Commission has entered into an effective agreement under subsection 274b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689). Non-agreement State is any other State.

002.09 AIRBORNE RADIOACTIVE MATERIAL. Airborne radioactive material is any radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

002.10 AIRBORNE RADIOACTIVITY AREA. Airborne radioactivity area is 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 180 NAC 4, 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% of the annual limit on intake (ALI) or 12 DAC-hours.

002.11 AS LOW AS REASONABLY ACHIEVABLE (ALARA). As low as reasonably achievable or ALARA is making every reasonable effort to maintain exposures to radiation as far below the dose limits in Title 180 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.

002.12 BACKGROUND RADIATION. Background radiation is 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 the control of the licensee. Background radiation does not include sources of radiation from radioactive materials regulated by the Department.

002.13 BECQUEREL (Bq). Becquerel is the International System of Units (SI) unit of activity. One becquerel is equal to 1 disintegration or transformation per second (dps or tps).

002.14 BIOASSAY. A bioassay is 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 180 NAC, radiobioassay is an equivalent term.

002.15 BRACHYTHERAPY. Brachytherapy is 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.

002.16 BYPRODUCT MATERIAL. Byproduct material is:

- (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; and
- (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 or thorium solution extraction processes. Underground ore bodies depleted by solution extraction operations do not constitute byproduct material.
- (C) Any:
 - (i) Discrete source of radium-226 that is produced, extracted, or converted after extraction for use for a commercial, medical, or research activity; or
 - (ii) 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
- (D) Any discrete source of naturally occurring radioactive material, other than source material, that:
 - (i) The United State Nuclear Regulatory Commission, in consultation with the Administrator of the United States Environmental Protection Agency, the United States 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
 - (ii) Is extracted or converted after extraction for use in a commercial, medical, or research activity.

002.17 CALENDAR QUARTER. A calendar quarter is not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year will begin in January and subsequent calendar quarters will be arranged so 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 may change their method for determining calendar quarters except at the beginning of a year.

002.18 CALIBRATION. Calibration is the determination of:

- (A) The response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or
- (B) The strength of a source of radiation relative to a standard.

002.19 CARRIER. A carrier is 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.

002.20 CHELATING AGENT. A substance containing amine polycarboxylic acids, hydroxycarboxylic acids, gluconic acid, and polycarboxylic acids is a chelating agent.

002.21 COLLECTIVE DOSE. 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 is collective dose.

002.22 COMMITTED DOSE EQUIVALENT (CDE) ($H_{T,50}$). A committed dose equivalent or CDE is 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.

002.23 COMMITTED EFFECTIVE DOSE EQUIVALENT (CEDE) ($H_{E,50}$). A committed effective dose equivalent or CEDE 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 ($H_{E,50} = \sum W_T H_{T,50}$).

002.24 CONSTRAINT (DOSE CONSTRAINT). A value above which specified licensee actions are required is a constraint or dose constraint.

002.25 CRITICAL GROUP. A critical group is the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

002.26 CURIE. That amount of radioactive material which disintegrates at the rate of 37 billion atoms per second is a curie. One curie = $3.7E+10$ disintegrations or transformations per second (dps or tps) = $3.7E+10$ becquerel (Bq) = $2.22E+12$ disintegrations or transformations per minute (dpm or pm).

002.27 DECOMMISSION. To decommission is to remove a facility or site safely from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use or release of the property under restricted conditions and termination of the license.

002.28 DECOMMISSIONING. Final operational activities at a facility to dismantle site structures, to decontaminate site surfaces and remaining structures, to stabilize and contain residual radioactive material, and to carry out any other activities to prepare the site for post-operational care is decommissioning.

002.29 DEEP DOSE EQUIVALENT (DDE) (H_d). Deep dose equivalent is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2) that applies to external whole body exposure.

002.30 DEPLETED URANIUM. Depleted uranium is 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.

002.31 DISTINGUISHABLE FROM BACKGROUND. The detectable concentration of a radionuclide that is statistically different from the background concentration of a radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate

measurement technology, survey, and statistical techniques means it is distinguishable from background.

002.32 DISCRETE SOURCE. A discrete source is 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.

002.33 DOSE. 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 Title 180, radiation dose is an equivalent term.

002.34 DOSE EQUIVALENT (H_T). Dose equivalent is 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 sievert (Sv) and rem.

002.35 DOSE LIMITS. Dose limits are the permissible upper bounds of radiation doses established according to this Title. For purposes of Title 180, limits is an equivalent term.

002.36 EFFECTIVE DOSE EQUIVALENT (EDE) (H_E). 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 ($H_E = \sum w_T H_T$) is the effective dose equivalent.

002.37 EMBRYO OR FETUS. An embryo or fetus is the developing human organism from conception until the time of birth.

002.38 ENTRANCE OR ACCESS POINT. An entrance or access point is any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed or registered radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

002.39 EXPLOSIVE MATERIAL. Explosive material is any chemical compound, mixture, or device which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

002.40 EXPONENT (E). An exponent indicates that the number 10 is to be raised to a given power. This power is indicated to the right of the symbol E. For example: 3E+4 symbolizes 3×10^4 and 3E-4 symbolizes 3×10^{-4} .

002.41 EXPOSURE. The act of being exposed to ionizing radiation or to radioactive material is exposure.

002.42 EXPOSURE. Exposure is 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). See subsection 014.01 Units of Exposure and Dose for the special unit. When not underlined or indicated as "exposure" (X) this term has its general meaning.

002.43 EXPOSURE RATE. Exposure rate is the exposure per unit of time, such as roentgen per minute (R/min) or milliroentgen per hour (mR/h).

002.44 EXTERNAL DOSE. An external dose is that portion of the dose equivalent received from any source of radiation outside the body.

002.45 EXTREMITY. The parts of the body including the hand, elbow, arm below the elbow, foot, knee, and leg below the knee is an extremity.

002.46 FORMER UNITED STATES ATOMIC ENERGY COMMISSION (AEC) OR UNITED STATES NUCLEAR REGULATORY COMMISSION (NRC) LICENSED FACILITIES. Nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where Atomic Energy Commission (AEC) or Nuclear Regulatory Commission (NRC) licenses have been terminated are former United States Atomic Energy commission or United States Nuclear Regulatory Commission licensed facilities.

002.47 GENERALLY APPLICABLE ENVIRONMENTAL RADIATION STANDARDS. Standards issued by the United States 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 are generally applicable environmental radiation standards.

002.48 GRAY (Gy). Gray or Gy is the International System of Units (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].

002.49 HAZARDOUS WASTE. Those wastes designated as hazardous in 40 CFR Chapter I, Part 261, Subpart A, § 261.2 - 261.4 and Subpart D are hazardous waste.

002.50 HEALING ARTS. Healing arts are diagnostic or healing treatment, or both, of human and animal maladies including but not limited to the following which are duly licensed by the state of Nebraska for the lawful practice of: medicine and its associated specialties, dentistry, veterinary medicine, osteopathy, chiropractic, and podiatry.

002.51 HIGH-LEVEL RADIOACTIVE WASTE. High-level radioactive waste is:

- (A) Irradiated reactor fuel;
- (B) Liquid wastes resulting from the operation of the first cycle solvent extraction system or equivalent and the concentrated wastes from subsequent extraction cycles or the equivalent in a facility for reprocessing irradiated reactor fuel;
- (C) Solids into which such liquid wastes have been converted; and
- (D) Other highly radioactive waste material as defined by the U.S. Nuclear Regulatory Commission.

002.52 HIGH RADIATION AREA. An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 1 milliseivert (0.1 rem) in 1 hour at 30 centimeters from the radiation

source or 30 centimeters from any surface that the radiation penetrates is a high radiation area.

002.53 HUMAN USE. Human use is the internal or external administration of radiation or radioactive material to human beings.

002.54 INDIAN TRIBE. An Indian tribe is an Indian or Alaska native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 United States Code (U.S.C.) 479a.

002.55 INDIVIDUAL. An individual is any human being.

002.56 INDIVIDUAL MONITORING. Individual monitoring is the assessment of:

- (A) Dose equivalent by the use of:
 - (i) Individual monitoring devices or
 - (ii) Survey data; or
- (B) Committed effective dose equivalent by:
 - (i) Bioassay or
 - (ii) 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 180 NAC 4.

002.57 INDIVIDUAL MONITORING DEVICES (INDIVIDUAL MONITORING EQUIPMENT). Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescence dosimeters (TLD's), pocket ionization chambers, and personal ("lapel") air sampling devices are individual monitoring devices. For the purposes of Title 180, personnel dosimeter and dosimeter are equivalent terms.

002.58 INSPECTION. An inspection is 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 Department. The licensee or registrant is notified of any items of noncompliance or recommendations, or both, of the Department.

002.59 INTERLOCK. An interlock is 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.

002.60 INTERNAL DOSE. An internal dose is that portion of the dose equivalent received from radioactive material taken into the body.

002.61 LENS DOSE EQUIVALENT (LDE). The lens dose equivalent is the dose equivalent from external exposure to the lens of eye taken at a tissue depth of 0.3 centimeter (300 mg/cm²).

002.62 LICENSE. A license is a credential issued by the Department according to the regulations adopted by the Department under 180 NAC.

002.63 LICENSED MATERIAL. Radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Department is licensed material.

002.64 LICENSEE. A licensee is any person who is licensed by the Department according to Title 180 and the Act.

002.65 LIMITS. See Dose Limits.

002.66 LOST OR MISSING SOURCE OF RADIATION. Source of radiation whose location is unknown is a lost or missing source of radiation. 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.

002.67 LOW-LEVEL RADIOACTIVE WASTE. Any radioactive waste not defined as high-level radioactive waste, spent nuclear fuel, or byproduct material is low-level radioactive waste.

002.68 MAJOR PROCESSOR. A major processor is 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 180 NAC 13-002, and in 10 CFR Chapter I, Part 71, Subpart A, § 71.4.

002.69 MANAGEMENT FACILITY. The land, buildings, and equipment which is intended to be used for the management of radioactive wastes is a management facility.

002.70 MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE. The handling, processing, storage, reduction in volume, disposal, or isolation of such waste from the biosphere in any manner is the management of low-level radioactive waste.

002.71 MEMBER OF THE PUBLIC. Any individual except when that individual is receiving an occupational dose is a member of the public.

002.72 MINOR. An individual less than 18 years of age is a minor.

002.73 MIXED WASTE. Low-level radioactive waste that also contains hazardous waste that is identified in Title 128, Nebraska Administrative Code is mixed waste.

002.74 MONITORING. Monitoring is 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 the purposes of Title 180 radiation monitoring and radiation protection monitoring are equivalent terms.

002.75 NATURALLY OCCURRING OR ACCELERATOR PRODUCED RADIOACTIVE MATERIAL (NARM). Naturally occurring or accelerator produced radioactive material is any

radioactive material that occurs naturally or is produced in an accelerator. It does not include byproduct, source, or special nuclear material.

002.76 NATIONALLY TRACKED SOURCE. A nationally tracked source is a sealed source containing a quantity equal to or greater than Category 1 or Category 2 levels of any radioactive material listed in Appendix H of 180 NAC 4. 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. 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.

002.77 NATURAL RADIOACTIVITY. Natural Radioactivity is radioactivity of naturally occurring nuclides.

002.78 NUCLEAR REGULATORY COMMISSION. The Nuclear Regulatory Commission is the United States Nuclear Regulatory Commission or its duly authorized representatives.

002.79 OCCUPATIONAL DOSE. An occupational dose is the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to sources of radiation from licensed/registered or unlicensed/unregistered sources of radiation, whether in the possession of the licensee, registrant, or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in according to 180 NAC 7-037, from voluntary participation in medical research programs, or as a member of the public.

002.80 PACKAGE. A package is the packaging together with its radioactive contents as presented for transport.

002.81 PARTICLE ACCELERATOR. See Accelerator.

002.82 PERSON. For the purposes of Title 180 a person is any individual, corporation, partnership, limited liability company, 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 just stated.

002.83 PERSONNEL DOSIMETER. See Individual Monitoring Devices.

002.84 PERSONNEL MONITORING EQUIPMENT. See Individual Monitoring Devices.

002.85 PHARMACIST. See Neb. Rev. Stat. § 38-2832.

002.86 PHYSICIAN. See Neb. Rev. Stat. § 38-2024 to 38-2045.

002.87 POSITRON EMISSION TOMOGRAPHY (PET) RADIONUCLIDE PRODUCTION FACILITY. A facility operating a cyclotron or accelerator for the purpose of producing PET radionuclides is a positron emission tomography radionuclide production facility or PET facility.

002.88 PUBLIC DOSE. A public dose is the dose received by a member of the public from exposure to sources of radiation released by a licensee or registrant, or to any other source of radiation under the control of a 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 to 180 NAC 7-037, or from voluntary participation in medical research programs.

002.89 PYROPHORIC LIQUID. Pyrophoric liquid is any liquid that ignites spontaneously in dry or moist air at or below 130°F (54.4 °C). 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.

002.90 QUALITY FACTOR (Q). A quality factor or Q is the modifying factor, listed in Tables I and II of 180 NAC 1- 014, that is used to derive dose equivalent from absorbed dose.

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

002.92 RADIATION. Ionizing and nonionizing radiation is as follows:

- (A) Ionizing radiation is gamma rays, x-rays, alpha and beta particles, high-speed electrons, neutrons, protons, and other atomic or nuclear particles or rays, but does not include sound or radiowaves or visible, infrared, or ultraviolet light; and
- (B) Nonionizing radiation is:
 - (i) Any electromagnetic radiation which can be generated during the operations of electronic products to such energy density levels as to present a biological hazard to occupational and public health and safety and the environment, other than ionizing electromagnetic radiation, and
 - (ii) Any sonic, ultrasonic, or infrasonic waves which are emitted from an electronic product as a result of the operation of an electronic circuit in such product and to such energy density levels as to present a biological hazard to occupational and public health and safety, and the environment.

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

002.94 RADIATION DOSE. See Dose.

002.95 RADIATION SAFETY OFFICER. An individual who has the knowledge and responsibility to apply appropriate radiation protection regulations is a radiation safety officer.

002.96 RADIOACTIVE MATERIAL. Radioactive material is any material whether solid, liquid, or gas, which emits ionizing radiation spontaneously. Radioactive material includes, but is not limited to, accelerator-produced material, byproduct material, naturally occurring material, source material, and special nuclear material.

002.97 RADIOACTIVITY. Radioactivity is the transformation of unstable atomic nuclei by the emission of radiation.

002.98 RADIOBIOASSAY. See Bioassay.

002.99 REGULATIONS OF THE UNITED STATES DEPARTMENT OF TRANSPORTATION. The regulations in 49 CFR Parts 100-189 are the regulations of the United States Department of Transportation.

002.100 REM. 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 Sv).

002.101 RESEARCH AND DEVELOPMENT. Research and development is the:

- (A) Theoretical analysis, exploration, or experimentation; or
- (B) 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.

002.102 RESIDUAL RADIOACTIVITY. Residual radioactivity is 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 according to the requirements of 180 NAC 4.

002.103 RESTRICTED AREA. A restricted area is 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.

002.104 ROENTGEN. The term roentgen refers to the special unit of exposure. One roentgen (R) equals 2.58E-4 coulombs per kilogram of air. See "Exposure" and 180 NAC 1-014.

002.105 SEALED SOURCE. A sealed source is radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material.

002.106 SHALLOW DOSE EQUIVALENT (SDE) (H_S). The term shallow dose equivalent applies to the external exposure of the skin of the whole body or the skin of an extremity that is taken at a tissue depth of 0.007 centimeter ($7\text{mg}/\text{cm}^2$).

002.107 SIEVERT (Sv). Sievert is the International System of Units (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 ($1\text{ Sv} = 100\text{ rem}$).

002.108 SOURCE MATERIAL. Source material is:

- (A) Uranium or thorium, or any combination thereof, in any physical or chemical form; or
- (B) Ores which contain by weight one-twentieth of 1% (0.05%) or more of uranium, thorium or any combination of uranium and thorium. Source material does not include special nuclear material.

002.109 SOURCE MATERIAL MILLING. Source material milling is any processing of ore, including underground solution extraction of unmined ore, primarily for the purpose of extracting or concentrating uranium or thorium there from and which results in the production of source material mill tailings.

002.110 SOURCES OF RADIATION. Sources of radiation are any radioactive material, any radiation-generating equipment or any device or equipment emitting or capable of emitting radiation or radioactive material.

002.111 SPECIAL FORM RADIOACTIVE MATERIAL. Special form radioactive material is 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) At least one dimension of the piece or capsule is not less than 5 millimeters (0.2 inch); and
- (C) It satisfies the test requirements specified by the United States Nuclear Regulatory Commission. A special form encapsulation designed in according to the United States Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985; a special form encapsulation designed according to the Nuclear Regulatory Commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998; and special form material that was successfully tested before September 10, 2015 according to the test requirements specified by the United States Nuclear Regulatory Commission in effect before September 10, 2015 may continue to be used. Any other special form encapsulation must meet the specifications of this definition.

002.112 SPECIAL NUCLEAR MATERIAL. Special nuclear material is:

- (A) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the United States 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 material listed in part (A) of this definition, but does not include source material.

002.113 SPECIAL NUCLEAR MATERIAL IN QUANTITIES NOT SUFFICIENT TO FORM A CRITICAL MASS. Special nuclear material in quantities not sufficient to form a critical mass is 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 according to 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 must not exceed 1. The following quantities in combination would not exceed the limitation and are within the formula:

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

002.114 SPENT NUCLEAR FUEL. Irradiated nuclear fuel that has undergone at least one year of decay since being used as a source of energy in a power reactor is spent nuclear fuel. Spent nuclear fuel includes the special nuclear material, byproduct material, source material, and other radioactive material associated with fuel assemblies.

002.115 SURVEY. A survey is 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.

002.116 TEST. A test is the process of verifying compliance with an applicable regulation.

002.117 TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE). The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures) is a total effective dose equivalent.

002.118 TOTAL ORGAN DOSE EQUIVALENT (TODE). The sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in 180 NAC 4-052.01, item A is a total organ dose equivalent.

002.119 TRANSURANIC WASTE. Radioactive waste material containing alpha-emitting radioactive elements, with radioactive half-lives greater than five years, having an atomic number greater than 92 in concentrations in excess of 100 nanocuries per gram is transuranic waste.

002.120 TRIBAL OFFICIAL. A tribal official is the highest ranking individual that represents Tribal leadership, such as the Chief, President, or Tribal Council leadership.

002.121 UNITED STATES DEPARTMENT OF ENERGY. The United States Department of Energy is 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 United States Atomic Energy Commission, its Chairman, members, officers and components and transferred to the United States Energy Research and Development Administration and to the Administrator thereof pursuant to § 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 § 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.)

002.122 UNREFINED AND UNPROCESSED ORE. Ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining is unrefined and unprocessed ore.

002.123 UNRESTRICTED AREA. An unrestricted area is an area, access to which is neither limited nor controlled by the licensee or registrant. Uncontrolled area is an equivalent term.

002.124 WASTE. Waste is 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, mill tailings, discrete sources of Radium 226, and discrete sources of naturally occurring radioactive material.

002.125 WASTE HANDLING LICENSEES. Persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste are waste handling licensees.

002.126 WEEK. Seven consecutive days starting on Sunday is a week.

002.127 WHOLE BODY. The whole body for purposes of external exposure, includes the head, trunk including male gonads, arms above the elbow, or legs above the knee.

002.128 WORKER. A worker is an individual engaged in work under a license or registration issued by the Department and controlled by a licensee or registrant, but does not include the licensee or registrant.

002.129 WORKING LEVEL (WL). Working level or WL is 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.

002.130 WORKING LEVEL MONTH (WLM). Working level month or WLM is 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.

002.131 YEAR. A year is the period of time beginning in January used to determine compliance with the provisions of Title 180 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.

003. EXEMPTIONS. The following are exempted from Title 180:

003.01 GENERAL PROVISION. The Department may, upon application or on its own initiative, grant exemptions or exceptions from the requirements of Title 180 if it determines the exemption or exception is authorized by law and is consistent with Neb. Rev. Stat. § 71-3507(4).

003.02 UNITED STATES DEPARTMENT OF ENERGY CONTRACTORS AND UNITED STATES NUCLEAR REGULATORY COMMISSION CONTRACTORS. Any United States Department of Energy contractor or subcontractor and any United States Nuclear Regulatory Commission contractor or subcontractor of the following categories operating within this State is exempt from Title 180 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 United States Department of Energy at United States 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 United States Department of Energy performing research in, or development, manufacture, storage, testing, or transportation of, atomic weapons or their components;
- (C) Prime contractors of the United States 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 United States Department of Energy or of the United States Nuclear Regulatory Commission when the State and the United States 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.

004. RECORDS. Each licensee and registrant must maintain records showing the receipt, transfer, and disposal of all sources of radiation. Additional record requirements are specified elsewhere in Title 180.

005. INSPECTIONS. Each licensee and registrant must allow the Department at all reasonable times an opportunity to inspect sources of radiation and the premises and facilities where sources of radiation are used or stored and make available to the Department for inspection, upon reasonable notice, records that are required to be maintained under Title 180. The Department may also make and retain copies of those records.

006. TESTS. When directed by the Department each licensee and registrant must perform or must allow the Department to perform, any tests the Department finds appropriate or necessary. This includes, but is not limited to, tests of:

- (A) Sources of radiation;
- (B) Facilities where sources of radiation are used or stored;
- (C) Radiation detection and monitoring instruments; and
- (D) Other equipment and devices used in connection with use or storage of licensed or registered sources of radiation.

007. ADDITIONAL REQUIREMENTS. In addition to Title 180 the Department may impose additional requirements on licensees or registrants it finds appropriate or necessary to minimize danger to public health and safety or property. These additional requirements can be imposed by rule, regulation, or order.

008. VIOLATIONS. See Neb. Rev. Stat. §§ 71-3517.

009. IMPOUNDING. See Neb. Rev. Stat. §§ 71-3516.

010. PROHIBITED USES. Use of the following is prohibited:

- (A) A hand-held fluoroscopic screen must not be used with x-ray equipment unless it has been listed in the Registry of Sealed Source and Devices or accepted for certification by the United States Food and Drug Administration, Center for Devices and Radiological Health.
- (B) A shoe-fitting fluoroscopic device.

011. TESTS FOR LEAKAGE AND CONTAMINATION OF SEALED SOURCES. Licensees and registrants must test sealed sources for leakage and contamination.

011.01 Sealed sources must be tested so that:

- (A) Each sealed source, except as specified in 180 NAC 1-011.02, is tested for leakage or contamination and the test results are received before the sealed source is put into use unless the licensee or registrant has a certificate from the transferor indicating that the sealed source was tested within six months before transfer to the licensee or registrant.
- (B) Each sealed source that is not designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed six months or at alternative intervals approved by the Department, after evaluation of information specified by 180 NAC 3-014.12 (C) and (D) of Title 180, or by an Agreement State, or the U.S. Nuclear Regulatory Commission.
- (C) Each sealed source that is not designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed six months or at alternative intervals approved by the Department, after evaluation of information specified by 180 NAC 3-014.12 (C) and (D) of Title 180, or by an Agreement State, or the U.S. Nuclear Regulatory Commission.
- (D) Each sealed source that is required to be tested for leakage or contamination is tested at any other time there is reason to suspect that the sealed source might have been damaged or might be leaking. The licensee or registrant must 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, must be capable of detecting the presence of 185 Bq (0.005 μ Ci) of radioactive material on a test sample. Test samples must be taken from the sealed source or from the surfaces of the container in 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 must be capable of detecting an absolute leakage rate of 37 Bq (0.001 μ Ci) 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 must be taken on the interior surface of brachytherapy source storage containers and must be capable of detecting the presence of 185 Bq (0.005 μ Ci) of a radium daughter which has a half-life greater than four days.

011.02 EXEMPTION. A licensee or registrant does not need to perform tests 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 3.7 MBq (100 μ Ci) or less of beta or photon-emitting material or 370 kBq (10 μ Ci) 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 or registrant must, 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 six months before the date of use or transfer.

011.03 PERSONS PERFORMING TESTS. Tests for leakage or contamination from sealed sources must be performed by persons specifically authorized by the Department, an Agreement State, or the United States Nuclear Regulatory Commission to perform such services.

011.04 UNITS. Test results must be kept in units of Becquerel or microcurie and maintained for inspection by the Department.

011.05 LEAKING SOURCES. The following must be considered evidence that the sealed source is leaking:

- (A) The presence of 185 Bq (0.005 μ Ci) or more of removable contamination on any test sample.
- (B) Leakage of 37 Bq (0.001 μ Ci) of radon-22 per 24 hours for brachytherapy sources manufactured to contain radium.
- (C) The presence of removable contamination resulting from the decay of 185 Bq (0.005 μ Ci) or more of radium.

011.06 USE OF LEAKING SOURCES. The licensee or registrant must immediately withdraw a leaking sealed source from use and must take action to prevent the spread of contamination. The leaking sealed source must be repaired or disposed of according to Title 180.

011.07 REPORTS OF LEAKING SOURCES. Reports of test results for leaking or contaminated sealed sources must be made as required by 180 NAC 4-064 by the licensee or registrant.

011.08 STORAGE OF SEALED SOURCES. No sealed source may be stored for a period of more than three years without being tested for leakage or contamination by the licensee or registrant.

012. COMMUNICATIONS. All communications and reports concerning Title 180, and applications should be addressed to:

Nebraska Department of Health and Human Services
Division of Public Health
Radiological Health
301 Centennial Mall South
P.O. Box 95026
Lincoln, Nebraska 68509-5026

013. CITIZENSHIP ATTESTATION. All applicants, licensees, and registrants, must meet the requirements set out in Neb. Rev. Stat. §§ 4-108 through 4-114, unless the applicant, licensee, or registrant is not an individual.

014. UNITS OF EXPOSURE AND DOSE. As used in Title 180:

014.01 COULOMB PER KILOGRAM. 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.

014.02 UNITS OF DOSE. The units of dose are:

- (A) Gray (Gy);
- (B) Rad;
- (C) Rem; and
- (D) Sievert.

014.03 QUALITY FACTORS. 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
X, gamma, or beta radiation and high-energy 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

Absorbed dose in gray is equal to 1 Sv or the absorbed dose in rad equal to 1 rem.

014.04 NEUTRON FLUENCE RATE. If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rems per hour or sieverts per hour, as provided in 180 NAC 1-014.03, 0.01 Sv (1 rem) of neutron radiation of unknown energies may, for purposes of Title 180, 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 gray or rad to dose equivalent in sievert or rem.

TABLE II

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

	Neutron Energy (MeV)	Quality Factor (Q)	Fluence per Unit Dose Equivalent (neutrons cm ⁻² rem ⁻¹)	Fluence per Unit Dose Equivalent (neutrons cm ⁻² sievert ⁻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

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

The fluence per unit dose equivalent is monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.

015. UNITS OF ACTIVITY. For the purposes of Title 180, activity is expressed in the System of International Units (SI) unit of becquerel (Bq) or in the special unit of curie (Ci), or their multiples, or disintegrations or transformations per unit of time.