



## DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

### Hazardous Materials and Waste Management Division

#### RADIATION CONTROL - GENERAL PROVISIONS

##### 6 CCR 1007-1 Part 01

*[Editor's Notes follow the text of the rules at the end of this CCR Document.]*

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**Adopted by the Board of Health on December 16, 2015.**

#### **PART 1: GENERAL PROVISIONS**

##### **1.1 Purpose and Scope.**

###### 1.1.1 Authority.

1.1.1.1 Rules and regulations set forth herein are adopted pursuant to the provisions of sections 25-1-108, 25-1.5-101(1)(k), 25-1.5-101(1)(l), and 25-11-104, CRS.

###### 1.1.2 Basis and Purpose.

1.1.2.1 A statement of basis and purpose accompanies this part and changes to this part. A copy may be obtained from the Department.

###### 1.1.3 Scope.

1.1.3.1 This part includes provisions generally applicable throughout all parts of these radiation control regulations.

###### 1.1.4 Applicability

1.1.4.1 Except as otherwise specifically provided herein, these regulations apply to all persons who receive, possess, own, acquire, use, process, store, transfer, or dispose any source of radiation.

1.1.4.2 Nothing in these regulations shall apply to any person to the extent such person is subject to regulation not relinquished by the U.S. Nuclear Regulatory Commission.<sup>1</sup>

<sup>1</sup> 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 the State and the U.S. Nuclear Regulatory Commission and to 10 CFR Part 150 (January 1, 2010) of the Commission's regulations.

###### 1.1.5 Published Material Incorporated By Reference.

1.1.5.1 Published material incorporated in Part 1 by reference is available in accord with Section 1.4.

**1.2 Definitions.**

1.2.1 Definitions of general applicability to the *Rules and Regulations Pertaining to Radiation Control* promulgated by the Department pursuant to provisions of sections 25-1-108, 25-1.5-101(1)(k), 25-1.5-101(1)(l), and 25-11-104, CRS, are set forth in section 1.2.2 and shall be liberally construed to protect the public health by controlling excess radiation.

1.2.2 As used in these regulations, each term below has the definition set forth. A cross-reference is provided for each common abbreviation. Any additional definition used only in a single part of these regulations is found in that part.

“A<sub>1</sub>” means the maximum activity of special form radioactive material permitted in a Type A package. This value is either listed in Appendix 17A or may be derived in accordance with the procedures prescribed in Appendix 17A.

“A<sub>2</sub>” means 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. This value is either listed in Appendix 17A or may be derived in accordance with the procedures prescribed in Appendix 17A.

“AAPM” means the American Association of Physicists in Medicine.

“Absorbed dose” (D) means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the gray (Gy) and the rad.

“Absorbed dose rate” means absorbed dose per unit time.

“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, “linear accelerator” or “particle accelerator” is an equivalent term.

“Accelerator-produced radioactive material” means any material made radioactive by an accelerator.

“Accessible surface” means the external surface of the radiation machine enclosure or housing provided by the manufacturer.

“Accident” means any unintended event (including an operating error, equipment failure or other mishap) that could:

- (1) Result in a dose in excess of regulatory limits on site or for the public; or
- (2) Have consequences or potential consequences which cannot be ignored from the point of view of protection or safety (such as an actual or potential substantial degradation of the level of protection or safety of the facility or release of radioactive material in sufficient quantity to warrant consideration of protective actions).

“Act” means Title 25, Article 11, Colorado Revised Statutes (CRS), as amended.

“Action levels”. See “action limits”.

“Action limits” means the minimum and maximum values of a quality assurance measurement that can be interpreted as representing acceptable performance with respect to the parameter being tested. Values less than the minimum or greater than the maximum action limit or level indicate that corrective action must be taken. Action limits or levels are also sometimes called control limits or levels.

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

“Acute” means radiation dose(s) or chemical exposure(s) occurring within a short period of time (24 hours or less).

“Address of use” means the facility designated on the license or registration where radioactive material is permitted to be received, produced, prepared, used, processed, or stored or where a radiation machine is permitted to be installed, operated, repaired or stored.

“Adult” means an individual 18 or more years of age.

“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 subsection 274b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

“Air kerma” (K) means the kinetic energy released in the mass of a small volume of air by ionizing radiation (see kerma). Air kerma is measured in joules per kilogram (J/kg). For diagnostic x-rays, air kerma is the same as the absorbed dose measured in gray (Gy) delivered to the volume of air in the absence of scatter.

“Air kerma rate” (AKR) means the air kerma per unit time.

“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.

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

“Airborne radioactivity area” means a room, enclosure, or area in which airborne radioactive material exists in a concentration:

- (1) In excess of the derived air concentration (DAC) specified in Appendix 4B, Table 4B1; or
- (2) 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.

“Airline respirator”. See “supplied-air respirator”.

“Alert” means an event may occur, is in progress, or has 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 any individual(s) offsite.

“ALI”. See “annual limit on intake”.

“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 human that would result in a committed effective dose equivalent of 0.05 Sv (5 rem) or a committed dose equivalent of 0.5 Sv (50 rem) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Part 4, Appendix 4B, Table 4B1, Columns 1 and 2.

“Annually” means either:

- (1) At intervals not to exceed 1 year; or
- (2) Once per year, at about the same time each year (plus or minus 1 month).

“ANSI” means the American National Standards Institute.

“Applicant” means any person who applies for a Department license, registration, certification or other acceptance, approval or permit.

“Area of use” means a portion of an address of use that has been set aside for the purpose of receiving, producing, preparing, processing, using, or storing radioactive material or installing, operating, repairing, or storing a radiation machine.

“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.

“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.

“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 (SAR) and self-contained breathing apparatus (SCBA) units.

“Authorized medical physicist” (AMP) means an individual who meets the Appendix 7B requirements that are applicable to a type of use of radioactive material licensed under Part 7 and has current Department approval to perform medical physics activities.

“Authorized nuclear pharmacist” (ANP) means a pharmacist who meets the Appendix 7C requirements that are applicable to a type of use of radioactive material licensed under Part 7 and has current Department approval to perform nuclear pharmacy activities.

“Authorized user” (AU) means an individual who meets State training and experience requirements and has Department approval for a use of radioactive material.

“Background radiation” means radiation from:

- (1) Extraterrestrial sources;

- (2) Naturally occurring radioactive material (which has not been technologically enhanced), including radon (except as a decay product of source or special nuclear material); and
- (3) Global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that are not under the control of the licensee or registrant.

Background radiation does not include sources of radiation from radioactive materials regulated by NRC.

“Becquerel” (Bq) means the SI unit of activity. One becquerel is equal to 1 disintegration per second (dps) or transformation per second ( $s^{-1}$ ).

“Becquerel per cubic meter”,  $1 \text{ Bq/m}^3$  (0.027 pCi/L), means a unit of radioactivity representing one disintegration per second per cubic meter.

“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.

“Brachytherapy” means a method of radiation therapy in which sealed, plated, embedded, activated, or electronic sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, intraluminal or interstitial application.

“Business day” means any day of the year, exclusive of Saturdays, Sundays, and State of Colorado holidays.

“Byproduct material” means:

- (1) Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material;
- (2) 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 these solution extraction operations do not constitute “byproduct material” within this definition);
- (3)
  - (a) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or
  - (b) Any material that:
    - (i) Has been made radioactive by use of a particle accelerator; and
    - (ii) Is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

- (4) Any discrete source of naturally occurring radioactive material, other than source material, that:
  - (a) The NRC, 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; and
  - (b) Before, on, or after August 8, 2005, is extracted, or converted after extraction, for use for a commercial, medical, or research activity;

“Calendar quarter”. See “quarter”.

“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.

“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.

“CCR” means the Colorado Code of Regulations.

“CFR” means Code of Federal Regulations.

“Chelating agent” means a substance that through binding allows efficient elimination of radionuclide contamination from the human body (decorporation), for example, amine polycarboxylic acids, hydroxy carboxylic acids, and polycarboxylic acids.

“Chiropractor” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice chiropractic health care.

“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.

“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.

“Commencement of construction” means taking any action defined as “construction” or any other activity at the site of a facility subject to the regulations that has a reasonable nexus to radiologic health and safety.

“Committed dose equivalent” ( $H_{T, 50}$ ) 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 ( $W_T$ ) applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ( $H_{E, 50} = \sum W_T \times H_{T, 50}$ ).

“Computer-readable medium” means that the Department’s computer can transfer the information from the medium into its memory.

“Constraint” (dose constraint) means a value above which specified action is required.

“Construction” means the installation of wells associated with radiological operations (e.g., production, injection, or monitoring well networks associated with in-situ recovery or other facilities), the installation of foundations, or in-place assembly, erection, fabrication, or testing for any structure, system, or component of a facility or activity subject to the regulations in Parts 3, 18, and 19 that are related to radiological safety or security. The term “construction” does not include:

- (1) Changes for temporary use of the land for public recreational purposes;
- (2) Site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values;
- (3) Preparation of the site for construction of the facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas;
- (4) Erection of fences and other access control measures that are not related to the safe use of, or security of, radiological materials subject to Parts 3, 18, and 19;
- (5) Excavation;
- (6) Erection of support buildings (e.g., construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility;
- (7) Building of service facilities (e.g., paved roads, parking lots, railroad spurs, exterior utility and lighting systems, sanitary sewerage treatment facilities, and transmission lines);
- (8) Procurement or fabrication of components or portions of the proposed facility occurring at other than the final, in-place location at the facility; or
- (9) Taking any other action that has no reasonable nexus to radiological health and safety.

“Contact hour” means an hour of training received through direct instruction.

“Continuing education” is lifelong learning to ensure that new information and knowledge is put into practice.

“Continuing education unit” (CEU) means one documentable contact hour.

“Controlled area” means an area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason and/or the occupancy and activity of those within is subject to supervision.

“Cost estimate” means a document containing the total costs that would be incurred if an independent contractor were hired to perform decommissioning of the facility and disposal of radioactive materials at the facility, and associated administrative indirect and legal costs to the Department in conducting decommissioning oversight.

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

“CRS” means the Colorado Revised Statutes.

“Cumulative air kerma” means the total air kerma accrued from the beginning of an examination or procedure and includes all contributions from fluoroscopic and radiographic irradiation.

“Curie” means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material that decays at the rate of  $3.7 \times 10^{10}$  transformations per second (s<sup>-1</sup>).

“Cyclotron” means a particle accelerator in which a magnetic field bends the path of charged particles. A cyclotron accelerates charged particles at energies usually in excess of 10 megaelectron volts and is commonly used for production of short half-life radionuclides for medical use.

“DAC”. See “derived air concentration”.

“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.

“Decommission” means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits:

- (1) Release of the property for unrestricted use and termination of the license; or
- (2) Release of the property under restricted conditions and termination of the license.

“Decommissioning funding plan” means a written document that contains a cost estimate for decommissioning and a description of the method for assuring funds for decommissioning, including means of adjusting cost estimates and associated funding levels periodically over the life of the facility.

“Decommissioning plan” means a written document that includes the licensee’s planned procedures and activities for decommissioning of the facility or site.

“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<sup>2</sup>).

“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.

“Dentist” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice dentistry.

“Department” means the Colorado Department of Public Health and Environment.

“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.

“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 Part 4, Appendix 4B, Table 4B1, Column 3.

“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 0.05 Sv (5 rem).

“Detector”. See “radiation detector”.

“Diagnostic imaging system” means an assemblage of components for the generation, emission, and reception of machine-produced x-rays and the transformation, storage and visual display of the resultant image.

“Direct supervision” means the supervisor is present in the facility and immediately available to observe, correct, assist and direct the supervisee throughout the performance of a procedure, as needed, but is not always required to be present in the room. For purposes of these regulations, “on-site supervision” is an equivalent term.

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

“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).

“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 measurement technology, survey, and statistical techniques.

“DOE” means the U.S. Department of Energy.

“Dose” is a generic term that means absorbed dose, dose equivalent, effective dose, 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.

“Dose commitment” means the total radiation dose to a part of the body that will result from retention of radioactive material in the body. For purposes of estimating the dose commitment, it is assumed that from the time of intake the period of exposure to retained material will not exceed 50 years.

“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 sievert (Sv) and rem.

“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.

“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.

“DOT” means the U.S. Department of Transportation.

“Drill” means a supervised, hands-on instruction period intended to test, develop or maintain a specific emergency response capability. A drill may be a component of an exercise.

“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 ( $H_E = \sum W_T \times H_T$ ).

“Embryo/fetus” means the developing human organism from conception until the time of birth.

“Emergency” means an event requiring prompt action to mitigate a threat to the health and safety of workers and the public or a threat of damage to the environment.

“Emergency planning zone” means a geographic area surrounding a specific facility for which special planning and preparedness efforts are carried out to ensure that prompt and effective protective actions can reduce or minimize the impact of releases of radioactive material to public health and safety or to the environment.

“Enriched uranium” means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

“Entrance exposure rate” means the exposure free-in-air per unit time.

“Entrance point” or “access point” means any location through which an individual could gain access to a radiation area, source of radiation or licensed or registered radioactive material, including an entry or exit portal of sufficient size to permit human entry, irrespective of its intended use.

“Evacuation” means the urgent removal of people from an area to avoid or reduce high-level, short-term exposure.

“Event” means a situation reasonably discrete in time, location and consequences.

“Examination” means performing a procedure, including selection of exposure settings, positioning the x-ray system and the patient, and initiating and terminating the exposure.

“Exercise” means a multi-faceted activity that tests the plans, procedures, adequacy of training, resources, and integrated capability of an emergency response system.

“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.

“Exposure” means being exposed to ionizing radiation or to radioactive material.

“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).<sup>2</sup>

<sup>2</sup> When not underlined as above, or indicated as “exposure” (X), the term “exposure” has a more general meaning in these regulations.

“Exposure rate” means the exposure per unit of time.

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

“Extremity” means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

“Facility” means the location within one building (or vehicle, or under one roof, or at one address) and under the same administrative control (multiple locations or addresses at a site or part of a site are considered together if so approved by the Department) at which:

- (1) The possession, use, processing or storage of radioactive material is or was authorized;
- (2) A radiation machine is or was installed, operated, repaired and/or stored; and/or
- (3) A source of radiation is located.

“FDA” means the United States Food and Drug Administration.

“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.

“Final radiation survey” means the survey of the facility or site after decommissioning activities have been completed during which the determination is made by the licensee that the facility or site meets the Department’s release criteria.

“Financial surety” or “financial warranty” means the method of assuring that sufficient funds will be available at the time of license termination and decommissioning of the facility to cover all costs associated with the decommissioning.

“Fissile material” means the radionuclides uranium-233, uranium-235, plutonium-239, and plutonium-241, 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.

“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.

“Fit test” means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

“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.

“General emergency” means an accident has occurred or is in progress which involves actual or imminent catastrophic reduction of facility safety systems with potential for loss of containment or confinement integrity or release of radioactive material that can be reasonably expected to exceed offsite protective action guides.<sup>3</sup>

<sup>3</sup> A definition of “general emergency” is provided for reference and completeness. It is unlikely that any Colorado licensee would need to plan for a general emergency.

“General supervision” means the procedure is under the supervisor’s overall direction and control but the supervisor’s presence is not required during the performance of the procedure.

“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.

“Gray” (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose resulting from deposition of 1 joule (J) of energy in 1 kilogram of material (100 rad).

“Hazardous waste” means any waste designated as hazardous by Department regulations in 6 CCR 1007-1-3.

“Healing arts” means any system, treatment, operation, diagnosis, prescription, or practice for the ascertainment, cure, relief, palliation, adjustment, or correction of any human disease, ailment, deformity, injury or unhealthy or abnormal physical or mental condition. For purposes of Parts 2, 6 and 24, “healing arts” includes animals other than humans.

“Helmet” (respiratory) means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

“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 1 mSv (0.1 rem) in 1 hour at 30 centimeters from any source of radiation or 30 centimeters from any surface that the radiation penetrates.

“Hood” (respiratory) means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

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

“ICRP” means the International Commission on Radiological Protection.

“Immediate” means within not more than fifteen minutes or as otherwise specified in writing by the licensee and approved by the Department.

“Incident” means any unintended event involving radiation for which the public dose is a fraction of regulatory limits and safety provisions are sufficient, but further degradation of safety systems could lead to an accident condition.

“Individual” means any human being. “Natural person” is an equivalent term.

“Individual monitoring” means the assessment of:

- (1) Dose equivalent by the use of:
  - (a) Individual monitoring devices; or
  - (b) Survey data; or
- (2) Committed effective dose equivalent by:
  - (a) Bioassay; or
  - (b) Determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours. (See the definition of DAC-hours).

“Individual monitoring device” mean a device designed to be worn by a single individual for the assessment of dose equivalent. For purposes of these regulations, “personnel dosimeter” and “dosimeter” are equivalent terms. Examples of individual monitoring devices are film badges, thermoluminescence dosimeters (TLDs), pocket ionization chambers, optically stimulated luminescence (OSL) dosimeters and personal (lapel) air sampling devices.

“Inhalation class”. See “class”.

“Inspection” means an official examination or observation including but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, license conditions and other requirements of the Department.

“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.

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

“Irradiation” means the exposure of a living being or matter to ionizing radiation.

“Kerma” (*K* [italicized]) means kinetic energy released in a unit mass, determined by the quotient  $K = dE_{tr} / dm$ , where  $dE_{tr}$  is the sum of the initial kinetic energies of all the charged ionizing particles (such as electrons) liberated (transferred,  $E_{tr}$ ) by uncharged ionizing particles (such as neutrons and photons) in air of mass  $dm$ . Kerma is measured in joules per kilogram (J/kg).

“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.

“Kilovolt” (kV) is a unit (a thousand volts) used to measure the nominal accelerating potential of charged particles used to create an x-ray beam.

“Kinetic energy” means the energy of motion of an object, which is completely described by magnitude alone and has no direction.

“Lens dose equivalent” (LDE) means the external exposure to the lens of the eye as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm<sup>2</sup>).

“License” means a license issued by the Department in accordance with the regulations adopted by the Department.<sup>4</sup>

<sup>4</sup> The term "license", "licensed material" or "licensee" is taken to have an equivalent meaning when these regulations apply to a license issued by another Agreement State or NRC.

"Licensed material" means radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Department. <sup>4</sup>

"Licensee" means any person who is:

- (1) Licensed by the Department <sup>4</sup> in accordance with these regulations and the Act;
- (2) Responsible for decommissioning by being:
  - (a) Registered with the Department;
  - (b) Subject to a record of possession of a radiation source or device under general license, for example, pursuant to 3.6.4.3(13); or
  - (c) Otherwise legally obligated to conduct decommissioning activities in accordance with these regulations and the Act; or
- (3) Responsible under 10 CFR 71 (January 1, 2010) as certificate holder, or applicant for a certificate of compliance, or under Part 17, for demonstrating that package design, fabrication, assembly and testing requirements are met with respect to a package before the time a package approval is issued. "Limits". See "dose limits".

"Loose-fitting facepiece" means a respiratory inlet covering that is designed to form a partial seal with the face.

"Lost or missing licensed source of radiation" means a licensed or registered 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.

"Lung class". See "class".

"mA" means milliampere.

"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 Type B quantities are defined in Part 17 of these regulations.

"Mammographer" means a registered radiologic technologist who has specialized training to perform mammography examinations.

"Management" means the chief executive officer, or other individual having the authority to manage, direct, or administer the licensee's activities, or delegate(s) of such individual.

"mAs" means milliampere second.

"Medical institution" means an organization in which two or more medical disciplines are practiced.

“Medical physicist” means an individual trained and experienced in a medical physics specialty.

“Medical use” means the intentional internal or external administration of radioactive material or radiation to humans or animals in the practice of the healing arts, including administration of radioactive materials to patients or human or animal research subjects under the supervision of an authorized user and operation of radiation machines for healing arts purposes.

“Member of the public” means an individual, except when that individual is receiving an occupational dose.

“MeV” means one mega electron volt, or one million electron volts. One MeV is the amount of energy acquired by a particle with one electron charge in passing through a potential difference of one million volts in a vacuum. One MeV is equivalent to  $1.60 \times 10^{-16}$  joules.

“Minor” means an individual less than 18 years of age.

“Misadministration” means an event that results in a dose or dosage administered to the wrong individual, or by the wrong mode of radiation delivery, or that differs from the prescribed dose or dosage, as stated in 7.21, 24.6, or an equivalent section of these regulations. “Reportable medical event” is an equivalent term.

“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.

“MQSA” means Mammography Quality Standards Act.

“NARM”. See “naturally occurring or accelerator-produced radioactive material” (NARM).

“Nationally tracked source” means a sealed source containing a quantity equal to or greater than a Category 2 level of any radioactive material listed in Appendix 4G. Category 1 nationally tracked sources are those containing radioactive material in 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.

In this context, a sealed source:

- (1) Means radioactive material that is sealed in a capsule or closely bonded, in a solid form, and is not exempt from regulatory control; and
- (2) Does not mean material encapsulated solely for disposal, or nuclear material contained in any fuel assembly, subassembly, fuel rod, or fuel pellet.

“Natural radioactivity” means radioactivity of naturally occurring nuclides.

“Natural thorium” means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight percent thorium-232).

“Natural uranium” means uranium containing the naturally occurring distribution of the uranium isotopes 234, 235 and 238 (approximately 0.711 weight percent uranium-235 and the remainder by weight essentially uranium 238) that is neither enriched nor depleted in the isotope uranium 235.

“Naturally occurring or accelerator produced radioactive material”(NARM) means any radioactive material that is not source or special nuclear material or byproduct material types (1) or (2).

“Naturally occurring radioactive material” (NORM) means any nuclide that is radioactive in its natural physical state and is not manufactured. “Naturally occurring radioactive material” does not include source material, special nuclear material, byproduct material, or by-products of fossil-fuel combustion, including bottom ash, fly ash, and flue-gas emission by-products.

“NCRP” means the National Council on Radiation Protection and Measurements.

“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.

“NIST” means the National Institute of Standards and Technology.

“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.

“NORM”. See “naturally occurring radioactive material” (NORM).

“Normal form radioactive material” means radioactive material that has not been demonstrated to qualify as “special form radioactive material”.

“NRC”. See “Nuclear Regulatory Commission”.

“Nuclear Regulatory Commission” (NRC) means the U.S. Nuclear Regulatory Commission or a duly authorized representative.

“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 or to radioactive material from licensed and unlicensed sources of radiation whether or not the sources of radiation are in the possession of the licensee, registrant or other person.

Occupational dose does not include doses received:

- (1) From background radiation;
- (2) From any medical administration the individual has received;
- (3) From exposure to individuals administered radioactive material and released in accordance with 7.26 of these regulations;
- (4) From voluntary participation in medical research programs; or
- (5) As a member of the public.

“Offsite response organization” means the non-licensee offsite organizations that may be needed to respond to an emergency, including, but not limited to, local fire, police, ambulance and hospital services.

“Operator” means an individual adequately trained in accordance with these regulations in the purpose and experienced in the practice of performing a radiographic examination and/or using a device containing radioactive material.

“Ore” means naturally occurring uranium-bearing, thorium-bearing, or radium-bearing material in its natural form, to be processed for its uranium or thorium content, prior to chemical processing including but not limited to roasting, beneficiating, or refining, and specifically includes material that has been physically processed, such as by crushing, grinding, screening, or sorting.

“Package” means the packaging together with its radioactive contents as presented for transport.

“Particle accelerator”. See “accelerator”.

“Patient” means an individual human being or an animal to whom radioactive materials or machine produced radiation is delivered for healing arts examination, diagnosis or treatment.

“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. “Natural person” means an individual human being.

“Personal supervision” means the supervisor is in attendance in the room with the supervisee during the performance of the procedure. For purposes of these regulations, “physical supervision” or “immediate supervision” or “individual supervision” is an equivalent term.

“Personnel monitoring equipment”. See “individual monitoring device”.

“PET” means positron emission tomography. See “positron emission tomography radionuclide production facility”.

“Phantom” means an object designed such that the interaction of ionizing radiation with the object is suitable for the evaluation of the particular characteristics of the radiation-producing system or anatomic region under consideration.

“Pharmacist” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice pharmacy.

“Physician” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine.

“Planned special exposure” means an infrequent exposure to radiation, separate from and in addition to the annual occupational dose limits.

“Podiatrist” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice podiatry.

“Positive-pressure respirator” means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

“Positron Emission Tomography (PET) radionuclide production facility” means a facility operating a cyclotron or accelerator for the purpose of producing PET radionuclides.

“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 facepiece.

“Practitioner of the healing arts” means any person upon whom the U.S. Food and Drug Administration has conferred the authority to administer prescription drugs.

“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.

“Principal activity” means an activity authorized by the license which is essential to achieving the purpose(s) for which the license was issued or amended.

Not included as principal activities are:

- (1) Radioactive material storage while no licensed material is accessed for use or disposal; and
- (2) Activity incidental to decontamination or decommissioning.

“Projected dose” means a future dose calculated for a specified time period on the basis of estimated or measured initial concentrations of radionuclides or exposure rates and in the absence of protective actions.

“Protective action” means an action taken by members of the public to protect themselves from radiation from an accident involving radioactive material. Protective action may include sheltering, evacuation, relocation, control of access, administration of a radioprotective drug, decontamination of persons, decontamination of land or property, or control of food or water.

“Protective action guide” means a projected dose from an accidental release of radioactive material at which protective action is to be considered.

“Protective apron” means an apron made of radiation-attenuating material(s) used to reduce exposure to radiation.

“Public dose” means the dose received by a member of the public from exposure to radiation or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee.

Public dose does not include occupational dose or doses received from:

- (1) Background radiation;
- (2) Any medical administration the individual has received;
- (3) Exposure to individuals administered radioactive material and released in accordance with Section 7.26 of these regulations; or
- (4) Voluntary participation in medical research programs.

“Pyrophoric liquid” means 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.

“Qualified expert” (QE) means an individual who meets the requirements of Appendix 2B or 2C and has current Department approval in a designated specialty to evaluate radiation shielding design and recommend radiation safety procedures.

“Qualified inspector” (QI) means an individual who meets the requirements of Appendix 2I and has current Department approval in a designated specialty to perform evaluations of radiation machines, facilities, service providers and operators for compliance with these regulations.

“Qualified trainer” (QT) means an individual whose training and experience adequately prepares the individual to carry out specified training assignments.

“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.

“Quality assurance” (QA) comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

“Quality Assurance Officer” means the individual responsible for the development, maintenance and oversight (including corrective action) of the quality assurance program.

“Quality control” (QC) comprises those quality assurance actions that relate to control of the physical characteristics and quality of the material or component to predetermined requirements, including the steps taken by an organization to measure performance, compare performance with standards, and act on any differences.

“Quality factor” (Q) means the modifying factor, listed in Appendix 1A, Table 1A-1 or Table 1A-2, that is used to derive dose equivalent from absorbed dose.

“Quantitative fit test” (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

“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 of the year is omitted or duplicated in consecutive quarters. See also “year”.

“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).

“Radiation” means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. For purposes of these regulations, ionizing radiation is an equivalent term. Radiation, as used in these regulations, does not include non-ionizing radiation, such as radiowaves or microwaves, visible, infrared, or ultraviolet light.

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

“Radiation detector” means a device that in the presence of radiation provides a signal or other indication suitable for use in measuring one or more quantities of incident radiation.

“Radiation dose”. See “dose”.

“Radiation machine” means any device capable of producing radiation except those devices with radioactive material as the only source of radiation. Radiation machine includes any accelerator and/or x-ray system, subsystem or equipment.

“Radiation safety officer” (RSO) means an individual who has demonstrated sufficient knowledge to apply radiation protection regulations appropriately and who has been assigned such responsibility by the licensee or registrant.

“Radioactive material” means any solid, liquid, or gas which emits radiation spontaneously.

“Radioactivity” means the transformation of unstable atomic nuclei by the emission of radiation.

“Radiobioassay”. See “bioassay”.

“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 International Commission on Radiological Protection (ICRP) Publication 23, “Report of the Task Group on Reference Man,” 1975.

“Registered medical physicist” (RMP) means an individual who meets the applicable requirements of Appendix 2B and has current Department approval to perform medical physics activities in a designated specialty.

“Registrant” means any person who is registered with the Department and is legally obligated to register with the Department pursuant to these regulations and the Act.

“Registration” means registration with the Department in accordance with the regulations adopted by the Department.

“Regulations of the DOT” means the regulations in 49 CFR Parts 100-189 and Parts 390-397 (October 1, 2014).

“Regulations of the NRC” means the regulations in 10 CFR Parts 1-50 and Parts 51-199 (January 1, 2015).

“Relocation” means the removal or, after a plume has passed, continued exclusion of people from contaminated areas to avoid chronic radiation dose.

“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).

“Reportable medical event” means an event that results in a dose or dosage administered to the wrong individual, or by the wrong mode of radiation delivery, or that differs from the prescribed dose or dosage, as stated in 7.21, 24.6, or an equivalent section of these regulations.

“Misadministration” is an equivalent term.

“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.

“Residual radioactivity” means radioactivity in structures, materiel, soils, groundwater, and other media at a site resulting from activities under the licensee’s control.

- (1) This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation.
- (2) 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 Part 4.

“Respiratory protective equipment” means an apparatus, such as a respirator, used to reduce an individual’s intake of airborne radioactive materials.

“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.

“Restricted use” means that a limit or control has been placed on future use of the facility and the facility is no longer under the control of the licensee, registrant, or holder of the record of possession. See also “unrestricted use”.

“Roentgen” means the special unit of exposure. One roentgen (R) equals  $2.58 \times 10^{-4}$  coulombs/kilogram of air. See “exposure”.

“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.

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

“Sealed source and device registry” (SSD) means the national registry, maintained by the NRC, which contains the registration certificates that summarize the radiation safety information for sealed sources and devices and describe the licensing and use conditions approved for the product.

“Self-contained breathing apparatus” (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

“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 ( $7 \text{ mg/cm}^2$ ).

“Sheltering” means the use of a structure for radiation protection from an airborne plume containing radioactive material.

“SI” means the abbreviation for the International System of Units.

“Sievert” 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 Sv = 100 rem).

“Site” means the area within the boundary of a location under the control of a person using or storing radioactive material or at which a source of radiation is located.

“Site boundary” means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee, registrant or person who controls a site.

“Site area emergency” means an event may occur, is in progress, or has 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.

“Source material” means uranium or thorium, or any combination of uranium or thorium, in any physical or chemical form, including ores that contain, by weight, one-twentieth of 1 percent (0.05 percent) or more, of uranium, thorium or any combination thereof. Source material does not include special nuclear material.

“Source material milling” means any activity that results in the production of radioactive material that meets byproduct material definition (2).

“Source of radiation” means any radioactive material or any device or equipment emitting, or capable of producing, radiation.

“Special form radioactive material” means radioactive material that satisfies the following conditions:

- (1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;
- (2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and
- (3) All test requirements specified by the NRC that are applicable and in effect at the time are met by the special form encapsulation design and/or construction.

“Special nuclear material” means:

- (1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the NRC, 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
- (2) Any material artificially enriched by any of the foregoing but does not include source material.

“Special nuclear material in quantities not sufficient to form a critical mass” means uranium enriched in the isotope<sup>235</sup> U in quantities not exceeding 350 grams of contained<sup>235</sup> U; <sup>233</sup> U 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:  $[175 \text{ (grams contained } 235\text{U)/}350] + [50 \text{ (grams contained } 233\text{U)/}200] + [50 \text{ (grams Pu)/}200] \leq 1$ .

“Specific activity of a material”, for a material in which the radionuclide is essentially uniformly distributed, means the radioactivity per unit mass of the material.

“Specific activity of a radionuclide” means the radioactivity of the radionuclide per unit mass of that nuclide.

“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.

“State” means the State of Colorado. If it is clear from the context that the term is being used in general, “state” means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

“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.

“Structured educational program” means an accredited educational program designed to impart particular knowledge and practical education through interrelated studies and supervised training.

“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.

“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.

“Technologically enhanced naturally occurring radioactive material” (TENORM) means naturally occurring radioactive material whose radionuclide concentrations are increased by or as a result of past or present human practices. “TENORM” does not include:

- (1) Background radiation or the natural radioactivity of rocks or soils;
- (2) “Byproduct material” or “source material”, as defined by Colorado statute or rule;  
or
- (3) Enriched or depleted uranium as defined by Colorado or federal statute or rule.

“Test” means the process of verifying compliance with an applicable regulation.

“These regulations” mean all parts of the State of Colorado “Rules and Regulations Pertaining to Radiation Control,” 6 CCR 1007-1.

“Tight-fitting facepiece” means a respiratory inlet covering that forms a complete seal with the face.

“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).

“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 in accordance with Part 4.

“Traceable to a national standard” means that a quantity or a measurement has been compared to a national standard directly, or indirectly through one or more intermediate steps, and that all comparisons have been documented.

“Transuranic” means radionuclides with atomic numbers greater than 92.

“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).

“Unirradiated uranium” means uranium containing not more than  $2 \times 10^3$  Bq (54 nanocurie) of plutonium per gram of uranium-235, not more than  $9 \times 10^6$  Bq (243 microcurie) of fission products per gram of uranium-235, and not more than  $5 \times 10^{-3}$  g of uranium 236 per gram of uranium-235.

“Unrefined and unprocessed ore” means ore in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining. Processing does not include sieving or encapsulation of ore or preparation of samples for laboratory analysis.

“Unrestricted area” means an area, access to which is neither limited nor controlled by the licensee or registrant. For purposes of these regulations, “uncontrolled area” is an equivalent term.

“Unrestricted use” means that the facility or area may be used by individuals for any purpose without limit or control of the licensee, registrant, or holder of the record of possession. See also “restricted use”.

“Uranium”. See depleted uranium, enriched uranium, or natural uranium.

“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 isoamylacetate check.

“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 5 Gy (500 rad) in 1 hour at 1 meter from a source of radiation or 1 meter from any surface that the radiation penetrates.<sup>5</sup>

<sup>5</sup> 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.

“Veterinarian” means an individual licensed by a State or Territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to practice veterinary medicine.

“Volumetric dental imaging system” means an x-ray machine that produces, for oral and maxillofacial structures, a three-dimensional tomographic data set or a time sequence of three-dimensional tomographic data sets. A dental x-ray machine only capable of producing a two dimensional image is not considered to be a volumetric dental imaging system.

“Waste” means low-level radioactive waste that is acceptable for disposal in a land disposal facility and, for purposes of this definition, that is not classified as high level radioactive waste, spent nuclear fuel, or byproduct material meeting definition (2), (3) or (4).

“Waste handling licensee” means a person licensed to receive and store radioactive waste prior to disposal and/or a person licensed to dispose of radioactive waste.

“Week” means 7 consecutive days starting on Sunday.

“Weighting factor” ( $w_T$ ) for an organ or tissue (T) means the proportion, listed in Appendix 1B, 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.

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

“Worker” means an individual engaged in work under a license or registration issued by the Department and controlled by a licensee or registrant.

“Working level” (WL) means any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of  $1.3 \times 10^5$  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.

“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).

“X-ray equipment” means an x-ray system, subsystem, or component thereof.

- (1) “Mobile or portable x-ray equipment” means x-ray equipment that is designed to be transported from place to place.
  - (a) Mobile x-ray equipment is often mounted in a vehicle or on a permanent base with wheels and/or casters for moving while completely assembled.
  - (b) Portable x-ray equipment includes x-ray equipment that is designed to be hand-carried and hand-held during use.
- (2) “Stationary x-ray equipment” means x-ray equipment that is installed in a fixed location.

“X-ray imaging system” or “x-ray system” means an assemblage of components for the controlled production of x rays.

- (1) At a minimum, an x-ray imaging system includes an x-ray high-voltage generator, an x-ray exposure control, a tube housing assembly, a beam-limiting device, and necessary supporting structures.
- (2) Additional components such as the image receptor(s) that function with the system are considered integral parts of the system.

“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. If a transition from one licensee or registrant to another occurs during a year, each licensee or registrant shall assure that no day is omitted or duplicated in consecutive years. See also “quarter”.

## **COMMUNICATIONS AND REFERENCED MATERIALS**

### **1.3 Communications.**

- 1.3.1 All communications and reports concerning parts of these regulations, and applications filed thereunder, should be addressed to the Department.

### **1.4 Referenced Materials.**

- 1.4.1 Parts of these regulations incorporate by reference (as identified within a particular section) materials originally published elsewhere. These regulations do not include amendments to or editions of incorporated materials published later than the effective date of the particular section.
- 1.4.2 Materials incorporated by reference will be available to the public for inspection during regular business hours or for copying at reasonable charge at the offices of the Hazardous Materials and Waste Management Division, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, CO 80246-1530.
- 1.4.3 The addresses of the Federal Agencies and Organizations originally issuing the referenced materials are available on the Division website at <http://www.cdphe.state.co.us/hm/index.htm>.
- 1.4.4 In accordance with Section 24-4-103(12.5)(c)(ii)(C), CRS, copies of any material that has been incorporated by reference have been provided to the State Publications Depository Library and Distribution Center and are available for interlibrary loan. The incorporated materials may be examined at any state publications depository library.

## **EXEMPTION FROM THE REGULATORY REQUIREMENTS**

### **1.5 Exemptions.**

- 1.5.1 The Department may, upon application or upon its own initiative, grant such exemption or exception from a requirement of these regulations as it determines is authorized by law and will not result in undue hazard to public health and safety or property.
- 1.5.2 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:

- 1.5.2.1 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;
- 1.5.2.2 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;
- 1.5.2.3 Prime contractors of the U.S. Department of Energy using or operating nuclear reactors or other nuclear devices in a U. S. Government owned vehicle or vessel; and
- 1.5.2.4 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 that:
  - (1) The exemption of the prime contractor or subcontractor is authorized by law; and
  - (2) 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.

## **GENERAL REGULATORY REQUIREMENTS**

### **1.6 Records.**

- 1.6.1 Each licensee and registrant shall maintain records showing the receipt, transfer, and disposal of all sources of radiation.
- 1.6.2 Additional record requirements are specified elsewhere in these regulations.

### **1.7 Inspections.**

- 1.7.1 Each licensee and registrant shall afford the Department at all reasonable times opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used, stored and/or located.
- 1.7.2 Each licensee and registrant shall make available to the Department for inspection, at all reasonable times, records maintained pursuant to these regulations.

### **1.8 Tests.**

- 1.8.1 Each licensee and registrant shall perform upon instructions from the Department, or shall permit the Department to perform, such reasonable tests as the Department deems appropriate or necessary including, but not limited to, tests of:
  - 1.8.1.1 Sources of radiation;
  - 1.8.1.2 Facilities wherein sources of radiation are used, stored and/or located;
  - 1.8.1.3 Radiation detection and monitoring instruments; and
  - 1.8.1.4 Other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

## **ADDITIONAL REGULATORY REQUIREMENTS**

### **1.9 Additional Requirements.**

- 1.9.1 The Department 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.

## **ENFORCEMENT REQUIREMENTS**

### **1.10 Violations.**

- 1.10.1 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.
- 1.10.2 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 law.
- 1.10.3 Additionally, any person who violates any provision of the Act or any regulation may be subject to a civil penalty as provided for in Part 13 or these regulations.
- 1.10.4 Submittal of false information shall be sufficient basis for rejecting or revoking any Department license, registration, certification or other acceptance, approval or permit.

### **1.11 Impounding.**

- 1.11.1 Sources of radiation shall be subject to impounding pursuant to the Act.

### **1.12 Prohibited Uses.**

- 1.12.1 A radiation producing machine or radioactive material shall not be used except in accord with these regulations.

## **SEVERABILITY**

### **1.13 Severability.**

- 1.13.1 Each provision of these regulations is severable, and if any provision or the application of the provision to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of these regulations shall not be affected thereby.

**PART 1, APPENDIX 1A: QUALITY FACTORS**

1A.1 Table 1A-1 lists the quality factors for converting absorbed dose in gray equal to 1 Sv or the absorbed dose in rad equal to 1 rem.

TABLE 1A-1: 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-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

1A.2 If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in sievert per hour or rem per hour, 0.01 Sv (1 rem) of neutron radiation of unknown energies may 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 1A-2 to convert a measured tissue dose in gray or rad to dose equivalent in sievert or rem.

TABLE 1A-2: MEAN QUALITY FACTORS (Q) AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

Neutron energy (MeV)	Quality factor <sup>6</sup> (Q)	Fluence per unit dose equivalent <sup>7</sup> (neutrons cm <sup>-2</sup> rem <sup>-1</sup> )	Fluence per unit dose equivalent <sup>7</sup> (neutrons cm <sup>-2</sup> Sv <sup>-1</sup> )
2.5×10 <sup>-8</sup> (thermal)	2	980×10 <sup>6</sup>	980×10 <sup>8</sup>
1×10 <sup>-7</sup>	2	980×10 <sup>6</sup>	980×10 <sup>8</sup>
1×10 <sup>-6</sup>	2	810×10 <sup>6</sup>	810×10 <sup>8</sup>
1×10 <sup>-5</sup>	2	810×10 <sup>6</sup>	810×10 <sup>8</sup>
1×10 <sup>-4</sup>	2	840×10 <sup>6</sup>	840×10 <sup>8</sup>
1×10 <sup>-3</sup>	2	980×10 <sup>6</sup>	980×10 <sup>8</sup>
1×10 <sup>-2</sup>	2.5	1010×10 <sup>6</sup>	1010×10 <sup>8</sup>
1×10 <sup>-1</sup>	7.5	170×10 <sup>6</sup>	170×10 <sup>8</sup>
5×10 <sup>-1</sup>	11	39×10 <sup>6</sup>	39×10 <sup>8</sup>
1	11	27×10 <sup>6</sup>	27×10 <sup>8</sup>
2.5	9	29×10 <sup>6</sup>	29×10 <sup>8</sup>
5	8	23×10 <sup>6</sup>	23×10 <sup>8</sup>
7	7	24×10 <sup>6</sup>	24×10 <sup>8</sup>
10	6.5	24×10 <sup>6</sup>	24×10 <sup>8</sup>
14	7.5	17×10 <sup>6</sup>	17×10 <sup>8</sup>
20	8	16×10 <sup>6</sup>	16×10 <sup>8</sup>
40	7	14×10 <sup>6</sup>	14×10 <sup>8</sup>
60	5.5	16×10 <sup>6</sup>	16×10 <sup>8</sup>
100	4	20×10 <sup>6</sup>	20×10 <sup>8</sup>
200	3.5	19×10 <sup>6</sup>	19×10 <sup>8</sup>

300	3.5	$16 \times 10^6$	$16 \times 10^8$
400	3.5	$14 \times 10^6$	$14 \times 10^8$

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

7 Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.

## **PART 1, APPENDIX 1B: 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 <sup>8</sup>	0.30
Whole Body <sup>9</sup>	1.00

8 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.

9 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.

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## **EDITOR'S NOTES**

6 CCR 1007-1 has been divided into separate parts for ease of use. Versions prior to 04/01/2007 are located in the first section, 6 CCR 1007-1. Prior versions can be accessed from the All Versions list on the rule's current version page. To view versions effective on or after 04/01/2007, select the desired part of the rule, for example 6 CCR 1007-1 Part 01 or 6 CCR 1007-1 Part 10.

### **History**

Part 01 entire rule eff. 08/30/2007.

Part 01 entire rule eff. 07/01/2010.

Part 01, Rules 1.1.4, 1.2 eff. 07/30/2010.

Part 01, Rules 1.2, 1.4.2, 1.4.3 eff. 04/30/2011.

Part 01, Rules 1.2.2, 1.4.4 eff. 02/14/2016.