

DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Hazardous Materials and Waste Management Division

6 CCR 1007-1

STATE BOARD OF HEALTH

RULES AND REGULATIONS PERTAINING TO RADIATION CONTROL

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 by the U.S. Nuclear Regulatory Commission.¹

¹ 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, 2009) 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.

31 **1.2 Definitions.**

32 1.2.1 Definitions of general applicability to the *Rules and Regulations Pertaining to Radiation Control*
33 promulgated by the Department pursuant to provisions of sections 25-1-108, 25-1.5-101(1)(k),
34 25-1.5-101(1)(l), and 25-11-104, CRS, are set forth in section 1.2.2 and shall be liberally
35 construed to protect the public health by controlling excess radiation.

36 1.2.2 As used in these regulations, each term below has the definition set forth. A cross-reference is
37 provided for each common abbreviation. Any additional definition used only in a single part of
38 these regulations is found in that part.

39 "A₁" means the maximum activity of special form radioactive material permitted in a Type A
40 package. This value is either listed in Appendix 17A or may be derived in accordance with the
41 procedures prescribed in Appendix 17A.

42 "A₂" means the maximum activity of radioactive material, other than special form, low specific
43 activity (LSA) and surface contaminated object (SCO) material, permitted in a Type A package.
44 This value is either listed in Appendix 17A or may be derived in accordance with the procedures
45 prescribed in Appendix 17A.

46 "AAPM" means the American Association of Physicists in Medicine.

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

49 "Absorbed dose rate" means absorbed dose per unit time.

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

54 "Accelerator-produced radioactive material" means any material made radioactive by an
55 accelerator.

56 "Accessible surface" means the external surface of the radiation machine enclosure or housing
57 provided by the manufacturer.

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

60 (1) Result in a dose in excess of regulatory limits on site or for the public; or

61 (2) Have consequences or potential consequences which cannot be ignored from
62 the point of view of protection or safety (such as an actual or potential substantial
63 degradation of the level of protection or safety of the facility or release of
64 radioactive material in sufficient quantity to warrant consideration of protective
65 actions).

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

- 67 "Action levels". See "action limits".
- 68 "Action limits" means the minimum and maximum values of a quality assurance measurement
69 that can be interpreted as representing acceptable performance with respect to the parameter
70 being tested. Values less than the minimum or greater than the maximum action limit or level
71 indicate that corrective action must be taken. Action limits or levels are also sometimes called
72 control limits or levels.
- 73 "Activity" means the rate of disintegration or transformation or decay of radioactive material. The
74 units of activity are the becquerel (Bq) and the curie (Ci).
- 75 "Acute" means radiation dose(s) or chemical exposure(s) occurring within a short period of time
76 (24 hours or less).
- 77 "Address of use" means the facility designated on the license or registration where radioactive
78 material is permitted to be produced, prepared, received, used, processed, or stored or where a
79 radiation machine is permitted to be installed, operated, repaired or stored.
- 80 "Adult" means an individual 18 or more years of age.
- 81 "Agreement State" means any State with which the U.S. Nuclear Regulatory Commission or the
82 U.S. Atomic Energy Commission has entered into an effective agreement under subsection 274b.
83 of the Atomic Energy Act of 1954, as amended (73 Stat. 689).
- 84 "Air kerma" (K) means the kinetic energy released in the mass of a small volume of air by ionizing
85 radiation (see kerma). Air kerma is measured in joules per kilogram (J/kg). For diagnostic x-rays,
86 air kerma is the same as the absorbed dose measured in gray (Gy) delivered to the volume of air
87 in the absence of scatter.
- 88 "Air kerma rate" (AKR) means the air kerma per unit time.
- 89 "Air-purifying respirator" means a respirator with an air purifying filter, cartridge, or canister that
90 removes specific air contaminants by passing ambient air through the air-purifying element.
- 91 "Airborne radioactive material" means any radioactive material dispersed in the air in the form of
92 dusts, fumes, particulates, mists, vapors, or gases.
- 93 "Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive
94 material exists in a concentration:
- 95 (1) In excess of the derived air concentration (DAC) specified in Appendix 4B,
96 Table 4B1; or
- 97 (2) To such a degree that an individual present in the area without respiratory
98 protective equipment could exceed, during the hours an individual is present in a
99 week, an intake of 0.6 percent of the annual limit on intake (ALI) or
100 12 DAC-hours.
- 101 "Airline respirator". See "supplied-air respirator".
- 102 "Alert" means an event may occur, is in progress, or has occurred that could lead to a release of
103 radioactive material but that the release is not expected to require a response by offsite response
104 organizations to protect any individual(s) offsite.

105 “ALI”. See “annual limit on intake”.

106 “Annual limit on intake” (ALI) means the derived limit for the amount of radioactive material taken
107 into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of
108 intake of a given radionuclide in a year by the reference human that would result in a committed
109 effective dose equivalent of 0.05 Sv (5 rem) or a committed dose equivalent of 0.5 Sv (50 rem) to
110 any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected
111 radionuclides are given in Part 4, Appendix 4B, Table 4B1, Columns 1 and 2.

112 “Annually” means either:

113 (1) At intervals not to exceed 1 year; or

114 (2) Once per year, at about the same time each year (plus or minus 1 month).

115 “ANSI” means the American National Standards Institute.

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

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

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

128 “Assigned protection factor” (APF) means the expected workplace level of respiratory protection
129 that would be provided by a properly functioning respirator or a class of respirators to properly
130 fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the
131 ambient airborne concentration by the APF.

132 “Atmosphere-supplying respirator” means a respirator that supplies the respirator user with
133 breathing air from a source independent of the ambient atmosphere, and includes
134 supplied-air respirators (SAR) and self-contained breathing apparatus (SCBA) units.

- 135 “Authorized medical physicist” (AMP) means an individual who meets the Appendix 7B
136 requirements that are applicable to a type of use of radioactive material licensed under Part 7 and
137 has current Department approval to perform medical physics activities.
- 138 “Background radiation” means radiation from:
- 139 (1) Extraterrestrial sources;
 - 140 (2) Naturally occurring radioactive material (which has not been technologically
141 enhanced), including radon (except as a decay product of source or special
142 nuclear material); and
 - 143 (3) Global fallout as it exists in the environment from the testing of nuclear explosive
144 devices or from past nuclear accidents such as Chernobyl that are not under the
145 control of the licensee or registrant.
- 146 “Becquerel” (Bq) means the SI unit of activity. One becquerel is equal to 1 disintegration per
147 second or transformation per second (dps or s⁻¹).
- 148 “Becquerel per cubic meter”, 1 Bq/m³ (0.027 pCi/L), means a unit of radioactivity representing
149 one disintegration per second per cubic meter.
- 150 “Bioassay” means the determination of kinds, quantities or concentrations, and, in some cases,
151 the locations of radioactive material in the human body, whether by direct measurement, *in-vivo*
152 counting, or by analysis and evaluation of materials excreted or removed from the human body.
153 For purposes of these regulations, “radiobioassay” is an equivalent term.
- 154 “Brachytherapy” means a method of radiation therapy in which sealed, plated, embedded,
155 activated, or electronic sources are utilized to deliver a radiation dose at a distance of up to a few
156 centimeters, by surface, intracavitary, intraluminal or interstitial application.
- 157 “Business day” means any day of the year, exclusive of Saturdays, Sundays, and State of
158 Colorado holidays.

- 159 "Byproduct material" means:
- 160 (1) Any radioactive material, except special nuclear material, yielded in or made
161 radioactive by exposure to the radiation incident to the process of producing or
162 utilizing special nuclear material;
- 163 (2) The tailings or wastes produced by the extraction or concentration of uranium or
164 thorium from ore processed primarily for its source material content, including
165 discrete surface wastes resulting from uranium or thorium solution extraction
166 processes (underground ore bodies depleted by these solution extraction
167 operations do not constitute "byproduct material" within this definition);
- 168 (3) Any material produced, extracted, or converted after extraction, for use for a
169 commercial, medical, or research activity, that:
- 170 (a) Is a discrete source of radium-226; or
- 171 (b) Has been made radioactive by use of a particle accelerator; or
- 172 (4) Any discrete source of naturally occurring radioactive material, other than source
173 material, that:
- 174 (a) Is extracted, or converted after extraction, for use for a commercial,
175 medical, or research activity; and
- 176 (b) Is determined by NRC to pose a threat to the public health and safety or
177 the common defense and security similar to the threat posed by a
178 discrete source of radium-226.
- 179 "Calendar quarter". See "quarter".
- 180 "Calibration" means the determination of:
- 181 (1) The response or reading of an instrument relative to a series of known radiation
182 values over the range of the instrument; or
- 183 (2) The strength of a source of radiation relative to a standard.
- 184 "CCR" means the Colorado Code of Regulations.
- 185 "CFR" means Code of Federal Regulations.
- 186 "Chelating agent" means a substance that through binding allows efficient elimination of
187 radionuclide contamination from the human body (decorporation), for example, amine
188 polycarboxylic acids, hydroxy carboxylic acids, and polycarboxylic acids.
- 189 "Chiropractor" means an individual licensed by a State or Territory of the United States, the
190 District of Columbia or the Commonwealth of Puerto Rico to practice chiropractic health care.
- 191 "Class" means a classification scheme for inhaled material according to its rate of clearance from
192 the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range
193 of clearance half-times: for class D, days, of less than 10 days, for class W, weeks, from 10 to
194 100 days, and for class Y, years, of greater than 100 days. For purposes of these regulations,
195 "lung class" and "inhalation class" are equivalent terms.

- 196 “Collective dose” means the sum of the individual doses received in a given period of time by a
197 specified population from exposure to a specified source of radiation.
- 198 “Commencement of construction” means any clearing of land, excavation or other substantial
199 action related to a proposed activity that might adversely affect the natural environment of a site;
200 this term does not include changes desirable for the temporary use of the land for public
201 recreational uses, limited borings to determine site characteristics as necessary for environmental
202 assessment or other pre-construction monitoring to establish background information related to
203 the suitability of a site, or to the protection of environmental values.
- 204 “Committed dose equivalent” ($H_{T,50}$) means the dose equivalent to organs or tissues of reference
205 (T) that will be received from an intake of radioactive material by an individual during the 50-year
206 period following the intake.
- 207 “Committed effective dose equivalent” ($H_{E,50}$) is the sum of the products of the weighting factors
208 (W_T) applicable to each of the body organs or tissues that are irradiated and the committed dose
209 equivalent to each of these organs or tissues ($H_{E,50} = \sum W_T \times H_{T,50}$).
- 210 “Computer-readable medium” means that the Department’s computer can transfer the information
211 from the medium into its memory.
- 212 “Constraint” (dose constraint) means a value above which specified action is required.
- 213 “Contact hour” means an hour of training received through direct instruction.
- 214 “Continuing education” is lifelong learning to ensure that new information and knowledge is put
215 into practice.
- 216 “Continuing education unit” (CEU) means one documentable contact hour.
- 217 “Controlled area” means an area, outside of a restricted area but inside the site boundary, access
218 to which can be limited for any reason and/or the occupancy and activity of those within is subject
219 to supervision.
- 220 “Cost estimate” means a document containing the total costs that would be incurred if an
221 independent contractor were hired to perform decommissioning of the facility and disposal of
222 radioactive materials at the facility, and associated administrative indirect and legal costs to the
223 Department in conducting decommissioning oversight.
- 224 “Critical group” means the group of individuals reasonably expected to receive the greatest
225 exposure to residual radioactivity for any applicable set of circumstances.
- 226 “CRS” means the Colorado Revised Statutes.
- 227 “Cumulative air kerma” means the total air kerma accrued from the beginning of an examination
228 or procedure and includes all contributions from fluoroscopic and radiographic irradiation.
- 229 “Curie” means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive
230 material that decays at the rate of 3.7×10^{10} transformations per second (s^{-1}).
- 231 “Cyclotron” means a particle accelerator in which a magnetic field bends the path of charged
232 particles. A cyclotron accelerates charged particles at energies usually in excess of
233 10 megaelectron volts and is commonly used for production of short half-life radionuclides for
234 medical use.

- 235 "DAC". See "derived air concentration".
- 236 "Declared pregnant woman" means a woman who has voluntarily informed the licensee or
237 registrant, in writing, of her pregnancy and the estimated date of conception. The declaration
238 remains in effect until the declared pregnant woman withdraws the declaration in writing or is no
239 longer pregnant.
- 240 "Decommission" means to remove a facility or site safely from service and reduce residual
241 radioactivity to a level that permits:
- 242 (1) Release of the property for unrestricted use and termination of the license; or
- 243 (2) Release of the property under restricted conditions and termination of the
244 license.
- 245 "Decommissioning funding plan" means a written document that contains a cost estimate for
246 decommissioning and a description of the method for assuring funds for decommissioning,
247 including means of adjusting cost estimates and associated funding levels periodically over the
248 life of the facility.
- 249 "Decommissioning plan" means a written document that includes the licensee's planned
250 procedures and activities for decommissioning of the facility or site.
- 251 "Deep dose equivalent" (H_D), which applies to external whole body exposure, means the dose
252 equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2).
- 253 "Demand respirator" means an atmosphere-supplying respirator that admits breathing air to the
254 facepiece only when a negative pressure is created inside the facepiece by inhalation.
- 255 "Dentist" means an individual licensed by a State or Territory of the United States, the District of
256 Columbia or the Commonwealth of Puerto Rico to practice dentistry.
- 257 "Department" means the Colorado Department of Public Health and Environment.
- 258 "Depleted uranium" means the source material uranium in which the isotope uranium-235 is less
259 than 0.711 weight percent of the total uranium present. Depleted uranium does not include
260 special nuclear material.
- 261 "Derived air concentration" (DAC) means the concentration of a given radionuclide in air which, if
262 breathed by the reference man for a working year of 2,000 hours under conditions of light work,
263 results in an intake of one ALI. For purposes of these regulations, the condition of light work is an
264 inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given
265 in Part 4, Appendix 4B, Table 4B1, Column 3.
- 266 "Derived air concentration-hour" (DAC-hour) means the product of the concentration of
267 radioactive material in air, expressed as a fraction or multiple of the derived air concentration for
268 each radionuclide, and the time of exposure to that radionuclide, in hours. A licensee or registrant
269 may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose
270 equivalent of 0.05 Sv (5 rem).
- 271 "Detector". See "radiation detector".
- 272 "Diagnostic imaging system" means an assemblage of components for the generation, emission,
273 and reception of machine-produced x-rays and the transformation, storage and visual display of
274 the resultant image.

- 275 “Direct supervision” means the supervisor is present in the facility and immediately available to
276 observe, correct, assist and direct the supervisee throughout the performance of a procedure, as
277 needed, but is not always required to be present in the room. For purposes of these regulations,
278 “on-site supervision” is an equivalent term.
- 279 “Discrete source” means a radionuclide that has been processed so that its concentration within a
280 material has been purposely increased for use for a commercial, medical, or research activity.
- 281 “Disposable respirator” means a respirator for which maintenance is not intended and that is
282 designed to be discarded after excessive breathing resistance, sorbent exhaustion, physical
283 damage, or end of service life renders it unsuitable for use. Examples of this type of respirator are
284 a disposable half mask respirator or a disposable escape-only self-contained breathing apparatus
285 (SCBA).
- 286 “Distinguishable from background” means that the detectable concentration of a radionuclide is
287 statistically different from the background concentration of that radionuclide in the vicinity of the
288 site or, in the case of structures, in similar materials using adequate measurement technology,
289 survey, and statistical techniques.
- 290 “DOE” means the U.S. Department of Energy.
- 291 “Dose” is a generic term that means absorbed dose, dose equivalent, effective dose, effective
292 dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ
293 dose equivalent, or total effective dose equivalent. For purposes of these regulations, “radiation
294 dose” is an equivalent term.
- 295 “Dose commitment” means the total radiation dose to a part of the body that will result from
296 retention of radioactive material in the body. For purposes of estimating the dose commitment, it
297 is assumed that from the time of intake the period of exposure to retained material will not exceed
298 50 years.
- 299 “Dose equivalent” (H_T) means the product of the absorbed dose in tissue, quality factor, and all
300 other necessary modifying factors at the location of interest. The units of dose equivalent are the
301 sievert (Sv) and rem.
- 302 “Dose limits” means the permissible upper bounds of radiation doses established in accordance
303 with these regulations. For purposes of these regulations, “limits” is an equivalent term.
- 304 “Dosimetry processor” means an individual or an organization that processes and evaluates
305 individual monitoring devices in order to determine the radiation dose delivered to the monitoring
306 devices.
- 307 “DOT” means the U.S. Department of Transportation.
- 308 “Drill” means a supervised, hands-on instruction period intended to test, develop or maintain a
309 specific emergency response capability. A drill may be a component of an exercise.
- 310 “Effective dose equivalent” (H_E) means the sum of the products of the dose equivalent to each
311 organ or tissue (H_T) and the weighting factor (W_T) applicable to each of the body organs or
312 tissues that are irradiated ($H_E = \sum W_T \times H_T$).
- 313 “Embryo/fetus” means the developing human organism from conception until the time of birth.
- 314 “Emergency” means an event requiring prompt action to mitigate a threat to the health and safety
315 of workers and the public or a threat of damage to the environment.

- 316 “Emergency planning zone” means a geographic area surrounding a specific facility for which
317 special planning and preparedness efforts are carried out to ensure that prompt and effective
318 protective actions can reduce or minimize the impact of releases of radioactive material to public
319 health and safety or to the environment.
- 320 “Enriched uranium” means uranium containing more uranium-235 than the naturally occurring
321 distribution of uranium isotopes.
- 322 “Entrance exposure rate” means the exposure free-in-air per unit time.
- 323 “Entrance point” or “access point” means any location through which an individual could gain
324 access to a radiation area, source of radiation or licensed or registered radioactive material,
325 including an entry or exit portal of sufficient size to permit human entry, irrespective of its intended
326 use.
- 327 “Evacuation” means the urgent removal of people from an area to avoid or reduce high-level,
328 short-term exposure.
- 329 “Event” means a situation reasonably discrete in time, location and consequences.
- 330 “Examination” means performing a procedure, including selection of exposure settings,
331 positioning the x-ray system and the patient, and initiating and terminating the exposure.
- 332 “Exercise” means a multi-faceted activity that tests the plans, procedures, adequacy of training,
333 resources, and integrated capability of an emergency response system.
- 334 “Explosive material” means any chemical compound, mixture, or device which produces a
335 substantial instantaneous release of gas and heat spontaneously or by contact with sparks or
336 flame.
- 337 “Exposure” means being exposed to ionizing radiation or to radioactive material.
- 338 “Exposure” means the quotient of dQ by dm where “ dQ ” is the absolute value of the total charge
339 of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated
340 by photons in a volume element of air having mass “ dm ” are completely stopped in air. The SI
341 unit of exposure is the coulomb per kilogram (C/kg).²
- 342 ² When not underlined as above, or indicated as “exposure” (X), the term “exposure” has a more general
343 meaning in these regulations.
- 344 “Exposure rate” means the exposure per unit of time.
- 345 “External dose” means that portion of the dose equivalent received from any source of radiation
346 outside the body.
- 347 “Extremity” means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

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

351 (1) The possession, use, processing or storage of radioactive material is or was
352 authorized;

353 (2) A radiation machine is or was installed, operated, repaired and/or stored; and/or

354 (3) A source of radiation is located.

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

356 “Filtering facepiece” (dust mask) means a negative pressure particulate respirator with a filter as
357 an integral part of the facepiece or with the entire facepiece composed of the filtering medium, not
358 equipped with elastomeric sealing surfaces and adjustable straps.

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

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

365 “Fissile material” means the radionuclides uranium-233, uranium-235, plutonium-239, and
366 plutonium-241, or any combination of these radionuclides. Fissile material means the fissile
367 nuclides themselves, not material containing fissile nuclides. Unirradiated natural uranium and
368 depleted uranium, and natural uranium or depleted uranium that has been irradiated in thermal
369 reactors only, are not included in this definition.

370 “Fit factor” means a quantitative estimate of the fit of a particular respirator to a specific individual,
371 and typically estimates the ratio of the concentration of a substance in ambient air to its
372 concentration inside the respirator when worn.

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

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

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

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

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

- 386 “Generally applicable environmental radiation standards” means standards issued by the
387 U.S. Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of
388 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or
389 quantities of radioactive material, in the general environment outside the boundaries of locations
390 under the control of persons possessing or using radioactive material.
- 391 “Gray” (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose
392 resulting from deposition of 1 joule (J) of energy in 1 kilogram of material (100 rad).
- 393 “Hazardous waste” means any waste designated as hazardous by Department regulations in
394 6 CCR 1007-1-3.
- 395 “Healing arts” means any system, treatment, operation, diagnosis, prescription, or practice for the
396 ascertainment, cure, relief, palliation, adjustment, or correction of any human disease, ailment,
397 deformity, injury or unhealthy or abnormal physical or mental condition. For purposes of Parts 2, 6
398 and 24, “healing arts” includes animals other than humans.
- 399 “Helmet” (respiratory) means a rigid respiratory inlet covering that also provides head protection
400 against impact and penetration.
- 401 “High radiation area” means an area, accessible to individuals, in which radiation levels from
402 radiation sources external to the body could result in an individual receiving a dose equivalent in
403 excess of 1 mSv (0.1 rem) in 1 hour at 30 centimeters from any source of radiation or
404 30 centimeters from any surface that the radiation penetrates.
- 405 “Hood” (respiratory) means a respiratory inlet covering that completely covers the head and neck
406 and may also cover portions of the shoulders and torso.
- 407 “Human use” means the internal or external administration of radiation or radioactive material to
408 human beings.
- 409 “ICRP” means the International Commission on Radiological Protection.
- 410 “Immediate” means within not more than fifteen minutes or as otherwise specified in writing by the
411 licensee and approved by the Department.
- 412 “Incident” means any unintended event involving radiation for which the public dose is a fraction
413 of regulatory limits and safety provisions are sufficient, but further degradation of safety systems
414 could lead to an accident condition.

415 "Individual" means any human being. "Natural person" is an equivalent term.

416 "Individual monitoring" means the assessment of:

417 (1) Dose equivalent by the use of:

418 (a) Individual monitoring devices; or

419 (b) Survey data; or

420 (2) Committed effective dose equivalent by:

421 (a) Bioassay; or

422 (b) Determination of the time-weighted air concentrations to which an
423 individual has been exposed, that is, DAC-hours. (See the definition of
424 DAC-hours).

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

430 "Inhalation class". See "class".

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

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

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

438 "Irradiation" means the exposure of a living being or matter to ionizing radiation.

439 "Kerma" (K [italicized]) means kinetic energy relaxed in a unit mass, determined by the quotient
440 $K = dE_{tr} / dm$, where dE_{tr} is the sum of the initial kinetic energies of all the charged ionizing
441 particles (such as electrons) liberated (transferred, E_{tr}) by uncharged ionizing particles (such as
442 neutrons and photons) in air of mass dm . Kerma is measured in joules per kilogram (J/kg).

443 "Kilo electron volt" (keV) means the energy equal to that acquired by a particle with one electron
444 charge in passing through a potential difference of one thousand volts in a vacuum.

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

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

449 "Lens dose equivalent" (LDE) means the external exposure to the lens of the eye as the dose
450 equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

451 "License" means a license issued by the Department in accordance with the regulations adopted
452 by the Department.⁴

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

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

457 "Licensee" means any person who is:

458 (1) Licensed by the Department⁴ in accordance with these regulations and the Act;

459 (2) Responsible for decommissioning by being:

460 (a) Registered with the Department;

461 (b) Subject to a record of possession of a radiation source or device under
462 general license, for example, pursuant to 3.6.4.3(13); or

463 (c) Otherwise legally obligated to conduct decommissioning activities in
464 accordance with these regulations and the Act; or

465 (3) Responsible under 10 CFR 71 (January 1, 2009) as certificate holder, or
466 applicant for a certificate of compliance, or under Part 17, for demonstrating that
467 package design, fabrication, assembly and testing requirements are met with
468 respect to a package before the time a package approval is issued.

469 "Limits". See "dose limits".

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

472 "Lost or missing licensed source of radiation" means licensed or registered source(s) of radiation
473 whose location is unknown. This definition includes licensed material that has been shipped but
474 has not reached its planned destination and whose location cannot be readily traced in the
475 transportation system.

476 "Lung class". See "class".

477 "mA" means milliamperere.

478 "Major processor" means a user processing, handling, or manufacturing radioactive material
479 exceeding Type A quantities as unsealed sources or material, or exceeding 4 times Type B
480 quantities as sealed sources, but does not include nuclear medicine programs, universities,
481 industrial radiographers, or small industrial programs. Type A and Type B quantities are defined
482 in Part 17 of these regulations.

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

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

487 "mAs" means milliamperere second.

- 488 "Medical institution" means an organization in which two or more medical disciplines are
489 practiced.
- 490 "Medical physicist" means an individual trained and experienced in a medical physics specialty.
- 491 "Medical use" means the intentional internal or external administration of radioactive material or
492 radiation to humans or animals in the practice of the healing arts, including administration of
493 radioactive materials to patients or human or animal research subjects under the supervision of
494 an authorized user and operation of radiation machines for healing arts purposes.
- 495 "Member of the public" means an individual, except when that individual is receiving an
496 occupational dose.
- 497 "MeV" means one mega electron volt, or one million electron volts. One MeV is the amount of
498 energy acquired by a particle with one electron charge in passing through a potential difference of
499 one million volts in a vacuum. One MeV is equivalent to 1.60×10^{-16} joules.
- 500 "Minor" means an individual less than 18 years of age.
- 501 "Misadministration" means an event that results in a dose or dosage administered to the wrong
502 individual, or by the wrong mode of radiation delivery, or that differs from the prescribed dose or
503 dosage, as stated in 7.21, 24.6, or an equivalent section of these regulations.
504 "Reportable medical event" is an equivalent term.
- 505 "Monitoring" means the measurement of radiation, radioactive material concentrations, surface
506 area activities or quantities of radioactive material and the use of the results of these
507 measurements to evaluate potential exposures and doses. For purposes of these regulations,
508 "radiation monitoring" and "radiation protection monitoring" are equivalent terms.
- 509 "MQSA" means Mammography Quality Standards Act.
- 510 "NARM". See "naturally occurring or accelerator-produced radioactive material" (NARM).
- 511 "Nationally tracked source" means a sealed source containing a quantity equal to or greater than
512 a Category 2 level of any radioactive material listed in Appendix 4G.
- 513 In this context, a sealed source:
- 514 (1) Means radioactive material that is sealed in a capsule or closely bonded, in a
515 solid form, and is not exempt from regulatory control; and
- 516 (2) Does not mean material encapsulated solely for disposal, or nuclear material
517 contained in any fuel assembly, subassembly, fuel rod, or fuel pellet.
- 518 "Natural radioactivity" means radioactivity of naturally occurring nuclides.
- 519 "Natural thorium" means thorium with the naturally occurring distribution of thorium isotopes
520 (essentially 100 weight percent thorium-232).
- 521 "Natural uranium" means uranium containing the naturally occurring distribution of the uranium
522 isotopes 234, 235 and 238 (approximately 0.711 weight percent uranium-235 and the remainder
523 by weight essentially uranium-238) that is neither enriched nor depleted in the isotope
524 uranium-235.

- 525 “Naturally occurring or accelerator produced radioactive material” (NARM) means any radioactive
526 material that is not source or special nuclear material or byproduct material types (1) or (2).
- 527 “Naturally occurring radioactive material” (NORM) means any radioactive material that is not
528 byproduct, source, or special nuclear material or produced in an accelerator.
- 529 “NCRP” means the National Council on Radiation Protection and Measurements.
- 530 “Negative-pressure respirator (tight-fitting)” means a respirator in which the air pressure inside the
531 facepiece is negative during inhalation with respect to the ambient air pressure outside the
532 respirator.
- 533 “NIST” means the National Institute of Standards and Technology.
- 534 “Nonstochastic effect” means a health effect, the severity of which varies with the dose and for
535 which a threshold is believed to exist. Radiation-induced cataract formation is an example of a
536 nonstochastic effect. For purposes of these regulations, “deterministic effect” is an equivalent
537 term.
- 538 “NORM”. See “naturally occurring radioactive material” (NORM).
- 539 “Normal form radioactive material” means radioactive material that has not been demonstrated to
540 qualify as “special form radioactive material”.
- 541 “NRC”. See “Nuclear Regulatory Commission”.
- 542 “Nuclear Regulatory Commission” (NRC) means the U.S. Nuclear Regulatory Commission or a
543 duly authorized representative.
- 544 “Occupational dose” means the dose received by an individual in the course of employment in
545 which the individual’s assigned duties involve exposure to radiation or to radioactive material from
546 licensed and unlicensed sources of radiation whether or not the sources of radiation are in the
547 possession of the licensee, registrant or other person. Occupational dose does not include doses
548 received (1) from background radiation, (2) from any medical administration the individual has
549 received, (3) from exposure to individuals administered radioactive material and released in
550 accordance with Section 7.26 of these regulations, (4) from voluntary participation in medical
551 research programs, or (5) as a member of the public.
- 552 “Offsite response organization” means the non-licensee offsite organizations that may be needed
553 to respond to an emergency, including, but not limited to, local fire, police, ambulance and
554 hospital services.
- 555 “Operator” means an individual adequately trained in accordance with these regulations in the
556 purpose and experienced in the practice of performing a radiographic examination and/or using a
557 device containing radioactive material.
- 558 “Package” means the packaging together with its radioactive contents as presented for transport.
- 559 “Particle accelerator”. See “accelerator”.
- 560 “Patient” means an individual human being or an animal to whom radioactive materials or
561 machine-produced radiation is delivered for healing arts examination, diagnosis or treatment.

- 562 "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or
563 private institution, group, agency, political subdivision of this State, any other State or political
564 subdivision or agency thereof, and any legal successor, representative, agent, or agency of the
565 foregoing. "Natural person" means an individual human being.
- 566 "Personal supervision" means the supervisor is in attendance in the room with the supervisee
567 during the performance of the procedure. For purposes of these regulations, "physical
568 supervision" or "immediate supervision" or "individual supervision" is an equivalent term.
- 569 "Personnel monitoring equipment". See "individual monitoring device".
- 570 "PET" means positron emission tomography. See "positron emission tomography radionuclide
571 production facility".
- 572 "Phantom" means an object designed such that the interaction of ionizing radiation with the object
573 is suitable for the evaluation of the particular characteristics of the radiation-producing system or
574 anatomic region under consideration.
- 575 "Pharmacist" means an individual licensed by a State or Territory of the United States, the District
576 of Columbia or the Commonwealth of Puerto Rico to practice pharmacy.
- 577 "Physician" means an individual licensed by a State or Territory of the United States, the District
578 of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine.
- 579 "Planned special exposure" means an infrequent exposure to radiation, separate from and in
580 addition to the annual occupational dose limits.
- 581 "Podiatrist" means an individual licensed by a State or Territory of the United States, the District
582 of Columbia or the Commonwealth of Puerto Rico to practice podiatry.
- 583 "Positive-pressure respirator" means a respirator in which the pressure inside the respiratory inlet
584 covering exceeds the ambient air pressure outside the respirator.
- 585 "Positron Emission Tomography (PET) radionuclide production facility" means a facility operating
586 a cyclotron or accelerator for the purpose of producing PET radionuclides.
- 587 "Powered air-purifying respirator" (PAPR) means an air-purifying respirator that uses a blower to
588 force the ambient air through air-purifying elements to the facepiece.
- 589 "Practitioner of the healing arts" means any person upon whom the U.S. Food and Drug
590 Administration has conferred the authority to administer prescription drugs.
- 591 "Pressure-demand respirator" means a positive-pressure atmosphere-supplying respirator that
592 admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece
593 by inhalation.
- 594 "Principal activity" means an activity authorized by the license which is essential to achieving the
595 purpose(s) for which the license was issued or amended. Not included as principal activities are
596 (1) radioactive material storage while no licensed material is accessed for use or disposal and
597 (2) activity incidental to decontamination or decommissioning.
- 598 "Projected dose" means a future dose calculated for a specified time period on the basis of
599 estimated or measured initial concentrations of radionuclides or exposure rates and in the
600 absence of protective actions.

- 601 "Protective action" means an action taken by members of the public to protect themselves from
602 radiation from an accident involving radioactive material. Protective action may include sheltering,
603 evacuation, relocation, control of access, administration of a radioprotective drug,
604 decontamination of persons, decontamination of land or property, or control of food or water.
- 605 "Protective action guide" means a projected dose from an accidental release of radioactive
606 material at which protective action is to be considered.
- 607 "Protective apron" means an apron made of radiation-attenuating material(s) used to reduce
608 exposure to radiation.
- 609 "Public dose" means the dose received by a member of the public from exposure to radiation or
610 radioactive material released by a licensee, or to any other source of radiation under the control
611 of a licensee. Public dose does not include occupational dose, or doses received from
612 background radiation, from any medical administration the individual has received, from exposure
613 to individuals administered radioactive material and released in accordance with Section 7.26 of
614 these regulations, or from voluntary participation in medical research programs.
- 615 "Pyrophoric liquid" means any liquid that ignites spontaneously in dry or moist air at or below
616 130 °F (54.4 °C). A pyrophoric solid is any solid material, other than one classed as an explosive,
617 which under normal conditions is liable to cause fires through friction, retained heat from
618 manufacturing or processing, or which can be ignited readily and, when ignited, burns so
619 vigorously and persistently as to create a serious transportation, handling, or disposal hazard.
620 Included are spontaneously combustible and water reactive materials.
- 621 "Qualified expert" (QE) means an individual who meets the requirements of Appendix 2B or 2C
622 and has current Department approval in a designated specialty to evaluate radiation shielding
623 design and recommend radiation safety procedures.
- 624 "Qualified inspector" (QI) means an individual who meets the requirements of Appendix 2I and
625 has current Department approval in a designated specialty to perform evaluations of radiation
626 machines, facilities, service providers and operators for compliance with these regulations.
- 627 "Qualified trainer" (QT) means an individual whose training and experience adequately prepares
628 the individual to carry out specified training assignments.
- 629 "Qualitative fit test" (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that
630 relies on the individual's response to the test agent.
- 631 "Quality assurance" (QA) comprises all those planned and systematic actions necessary to
632 provide adequate confidence that a system or component will perform satisfactorily in service.
- 633 "Quality Assurance Officer" means the individual responsible for the development, maintenance
634 and oversight (including corrective action) of the quality assurance program.
- 635 "Quality control" (QC) comprises those quality assurance actions that relate to control of the
636 physical characteristics and quality of the material or component to predetermined requirements,
637 including the steps taken by an organization to measure performance, compare performance with
638 standards, and act on any differences.
- 639 "Quality factor" (Q) means the modifying factor, listed in Appendix 1A, Table 1A-1 or Table 1A-2,
640 that is used to derive dose equivalent from absorbed dose.
- 641 "Quantitative fit test" (QNFT) means an assessment of the adequacy of respirator fit by
642 numerically measuring the amount of leakage into the respirator.

- 643 "Quarter" means a period of time equal to one-fourth of the year observed by the licensee,
644 approximately 13 consecutive weeks, providing that the beginning of the first quarter in a year
645 coincides with the starting date of the year and that no day of the year is omitted or duplicated in
646 consecutive quarters. See also "year".
- 647 "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of
648 100 ergs per gram or 0.01 joule per kilogram (0.01 gray).
- 649 "Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed
650 electrons, high-speed protons, and other particles capable of producing ions. For purposes of
651 these regulations, ionizing radiation is an equivalent term. Radiation, as used in these
652 regulations, does not include non-ionizing radiation, such as radiowaves or microwaves, visible,
653 infrared, or ultraviolet light.
- 654 "Radiation area" means any area, accessible to individuals, in which radiation levels could result
655 in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) in 1 hour at
656 30 centimeters from the source of radiation or from any surface that the radiation penetrates.
- 657 "Radiation detector" means a device that in the presence of radiation provides a signal or other
658 indication suitable for use in measuring one or more quantities of incident radiation.
- 659 "Radiation dose". See "dose".
- 660 "Radiation machine" means any device capable of producing radiation except those devices with
661 radioactive material as the only source of radiation.
- 662 "Radiation safety officer" (RSO) means an individual who has demonstrated sufficient knowledge
663 to apply radiation protection regulations appropriately and who has been assigned such
664 responsibility by the licensee or registrant.
- 665 "Radioactive material" means any solid, liquid, or gas which emits radiation spontaneously.
- 666 "Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.
- 667 "Radiobioassay". See "bioassay".
- 668 "Reference man" means a hypothetical aggregation of human physical and physiological
669 characteristics determined by international consensus. These characteristics may be used by
670 researchers and public health workers to standardize results of experiments and to relate
671 biological insult to a common base. A description of the reference man is contained in
672 International Commission on Radiological Protection (ICRP) Publication 23, "Report of the Task
673 Group on Reference Man," 1975.
- 674 "Registered medical physicist" (RMP) means an individual who meets the applicable
675 requirements of Appendix 2B and has current Department approval to perform medical physics
676 activities in a designated specialty.
- 677 "Registrant" means any person who is registered with the Department and is legally obligated to
678 register with the Department pursuant to these regulations and the Act.
- 679 "Registration" means registration with the Department in accordance with the regulations adopted
680 by the Department.
- 681 "Regulations of the DOT" means the regulations in 49 CFR Parts 100-189 and Parts 390-397
682 (October 1, 2009).

- 683 "Regulations of the NRC" means the regulations in 10 CFR Parts 1-50 and Parts 51-199
684 (January 1, 2009).
- 685 "Relocation" means the removal or, after a plume has passed, continued exclusion of people from
686 contaminated areas to avoid chronic radiation dose.
- 687 "Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose
688 equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor
689 (1 rem = 0.01 sievert).
- 690 "Reportable medical event" means an event that results in a dose or dosage administered to the
691 wrong individual, or by the wrong mode of radiation delivery, or that differs from the prescribed
692 dose or dosage, as stated in 7.21, 24.6, or an equivalent section of these regulations.
693 "Misadministration" is an equivalent term.
- 694 "Research and development" means (1) theoretical analysis, exploration, or experimentation or
695 (2) the extension of investigative findings and theories of a scientific or technical nature into
696 practical application for experimental and demonstration purposes, including the experimental
697 production and testing of models, devices, equipment, materials, and processes. Research and
698 development does not include the internal or external administration of radiation or radioactive
699 material to human beings.
- 700 "Residual radioactivity" means radioactivity in structures, materiel, soils, groundwater, and other
701 media at a site resulting from activities under the licensee's control. This includes radioactivity
702 from all licensed and unlicensed sources used by the licensee, but excludes background
703 radiation. It also includes radioactive materials remaining at the site as a result of routine or
704 accidental releases of radioactive material at the site and previous burials at the site, even if
705 those burials were made in accordance with the provisions of Part 4.
- 706 "Respiratory protective equipment" means an apparatus, such as a respirator, used to reduce an
707 individual's intake of airborne radioactive materials.
- 708 "Restricted area" means an area, access to which is limited by the licensee or registrant for the
709 purpose of protecting individuals against undue risks from exposure to sources of radiation.
710 Restricted area does not include areas used as residential quarters, but separate rooms in a
711 residential building may be set apart as a restricted area.
- 712 "Restricted use" means that a limit or control has been placed on future use of the facility and the
713 facility is no longer under the control of the licensee, registrant, or holder of the record of
714 possession. See also "unrestricted use".
- 715 "Roentgen" means the special unit of exposure. One roentgen (R) equals
716 2.58×10^{-4} coulombs/kilogram of air. See "exposure".
- 717 "Sanitary sewerage" means a system of public sewers for carrying off waste water and refuse, but
718 excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the
719 licensee or registrant.
- 720 "Sealed source" means any radioactive material that is encased in a capsule designed to prevent
721 leakage or escape of the radioactive material.
- 722 "Sealed source and device registry" (SSD) means the national registry, maintained by the NRC,
723 which contains the registration certificates that summarize the radiation safety information for
724 sealed sources and devices and describe the licensing and use conditions approved for the
725 product.

- 726 “Self-contained breathing apparatus” (SCBA) means an atmosphere-supplying respirator for
727 which the breathing air source is designed to be carried by the user.
- 728 “Shallow dose equivalent” (H_S), which applies to the external exposure of the skin of the whole
729 body or the skin of an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter
730 (7 mg/cm^2).
- 731 “Sheltering” means the use of a structure for radiation protection from an airborne plume
732 containing radioactive material.
- 733 “SI” means the abbreviation for the International System of Units.
- 734 “Sievert” means the SI unit of any of the quantities expressed as dose equivalent. The dose
735 equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor
736 ($1 \text{ Sv} = 100 \text{ rem}$).
- 737 “Site” means the area within the boundary of a location under the control of a person using or
738 storing radioactive material or at which a source of radiation is located.
- 739 “Site boundary” means that line beyond which the land or property is not owned, leased, or
740 otherwise controlled by the licensee, registrant or person who controls a site.
- 741 “Site area emergency” means an event may occur, is in progress, or has occurred that could lead
742 to a significant release of radioactive material and that could require a response by offsite
743 response organizations to protect persons offsite.
- 744 “Source material” means material, in any physical or chemical form, including ores, that contains
745 by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium or any
746 combination thereof. Source material does not include special nuclear material.
- 747 “Source material milling” means any activity that results in the production of radioactive material
748 that meets byproduct material definition (2).
- 749 “Source of radiation” means any radioactive material or any device or equipment emitting, or
750 capable of producing, radiation.
- 751 “Special form radioactive material” means radioactive material that satisfies the following
752 conditions:
- 753 (1) It is either a single solid piece or is contained in a sealed capsule that can be
754 opened only by destroying the capsule;
 - 755 (2) The piece or capsule has at least one dimension not less than 5 millimeters
756 (0.2 inch); and
 - 757 (3) All test requirements specified by the NRC that are applicable and in effect at the
758 time are met by the special form encapsulation design and/or construction.

- 759 "Special nuclear material" means:
- 760 (1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope
761 235, and any other material that the NRC, pursuant to the provisions of
762 Section 51 of the Atomic Energy Act of 1954, as amended, determines to be
763 special nuclear material, but does not include source material; or
- 764 (2) Any material artificially enriched by any of the foregoing but does not include
765 source material.
- 766 "Special nuclear material in quantities not sufficient to form a critical mass" means uranium
767 enriched in the isotope ^{235}U in quantities not exceeding 350 grams of contained ^{235}U ; ^{233}U in
768 quantities not exceeding 200 grams; plutonium in quantities not exceeding 200 grams; or any
769 combination of them in accordance with the following formula--for each kind of special nuclear
770 material, determine the ratio between the quantity of that special nuclear material and the quantity
771 specified above for the same kind of special nuclear material. The sum of such ratios for all of the
772 kinds of special nuclear material in combination shall not exceed 1. For example, the following
773 quantities in combination would not exceed the limitation and are within the formula:
774 $[175 \text{ (grams contained } 235\text{U)/}350] + [50 \text{ (grams contained } 233\text{U)/}200] + [50 \text{ (grams Pu)/}200] \leq 1$.
- 775 "Specific activity of a material", for a material in which the radionuclide is essentially uniformly
776 distributed, means the radioactivity per unit mass of the material.
- 777 "Specific activity of a radionuclide" means the radioactivity of the radionuclide per unit mass of
778 that nuclide.
- 779 "Spent nuclear fuel" or "spent fuel" means fuel that has been withdrawn from a nuclear reactor
780 following irradiation, has undergone at least 1 year's decay since being used as a source of
781 energy in a power reactor, and has not been chemically separated into its constituent elements
782 by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source
783 material, and other radioactive materials associated with fuel assemblies.
- 784 "State" means the State of Colorado. If it is clear from the context that the term is being used in
785 general, "state" means a State of the United States, the District of Columbia, the Commonwealth
786 of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the
787 Northern Mariana Islands.
- 788 "Stochastic effect" means a health effect that occurs randomly and for which the probability of the
789 effect occurring, rather than its severity, is assumed to be a linear function of dose without
790 threshold. Hereditary effects and cancer incidence are examples of stochastic effects. For
791 purposes of these regulations, "probabilistic effect" is an equivalent term.
- 792 "Structured educational program" means an accredited educational program designed to impart
793 particular knowledge and practical education through interrelated studies and supervised training.
- 794 "Supplied-air respirator" (SAR) or airline respirator means an atmosphere-supplying respirator for
795 which the source of breathing air is not designed to be carried by the user.
- 796 "Survey" means an evaluation of the radiological conditions and potential hazards incident to the
797 production, use, transfer, release, disposal, or presence of sources of radiation. When
798 appropriate, such evaluation includes, but is not limited to, tests, physical examinations, and
799 measurements of levels of radiation or concentrations of radioactive material present.
- 800 "Test" means the process of verifying compliance with an applicable regulation.

- 801 "These regulations" mean all parts of the State of Colorado "Rules and Regulations Pertaining to
802 Radiation Control," 6 CCR 1007-1.
- 803 "Tight-fitting facepiece" means a respiratory inlet covering that forms a complete seal with the
804 face.
- 805 "Total effective dose equivalent" (TEDE) means the sum of the effective dose equivalent for
806 external exposures and the committed effective dose equivalent for internal exposures.
- 807 "Total organ dose equivalent" (TODE) means the sum of the deep dose equivalent and the
808 committed dose equivalent to the organ receiving the highest dose in accordance with Part 4.
- 809 "Traceable to a national standard" means that a quantity or a measurement has been compared
810 to a national standard directly, or indirectly through one or more intermediate steps, and that all
811 comparisons have been documented.
- 812 "U.S. Department of Energy" means the Department of Energy established by Public Law 95-91,
813 August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the Department exercises
814 functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members,
815 officers and components and transferred to the U.S. Energy Research and Development
816 Administration and to the Administrator thereof pursuant to Sections 104(b), (c) and (d) of the
817 Energy Reorganization Act of 1974 (Public Law 93 438, October 11, 1974, 88 Stat. 1233 at 1237
818 42 U.S.C. 5814, effective January 19, 1975) and retransferred to the Secretary of Energy
819 pursuant to Section 301(a) of the Department of Energy Organization Act (Public Law 95-91,
820 August 4, 1977, 91 Stat. 565 at 577-578, 42 U.S.C. 7151, effective October 1, 1977).
- 821 "Unirradiated uranium" means uranium containing not more than 2×10^3 Bq (54 nanocurie) of
822 plutonium per gram of uranium-235, not more than 9×10^6 Bq (243 microcurie) of fission products
823 per gram of uranium-235, and not more than 5×10^{-3} g of uranium-236 per gram of uranium-235.
- 824 "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as
825 grinding, roasting, beneficiating, or refining.
- 826 "Unrestricted area" means an area, access to which is neither limited nor controlled by the
827 licensee or registrant. For purposes of these regulations, "uncontrolled area" is an equivalent
828 term.
- 829 "Unrestricted use" means that the facility or area may be used by individuals for any purpose
830 without limit or control of the licensee, registrant, or holder of the record of possession. See also
831 "restricted use".
- 832 "Uranium". See depleted uranium, enriched uranium, or natural uranium.
- 833 "User seal check" (fit check) means an action conducted by the respirator user to determine if the
834 respirator is properly seated to the face. Examples include negative pressure check, positive
835 pressure check, irritant smoke check, or isoamylacetate check.
- 836 "Very high radiation area" means an area, accessible to individuals, in which radiation levels from
837 radiation sources external to the body could result in an individual receiving an absorbed dose in
838 excess of 5 Gy (500 rad) in 1 hour at 1 meter from a source of radiation or 1 meter from any
839 surface that the radiation penetrates.⁵
- 840 ⁵ At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather
841 than units of dose equivalent, sievert and rem.

- 842 "Veterinarian" means an individual licensed by a State or Territory of the United States, the
843 District of Columbia or the Commonwealth of Puerto Rico to practice veterinary medicine.
- 844 "Waste" means low-level radioactive waste that is acceptable for disposal in a land disposal
845 facility and, for purposes of this definition, that is not classified as high level radioactive waste,
846 spent nuclear fuel, or byproduct material meeting definition (2), (3) or (4).
- 847 "Waste handling licensees" means persons licensed to receive and store radioactive wastes prior
848 to disposal and/or persons licensed to dispose of radioactive waste.
- 849 "Week" means 7 consecutive days starting on Sunday.
- 850 "Weighting factor" (w_T) for an organ or tissue (T) means the proportion, listed in Appendix 1B, of
851 the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of
852 stochastic effects when the whole body is irradiated uniformly.
- 853 "Whole body" means, for purposes of external exposure, head, trunk including male gonads,
854 arms above the elbow, or legs above the knee.
- 855 "Worker" means an individual engaged in work under a license or registration issued by the
856 Department and controlled by a licensee or registrant.
- 857 "Working level" (WL) means any combination of short-lived radon daughters in 1 liter of air that
858 will result in the ultimate emission of 1.3×10^5 MeV of potential alpha particle energy. The
859 short-lived radon daughters are: for radon-222: polonium-218, lead-214, bismuth-214, and
860 polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212.
- 861 "Working level month" (WLM) means an exposure to 1 working level for 170 hours (2,000 working
862 hours per year divided by 12 months per year is approximately equal to 170 hours per month).
- 863 "X-ray equipment" means an x-ray system, subsystem, or component thereof.
- 864 (1) "Mobile or portable x-ray equipment" means x-ray equipment that is designed to
865 be transported from place to place.
- 866 (a) Mobile x-ray equipment is often mounted in a vehicle or on a permanent
867 base with wheels and/or casters for moving while completely assembled.
- 868 (b) Portable x-ray equipment includes x-ray equipment that is designed to be
869 hand-carried and hand-held during use.
- 870 (2) "Stationary x-ray equipment" means x-ray equipment that is installed in a fixed
871 location.
- 872 "X-ray imaging system" or "x-ray system" means an assemblage of components for the controlled
873 production of x-rays.
- 874 (1) At a minimum, an x-ray imaging system includes an x-ray high-voltage generator,
875 an x-ray exposure control, a tube housing assembly, a beam-limiting device, and
876 necessary supporting structures.
- 877 (2) Additional components such as the image receptor(s) that function with the
878 system are considered integral parts of the system.

879 "Year" means the period of time beginning in January used to determine compliance with the
880 provisions of these regulations. The licensee or registrant may change the starting date of the
881 year used to determine compliance by the licensee or registrant provided that the change is made
882 at the beginning of the year. If a transition from one licensee or registrant to another occurs
883 during a year, each licensee or registrant shall assure that no day is omitted or duplicated in
884 consecutive years. See also "quarter".

885 **COMMUNICATIONS AND REFERENCED MATERIALS**

886 **1.3 Communications.**

887 1.3.1 All communications and reports concerning parts of these regulations, and applications filed
888 thereunder, should be addressed to the Department.

889 **1.4 Referenced Materials.**

890 1.4.1 Parts of these regulations incorporate by reference (as identified within a particular section)
891 materials originally published elsewhere. These regulations do not include amendments to or
892 editions of incorporated materials published later than the effective date of the particular section.

893 1.4.2 The Department of Public Health and Environment maintains copies of the complete text of the
894 incorporated materials for public inspection during regular business hours.

895 1.4.3 The Hazardous Materials And Waste Management Division will provide certified copies of any
896 non-copyrighted referenced material at cost upon request. Information regarding how the
897 incorporated material may be obtained or examined is available from:

898 Director, Hazardous Materials and Waste Management Division

899 Colorado Department of Public Health and Environment

900 4300 Cherry Creek Drive South

901 Denver, CO 80246-1530

902 1.4.4 In accordance with Section 24-4-103(12.5)(c)(ii)(C), CRS, copies of any material that has been
903 incorporated by reference have been provided to the State Publications Depository Library and
904 Distribution Center and are available for interlibrary loan. The incorporated materials may be
905 examined at any state publications depository library.

906 **EXEMPTION FROM THE REGULATORY REQUIREMENTS**

907 **1.5 Exemptions.**

908 1.5.1 The Department may, upon application or upon its own initiative, grant such exemption or
909 exception from a requirement of these regulations as it determines is authorized by law and will
910 not result in undue hazard to public health and safety or property.

- 911 1.5.2 Any U.S. Department of Energy contractor or subcontractor and any U.S. Nuclear Regulatory
912 Commission contractor or subcontractor of the following categories operating within this State is
913 exempt from these regulations to the extent that such contractor or subcontractor under his
914 contract receives, possesses, uses, transfers or acquires sources of radiation:
- 915 1.5.2.1 Prime contractors performing work for the U.S. Department of Energy at U.S.
916 Government-owned or -controlled sites, including the transportation of sources of
917 radiation to or from such sites and the performance of contract services during temporary
918 interruptions of such transportation;
- 919 1.5.2.2 Prime contractors of the U.S. Department of Energy performing research in, or
920 development, manufacture, storage, testing, or transportation of, atomic weapons or
921 components thereof;
- 922 1.5.2.3 Prime contractors of the U.S. Department of Energy using or operating nuclear reactors
923 or other nuclear devices in a U. S. Government-owned vehicle or vessel; and
- 924 1.5.2.4 Any other prime contractor or subcontractor of the U.S. Department of Energy or of the
925 U.S. Nuclear Regulatory Commission when the State and the U.S. Nuclear Regulatory
926 Commission jointly determine that:
- 927 (1) The exemption of the prime contractor or subcontractor is authorized by law; and
- 928 (2) Under the terms of the contract or subcontract, there is adequate assurance that
929 the work thereunder can be accomplished without undue risk to the public health
930 and safety.

931 **GENERAL REGULATORY REQUIREMENTS**

932 **1.6 Records.**

- 933 1.6.1 Each licensee and registrant shall maintain records showing the receipt, transfer, and disposal of
934 all sources of radiation.
- 935 1.6.2 Additional record requirements are specified elsewhere in these regulations.

936 **1.7 Inspections.**

- 937 1.7.1 Each licensee and registrant shall afford the Department at all reasonable times opportunity to
938 inspect sources of radiation and the premises and facilities wherein such sources of radiation are
939 used, stored and/or located.
- 940 1.7.2 Each licensee and registrant shall make available to the Department for inspection, at all
941 reasonable times, records maintained pursuant to these regulations.

942 **1.8 Tests.**

- 943 1.8.1 Each licensee and registrant shall perform upon instructions from the Department, or shall permit
944 the Department to perform, such reasonable tests as the Department deems appropriate or
945 necessary including, but not limited to, tests of:
- 946 1.8.1.1 Sources of radiation;
- 947 1.8.1.2 Facilities wherein sources of radiation are used, stored and/or located;

948 1.8.1.3 Radiation detection and monitoring instruments; and

949 1.8.1.4 Other equipment and devices used in connection with utilization or storage of licensed or
950 registered sources of radiation.

951 **ADDITIONAL REGULATORY REQUIREMENTS**

952 **1.9 Additional Requirements.**

953 1.9.1 The Department may, by rule, regulation, or order, impose upon any licensee or registrant such
954 requirements in addition to those established in these regulations, as it deems appropriate or
955 necessary to minimize danger to public health and safety or property.

956 **ENFORCEMENT REQUIREMENTS**

957 **1.10 Violations.**

958 1.10.1 An injunction or other court order may be obtained prohibiting any violation of any provision of the
959 Act or any regulation or order issued thereunder.

960 1.10.2 Any person who willfully violates any provision of the Act or any regulation or order issued
961 thereunder may be guilty of a misdemeanor and, upon conviction, may be punished by fine or
962 imprisonment or both, as provided by law.

963 1.10.3 Additionally, any person who violates any provision of the Act or any regulation may be subject to
964 a civil penalty as provided for in Part 13 or these regulations.

965 1.10.4 Submittal of false information shall be sufficient basis for rejecting or revoking any Department
966 license, registration, certification or other acceptance, approval or permit.

967 **1.11 Impounding.**

968 1.11.1 Sources of radiation shall be subject to impounding pursuant to the Act.

969 **1.12 Prohibited Uses.**

970 1.12.1 A radiation producing machine or radioactive material shall not be used except in accord with
971 these regulations.

972 **SEVERABILITY**

973 **1.13 Severability.**

974 1.13.1 Each provision of these regulations is severable, and if any provision or the application of the
975 provision to any circumstance is held invalid, the application of such provision to other
976 circumstances, and the remainder of these regulations shall not be affected thereby.
977

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

979 1A.1 Table 1A-1 lists the quality factors for converting absorbed dose in gray equal to 1 Sv or the
980 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

981 1A.2 If it is more convenient to measure the neutron fluence rate than to determine the neutron dose
982 equivalent rate in sievert per hour or rem per hour, 0.01 Sv (1 rem) of neutron radiation of
983 unknown energies may be assumed to result from a total fluence of 25 million neutrons per
984 square centimeter incident upon the body. If sufficient information exists to estimate the
985 approximate energy distribution of the neutrons, the licensee or registrant may use the fluence
986 rate per unit dose equivalent or the appropriate Q value from Table 1A-2 to convert a measured
987 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 ⁶ (Q)	Fluence per unit dose equivalent ⁷ (neutrons cm ⁻² rem ⁻¹)	Fluence per unit dose equivalent ⁷ (neutrons cm ⁻² Sv ⁻¹)
2.5×10 ⁻⁸ (thermal)	2	980×10 ⁶	980×10 ⁸
1×10 ⁻⁷	2	980×10 ⁶	980×10 ⁸
1×10 ⁻⁶	2	810×10 ⁶	810×10 ⁸
1×10 ⁻⁵	2	810×10 ⁶	810×10 ⁸
1×10 ⁻⁴	2	840×10 ⁶	840×10 ⁸
1×10 ⁻³	2	980×10 ⁶	980×10 ⁸
1×10 ⁻²	2.5	1010×10 ⁶	1010×10 ⁸
1×10 ⁻¹	7.5	170×10 ⁶	170×10 ⁸

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

Neutron energy (MeV)	Quality factor ⁶ (Q)	Fluence per unit dose equivalent ⁷ (neutrons cm ⁻² rem ⁻¹)	Fluence per unit dose equivalent ⁷ (neutrons cm ⁻² Sv ⁻¹)
5×10 ⁻¹	11	39×10 ⁶	39×10 ⁸
1	11	27×10 ⁶	27×10 ⁸
2.5	9	29×10 ⁶	29×10 ⁸
5	8	23×10 ⁶	23×10 ⁸
7	7	24×10 ⁶	24×10 ⁸
10	6.5	24×10 ⁶	24×10 ⁸
14	7.5	17×10 ⁶	17×10 ⁸
20	8	16×10 ⁶	16×10 ⁸
40	7	14×10 ⁶	14×10 ⁸
60	5.5	16×10 ⁶	16×10 ⁸
100	4	20×10 ⁶	20×10 ⁸
200	3.5	19×10 ⁶	19×10 ⁸
300	3.5	16×10 ⁶	16×10 ⁸
400	3.5	14×10 ⁶	14×10 ⁸

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

990 ⁷ Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.
991

992 **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 ⁸	0.30
Whole Body ⁹	1.00

993 ⁸ 0.30 results from 0.06 for each of 5 "remainder" organs, excluding the skin and the lens of the eye, that receive
 994 the highest doses.

995 ⁹ For the purpose of weighting the external whole body dose, for adding it to the internal dose, a single weighting
 996 factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure will be approved on a
 997 case-by-case basis until such time as specific guidance is issued.