



STATE OF WASHINGTON  
DEPARTMENT OF HEALTH  
DIVISION OF RADIATION PROTECTION

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September 28, 2001

Frederick C. Combs, Deputy Director  
Office of State and Tribal Programs  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Dear Mr. Combs:

This is a request for review of our final regulations pertaining to “respiratory protection and controls to restrict internal exposure” and “minor corrections and clarifying changes” (RATS ID 1999-3 and 1998-5, respectively). It appears we failed to e-mail a request to review the proposed rules (or maybe the system “ate it”!) As you are probably aware by now, the “Nimda virus” knocked out our computers last week and we are still not re-connected to the world! Thus we are resorting to “snail mail” to rectify our previous error in not sending out our regulations for your review!

However, please note that our current rule making efforts are specifically designed to adopt federal rules “without material change” so we do not anticipate any problems with your review of the final rules. Enclosed are the “as published” regulations found in Issue 01-05 of the Washington State Register.

If you have any questions, please feel free to contact me at (360) 236-3221.

Sincerely,

Terry C. Frazee, Supervisor  
Radioactive Materials Section

Enclosures

01 OCT -3 PM 5:52

DSP

STP-006 Template  
RIDS Code: SPO8

AMENDATORY SECTION (Amending WSR 00-08-013, filed 3/24/00, effective 4/24/00)

**WAC 246-220-010 Definitions.** As used in these regulations, these terms have the definitions set forth below. Additional definitions used only in a certain part will be found in that part.

(1) "Absorbed dose" 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.

(2) "Accelerator produced material" means any material made radioactive by exposing it in a particle accelerator.

(3) "Act" means Nuclear energy and radiation, chapter 70.98 RCW.

(4) "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).

(5) "Adult" means an individual eighteen or more years of age.

(6) "Agreement state" means any state with which the United States Nuclear Regulatory Commission has entered into an effective agreement under section 274 b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

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

(8) "Airborne radioactivity area" means a room, enclosure, or operating area in which airborne radioactive material exists in concentrations (a) in excess of the derived air concentration (DAC) specified in WAC 246-221-290, Appendix A, or (b) to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or twelve DAC-hours.

(9) "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.

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

~~((+10+))~~ (11) "Annual limit on intake" (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 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 WAC 246-221-290.

~~((+11+))~~ (12) "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.

(13) "Atmosphere-supplying respirator" means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

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

~~((+12+))~~ (15) "Becquerel" (Bq) means the SI unit of activity. One becquerel is equal to 1 disintegration or transformation per second ( $s^{-1}$ ).

~~((+13+))~~ (16) "Bioassay" means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these regulations, "radiobioassay" is an equivalent term.

~~((+14+))~~ (17) "Byproduct material" means: (a) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and (b) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any 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.

~~((+15+))~~ (18) "Calendar quarter" means not less than twelve consecutive weeks nor more than fourteen consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from inclusion within a calendar quarter. No licensee or registrant shall change the method of determining calendar quarters for purposes of these regulations except at the beginning of a calendar year.

~~((+16+))~~ (19) "Calibration" means the determination of (a) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (b) the

strength of a source of radiation relative to a standard.

((+17+)) (20) "CFR" means Code of Federal Regulations.

((+18+)) (21) "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 ten days, for Class W, Weeks, from ten to one hundred days, and for Class Y, Years, of greater than one hundred days. For purposes of these regulations, "lung class" and "inhalation class" are equivalent terms. For "class of waste" see WAC 246-249-040.

((+19+)) (22) "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.

((+20+)) (23) "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 fifty-year period following the intake.

((+21+)) (24) "Committed effective dose equivalent" ( $H_{E,50}$ ) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ( $H_{E,50} = \sum w_T H_{T,50}$ ).

((+22+)) (25) "Constraint" or dose constraint means a value above which specified licensee actions are required.

((+23+)) (26) "Controlled area." See "Restricted area."

((+24+)) (27) "Curie" means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of  $3.7 \times 10^{10}$  transformations per second (tps).

((+25+)) (28) "Declared pregnant woman" means a woman who has voluntarily informed (~~(her employer)~~) the licensee or registrant, in writing, of her pregnancy, and (~~(her)~~) 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.

((+26+)) (29) "Deep dose equivalent" ( $H_d$ ), which applies to external whole body exposure, means the dose equivalent at a tissue depth of 1 centimeter ( $1000 \text{ mg/cm}^2$ ).

((+27+)) (30) "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.

(31) "Department" means the department of health, division of radiation protection, which has been designated as the state radiation control agency.

((+28+)) (32) "Depleted uranium" means the source material uranium in which the isotope Uranium-235 is less than 0.711 percent by weight of the total uranium present. Depleted uranium does not include special nuclear material.

((+29+)) (33) "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 two thousand 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 two thousand hours in a year. DAC values are given in WAC 246-221-290.

((+30+)) (34) "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 two thousand DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 0.05 Sv (5 rem).

((+31+)) (35) "Disposablè 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).

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

((+32+)) (37) "Dose commitment" means the total radiation dose to a part of the body that will result from retention in the body of radioactive material. 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 fifty years.

((+33+)) (38) "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.

((+34+)) (39) "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.

((+35+)) (40) "Dosimetry processor" means a person that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

((+36+)) (41) "dpm" means disintegrations per minute. See also "curie."

((+37+)) (42) "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 ( $H_E = \sum w_T H_T$ ).

((+38+)) (43) "Embryo/fetus" means the developing human organism from conception until the time of birth.

((+39+)) (44) "Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, without respect to their intended use.

((+40+)) (45) "Exposure" means (a) (~~(, when used as a verb)~~), being exposed to ionizing radiation or to radioactive material, or

(b) (~~(, when used as a noun,)~~) the quotient of  $\Delta Q$  by  $\Delta m$  where " $\Delta Q$ " 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 " $\Delta m$ " are completely stopped in air. The special unit of exposure is the roentgen (R) and the SI equivalent is the coulomb per kilogram. One roentgen is equal to  $2.58 \times 10^{-4}$  coulomb per kilogram of air.

~~((41))~~ (46) "Exposure rate" means the exposure per unit of time, such as roentgen per minute and milliroentgen per hour.

~~((42))~~ (47) "External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

~~((43))~~ (48) "Extremity" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

~~((44))~~ "Eye dose equivalent" means the external dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeter ( $300 \text{ mg/cm}^2$ ).

~~((45))~~ (49) "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.

(50) "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.

(51) "Fit test" means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

(52) "Former United States Atomic Energy Commission (AEC) or United States 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.

~~((46))~~ (53) "Generally applicable environmental radiation standards" means standards issued by the United States Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

~~((47))~~ (54) "Gray" (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule/kilogram (100 rad).

~~((48))~~ (55) "Healing arts" means the disciplines of medicine, dentistry, osteopathy, chiropractic, podiatry, and veterinary medicine.

~~((49))~~ (56) "Helmet" means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

(57) "High radiation area" means any 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 one hour at 30 centimeters from any source of radiation or 30 centimeters from any surface that the radiation penetrates. For purposes of these regulations, rooms or areas in which diagnostic x-ray systems are used for healing arts purposes are not considered high radiation areas.

((+50+)) (58) "Hood" means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

(59) "Human use" means the intentional internal or external administration of radiation or radioactive material to human beings.

((+51+)) (60) "Immediate" or "immediately" means as soon as possible but no later than four hours after the initiating condition.

((+52+)) (61) "IND" means investigatory new drug for which an exemption has been claimed under the United States Food, Drug and Cosmetic Act (Title 21 CFR).

((+53+)) (62) "Individual" means any human being.

((+54+)) (63) "Individual monitoring" means the assessment of:

(a) Dose equivalent (i) by the use of individual monitoring devices or (ii) by the use of survey data; or

(b) Committed effective dose equivalent (i) by bioassay or (ii) by determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours.

((+55+)) (64) "Individual monitoring devices" (individual monitoring equipment) means devices designed to be worn by a single individual for the assessment of dose equivalent (~~(. For purposes of these regulations, individual monitoring equipment, personnel monitoring device, personnel dosimeter, and dosimeter are equivalent terms. Examples of individual monitoring devices are)~~) such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices.

((+56+)) (65) "Inspection" means an official examination or observation by the department including but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements and conditions of the department.

((+57+)) (66) "Interlock" means a device arranged or connected such that the occurrence of an event or condition is required before a second event or condition can occur or continue to occur.

((+58+)) (67) "Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

((+59+)) (68) "Irretrievable source" means any sealed source containing licensed material which is pulled off or not connected to the wireline downhole and for which all reasonable effort at recovery, as determined by the department, has been expended.

((+60+)) (69) "Lens dose equivalent" (LDE) applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm<sup>2</sup>).

(70) "License" means a license issued by the department in accordance with the regulations adopted by the department.

((+61+)) (71) "Licensed material" means radioactive material received, possessed, used, transferred, or disposed under a general

or specific license issued by the department.

((+62+)) (72) "Licensee" means any person who is licensed by the department in accordance with these regulations and the act.

((+63+)) (73) "Licensing state" means any state with regulations equivalent to the suggested state regulations for control of radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the Conference of Radiation Control Program Directors, Inc.

((+64+)) (74) "Loose-fitting facepiece" means a respiratory inlet covering that is designed to form a partial seal with the face.

(75) "Lost or missing licensed material" means licensed material 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.

((+65+)) (76) "Member of the public" means an individual except when the individual is receiving an occupational dose.

((+66+)) (77) "Minor" means an individual less than eighteen years of age.

((+67+)) (78) "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.

((+68+)) (79) "NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include by-product, source, or special nuclear material. For the purpose of meeting the definition of a Licensing State by the Conference of Radiation Control Program Directors, Inc. (CRCPD), NARM refers only to discrete sources of NARM. Diffuse sources of NARM are excluded from consideration by the CRCPD for Licensing State designation purposes.

((+69+)) (80) "Natural radioactivity" means radioactivity of naturally occurring nuclides.

((+70+)) (81) "NDA" means a new drug application which has been submitted to the United States Food and Drug Administration.

((+71+)) (82) "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.

(83) "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, a "deterministic effect" is an equivalent term.

((+72+)) (84) "Nuclear Regulatory Commission" (NRC) means the United States Nuclear Regulatory Commission or its duly authorized representatives.

((+73+)) (85) "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 in the possession of the licensee, registrant, or other person. Occupational dose does not include dose received: From background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released pursuant to chapters 246-239 and 246-240 WAC, from voluntary participation in medical research programs, or as a member of the public.

((+74+)) (86) "Ore refineries" means all processors of a radioactive material ore.

((+75+)) (87) "Particle 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.

((+76+)) (88) "Permittee" means a person who has applied for, and received, a valid site use permit for use of the low-level waste disposal facility at Hanford, Washington.

((+77+)) (89) "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, but shall not include federal government agencies.

((+78+)) (90) "Personal supervision" means supervision such that the supervisor is physically present at the facility and in such proximity that contact can be maintained and immediate assistance given as required.

((+79+)) (91) "Personnel monitoring equipment." See individual monitoring devices.

((+80+)) (92) "Pharmacist" means an individual licensed by this state to compound and dispense drugs, and poisons.

((+81+)) (93) "Physician" means an individual licensed by this state to prescribe and dispense drugs in the practice of medicine.

((+82+)) (94) "Planned special exposure" means an infrequent exposure to radiation, separate from and in addition to the annual occupational dose limits.

((+83+)) (95) "Positive pressure respirator" means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

(96) "Powered air-purifying respirator" (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

(97) "Practitioner" means an individual licensed by the state in the practice of a healing art (i.e., physician, dentist, podiatrist, chiropractor, etc.).

((+84+)) (98) "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.

(99) "Public dose" means the dose received by a member of the public from exposure to sources of radiation under the licensee's

or registrant's control or to radiation or radioactive material released by the licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released pursuant to chapters 246-239 and 246-240 WAC, or from voluntary participation in medical research programs.

((+85+)) (100) "Qualified expert" means an individual who has demonstrated to the satisfaction of the department he/she has the knowledge, training, and experience to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs. The department reserves the right to recognize the qualifications of an individual in specific areas of radiation protection.

((+86+)) (101) "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.

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

TABLE I  
QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

TYPE OF RADIATION	Quality Factor (Q)	Absorbed Dose Equal to A Unit Dose Equivalent <sup>a</sup>
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

<sup>a</sup> Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 Sv.

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

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

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

<sup>a</sup> Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue-equivalent phantom.

<sup>b</sup> Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

((+87+)) (103) "Quantitative fit test" (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

(104) "Quarter" means a period of time equal to one-fourth of the year observed by the licensee, approximately thirteen consecutive weeks, providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

((+88+)) (105) "Rad" means the special unit of absorbed dose. One rad equals one-hundredth of a joule per kilogram of material; for example, if tissue is the material of interest, then 1 rad equals 100 ergs per gram of tissue. One rad is equal to an absorbed dose of 100 erg/gram or 0.01 joule/kilogram (0.01 gray).

((+89+)) (106) "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 magnetic fields or nonionizing radiation, such as radiowaves or microwaves, visible, infrared, or ultraviolet light.

~~((90))~~ (107) "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 one hour at thirty centimeters from the source of radiation or from any surface that the radiation penetrates.

~~((91))~~ (108) "Radiation machine" means any device capable of producing ionizing radiation except those devices with radioactive materials as the only source of radiation.

~~((92))~~ (109) "Radiation safety officer" means an individual who has the knowledge and responsibility to apply appropriate radiation protection regulations and has been assigned such responsibility by the licensee or registrant.

~~((93))~~ (110) "Radiation source." See "Source of radiation."

~~((94))~~ (111) "Radioactive material" means any material (solid, liquid, or gas) which emits radiation spontaneously.

~~((95))~~ (112) "Radioactive waste" means any radioactive material which is no longer of use and intended for disposal or treatment for the purposes of disposal.

~~((96))~~ (113) "Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.

~~((97))~~ (114) "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.

~~((98))~~ (115) "Registrable item" means any radiation machine except those exempted by RCW 70.98.180 or exempted by the department pursuant to the authority of RCW 70.98.080.

~~((99))~~ (116) "Registrant" means any person who is registered by the department or is legally obligated to register with the department in accordance with these regulations and the act.

~~((100))~~ (117) "Registration" means registration with the department in accordance with the regulations adopted by the department.

~~((101))~~ (118) "Regulations of the United States Department of Transportation" means the regulations in 49 CFR Parts 170-189, 14 CFR Part 103, and 46 CFR Part 146.

~~((102))~~ (119) "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 Sv).

~~((103))~~ (120) "Research and development" means: (a) Theoretical analysis, exploration, or experimentation; or (b) 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.

((+104)) (121) "Respiratory protective equipment" means an apparatus, such as a respirator, used to reduce an individual's intake of airborne radioactive materials.

((+105)) (122) "Restricted area" means any area to which access is limited by the licensee or registrant for purposes of protecting individuals against undue risks from exposure to radiation and radioactive material. "Restricted area" shall not include any areas used for residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

((+106)) (123) "Roentgen" (R) means the special unit of exposure. One roentgen equals  $2.58 \times 10^{-4}$  coulombs/kilogram of air.

((+107)) (124) "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.

((+108)) (125) "Sealed source" means any radioactive material that is encased in a capsule designed to prevent leakage or the escape of the radioactive material.

((+109)) (126) "Self-contained breathing apparatus" (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

(127) "Shallow dose equivalent" ( $H_s$ ), which applies to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter ( $7 \text{ mg/cm}^2$ ) averaged over an area of 1 square centimeter.

((+110)) (128) "SI" means an abbreviation of the International System of Units.

((+111)) (129) "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).

((+112)) (130) "Site area emergency" means events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by offsite response organizations to protect persons offsite.

((+113)) (131) "Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

((+114)) (132) "Source container" means a device in which radioactive material is transported or stored.

((+115)) (133) "Source material" means: (a) Uranium or thorium, or any combination thereof, in any physical or chemical form, or (b) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of (i) uranium, (ii) thorium, or (iii) any combination thereof. Source material does not include special nuclear material.

((+116)) (134) "Source material milling" means the extraction or concentration of uranium or thorium from any ore processing primarily for its source material content.

((+117)) (135) "Source of radiation" means any radioactive material, or any device or equipment emitting or capable of producing ionizing radiation.

~~((118))~~ (136) "Special nuclear material" means:

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

(b) Any material artificially enriched in any of the foregoing, but does not include source material.

~~((119))~~ (137) "Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U-235 in quantities not exceeding three hundred fifty grams of contained U-235; Uranium-233 in quantities not exceeding two hundred grams; Plutonium in quantities not exceeding two hundred 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" (i.e., unity). For example, the following quantities in combination would not exceed the limitation and are within the formula:

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

~~((120))~~ (138) "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.

~~((121))~~ (139) "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.

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

~~((122))~~ (141) "Test" means (a) the process of verifying compliance with an applicable regulation, or (b) a method for determining the characteristics or condition of sources of radiation or components thereof.

~~((123))~~ (142) "These regulations" mean all parts of the rules for radiation protection of the state of Washington.

~~((124))~~ (143) "Tight-fitting facepiece" means a respiratory inlet covering that forms a complete seal with the face.

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

~~((125))~~ (145) "Total organ dose equivalent" (TODE) ~~((#))~~ means the sum of the deep dose equivalent and the committed dose equivalent to the organ or tissue receiving the highest dose.

~~((126))~~ (146) "United States 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 United States Atomic Energy Commission, its chairman, members, officers and components and transferred to the United States Energy Research and Development Administration and to the administrator thereof pursuant to 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).

~~((127))~~ (147) "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

~~((128))~~ (148) "Unrestricted area" (uncontrolled area) means any area which is not a restricted area. Areas where the external dose exceeds 2 mrem in any one hour or where the public dose, taking into account occupancy factors, will exceed 100 mrem total effective dose equivalent in any one year must be restricted.

~~((129))~~ (149) "User seal check" (fit check) means an action conducted by the respirator user to determine if the respirator is properly seated to the face. Examples include negative pressure check, positive pressure check, irritant smoke check, or isoamyl acetate check.

(150) "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 one hour at one meter from a source of radiation or one meter from any surface that the radiation penetrates.

~~((130))~~ (151) "Waste handling licensees" mean persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste.

~~((131))~~ (152) "Week" means seven consecutive days starting on Sunday.

~~((132))~~ (153) "Weighting factor"  $w_T$  for an organ or tissue (T) means the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of  $w_T$  are:

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ORGAN DOSE WEIGHTING FACTORS

Organ or Tissue	$w_T$
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30 <sup>a</sup>
<b>Whole Body</b>	<b>1.00<sup>b</sup></b>

<sup>a</sup> 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.

<sup>b</sup> 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.

((~~133~~)) (154) "Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow, or legs above the knee.

((~~134~~)) (155) "Worker" means an individual engaged in activities under a license or registration issued by the department and controlled by a licensee or registrant but does not include the licensee or registrant. Where the licensee or registrant is an individual rather than one of the other legal entities defined under "person," the radiation exposure limits for the worker also apply to the individual who is the licensee or registrant. If students of age eighteen years or older are subjected routinely to work involving radiation, then the students are considered to be workers. Individuals of less than eighteen years of age shall meet the requirements of WAC 246-221-050.

((~~135~~)) (156) "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.

((~~136~~)) (157) "Working level month" (WLM) means an exposure to one working level for one hundred seventy hours -- two thousand working hours per year divided by twelve months per year is approximately equal to one hundred seventy hours per month.

((~~137~~)) (158) "Year" means the period of time beginning in January used to determine compliance with the provisions of these regulations. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

AMENDATORY SECTION (Amending WSR 99-15-105, filed 7/21/99, effective 8/21/99)

**WAC 246-221-005 Radiation protection programs.** (1) Each specific licensee shall develop, document, and implement a radiation protection program sufficient to ensure compliance with the provisions of this chapter.

(2) The licensee shall use, to the extent (~~(practicable)~~) practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

(3) The licensee shall review the radiation protection program content and implementation at the frequency specified in the license.

(4) To implement the ALARA requirements of subsection (2) of this section, and notwithstanding the requirements of WAC 246-221-060, a constraint on air emission of radioactive material to the environment, excluding radon-220, radon-222 and their daughters, shall be established by licensees such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 0.1 mSv (10 mrem) per year from these emissions. This dose constraint does not apply to sealed sources or to accelerators less than 200MeV. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in WAC 246-221-260 and promptly take appropriate corrective action to ensure against recurrence.

(5) Each licensee shall maintain records of the radiation protection program, including:

(a) The provisions of the program; and

(b) Audits, where required, and other reviews of program content and implementation.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-010 Occupational dose limits for adults.** (1) The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to WAC 246-221-030, to the following dose limits:

(a) An annual limit, which is the more limiting of:

(i) The total effective dose equivalent being equal to 0.05 Sv

(5 rem); or

(ii) The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.50 Sv (50 rem).

(b) The annual limits to the lens of the eye, to the skin, and to the extremities which are:

(i) (~~An eye~~) A lens dose equivalent of 0.15 Sv (15 rem); and

(ii) A shallow dose equivalent of 0.50 Sv (50 rem) to the skin or to any extremity.

(2) Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, must be subtracted from the limits specified in WAC 246-221-030 for planned special exposures that the individual may receive during the current year and during the individual's lifetime.

(3) The assigned deep dose equivalent and shallow dose equivalent shall be for the portion of the body receiving the highest exposure. The deep dose equivalent, (~~eye~~) lens dose equivalent and shallow dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.

(4) Derived air concentration (DAC) and annual limit on intake (ALI) values are specified in WAC 246-221-290 and may be used to determine the individual's dose and to demonstrate compliance with the occupational dose limits.

(5) Notwithstanding the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity.

(6) The licensee or registrant shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person during the current year as determined in accordance with WAC 246-221-020.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-015 Compliance with requirements for summation of external and internal doses.** (1) If the licensee is required to monitor (~~pursuant to~~) under both WAC 246-221-090 and 246-221-100, the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee is required to monitor only (~~pursuant to~~) under WAC 246-221-090 or only (~~pursuant to~~) under WAC 246-221-100, then summation is not required to demonstrate compliance with the dose limits. The licensee may demonstrate compliance with the requirements for

summation of external and internal doses (~~(pursuant to)~~) under subsections (2), (3), and (4) of this section. The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.

(2) **Intake by inhalation.** If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

(a) The sum of the fractions of the inhalation ALI for each radionuclide; or

(b) The total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by two thousand; or

(c) The sum of the calculated committed effective dose equivalents to all significantly irradiated organs or tissues (T) calculated from bioassay data using appropriate biological models and expressed as a fraction of the annual limit. For purposes of this requirement, an organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factors,  $w_T$ , and the committed dose equivalent,  $H_{T,50}$ , per unit intake is greater than ten percent of the maximum weighted value of  $H_{50}$ , that is,  $w_T H_{T,50}$ , per unit intake for any organ or tissue.

(3) **Intake by oral ingestion.** If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than ten percent of the applicable oral ALI, the licensee shall account for this intake and include it in demonstrating compliance with the limits.

(4) **Intake through wounds or absorption through skin.** The licensee shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption. The intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be evaluated or accounted for pursuant to this section.

(5) **External dose from airborne radioactive material.** Licensees shall, when determining the dose from airborne radioactive material, include the contribution to the deep dose equivalent, (~~(eye)~~) lens dose equivalent, and shallow dose equivalent from external exposure to the radioactive cloud. Airborne radioactivity measurements and DAC values shall not be used as the primary means to assess the deep dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep dose equivalent to an individual shall be based upon measurements using instruments or individual monitoring devices.

**WAC 246-221-030 Requirements for planned special exposures.**

A licensee or registrant may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in WAC 246-221-010 provided that each of the following conditions is satisfied:

(1) The licensee or registrant authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the ~~((higher))~~ dose estimated to result from the planned special exposure are unavailable or impractical.

(2) The licensee or registrant, and employer if the employer is not the licensee or registrant, specifically authorizes the planned special exposure, in writing, before the exposure occurs.

(3) Before a planned special exposure, the licensee or registrant ensures that each individual involved is:

(a) Informed of the purpose of the planned operation; and

(b) Informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and

(c) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(4) Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant ascertains prior doses as required by WAC 246-221-020(2) during the lifetime of the individual for each individual involved.

(5) Subject to WAC 246-221-010(2), the licensee or registrant shall not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed:

(a) The numerical values of any of the dose limits in WAC 246-221-010(1) in any year; and

(b) Five times the annual dose limits in WAC 246-221-010(1) during the individual's lifetime.

(6) The licensee or registrant maintains records that describe:

(a) The exceptional circumstances requiring the use of a planned special exposure; ~~((and))~~

(b) The name of the management official who authorized the planned special exposure and a copy of the signed authorization; ~~((and))~~

(c) What actions were necessary; ~~((and))~~

(d) Why the actions were necessary; ~~((and))~~

(e) What precautions were taken to assure that doses were maintained ALARA; and

(f) What individual and collective doses were expected to result.

(7) The licensee or registrant records the best estimate of the dose resulting from the planned special exposure in the individual's record and informs the individual, in writing, of the dose within thirty days from the date of the planned special

exposure. The dose from planned special exposures shall not be considered in controlling future occupational dose of the individual (~~((pursuant to))~~) under WAC 246-221-010(1) but shall be included in evaluations required by subsections (4) and (5) of this section.

(8) The licensee or registrant submits a written report in accordance with WAC 246-221-265.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-055 Dose equivalent to an embryo/fetus.** (1) The licensee or registrant shall ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 5 mSv (0.5 rem).

(2) Once pregnancy has been declared, the licensee or registrant shall make every effort to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman (~~((so as))~~) in order to satisfy the limit in subsection (1) of this section.

(3) If by the time the woman declares pregnancy to the licensee or registrant, the dose equivalent to the embryo/fetus has exceeded 4.5 mSv (0.45 rem), the licensee or registrant shall be deemed to be in compliance with subsection (1) of this section if the additional dose equivalent to the embryo/fetus does not exceed 0.50 mSv (0.05 rem) during the remainder of the pregnancy.

(4) The dose equivalent to an embryo/fetus shall be taken as the sum of:

(a) The (~~((calculated dose equivalent to the embryo/fetus resulting from external exposure of the declared pregnant woman or, in the absence of this information, the))~~) deep dose equivalent to the declared pregnant woman; and

(b) The dose equivalent to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(5) The licensee or registrant shall maintain the records of dose equivalent to an embryo/fetus with the records of dose equivalent to the declared pregnant woman. The declaration of pregnancy, including the estimated date of conception, shall also be kept on file, but may be maintained separately from the dose records.

**WAC 246-221-090 Personnel monitoring for external dose.** Each licensee or registrant shall monitor occupational exposure from sources of radiation at levels sufficient to demonstrate compliance with the occupational dose limits of WAC 246-221-010, 246-221-030, 246-221-050 and 246-221-055.

(1) Each licensee or registrant shall monitor occupational exposure to radiation from licensed (or registered) and unlicensed (or unregistered) radiation sources under the control of the licensee or registrant and shall supply and shall require the use of individual monitoring devices by:

(a) Each adult likely to receive, in one year from sources external to the body, a dose in excess of ten percent of the applicable limits specified in WAC 246-221-010(1).

(b) Each minor (~~(or declared pregnant woman)~~) likely to receive, in one year from sources external to the body, a (~~dose in excess of ten percent of the applicable limits specified in WAC 246-221-050 or 246-221-055~~) deep dose equivalent in excess of 1 mSv (0.1 rem), a lens dose equivalent in excess of 1.5 mSv (0.15 rem), or a shallow dose equivalent to the skin or to the extremities in excess of 5 mSv (0.5 rem).

(c) Each declared pregnant woman likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem). All of the occupational dose limits specified in WAC 246-221-010 continue to be applicable to the declared pregnant worker as long as the embryo/fetus dose limit is not exceeded.

(d) Each individual who enters a high or very high radiation area.

(2) Personnel monitoring devices assigned to an individual:

(a) Shall not intentionally be exposed to give a false or erroneous reading;

(b) Shall be assigned to one individual per exposure interval (i.e., weekly, monthly) and used to determine exposure for that individual only;

(c) Shall not be worn by any individual other than that individual originally assigned to the device;

(d) Personnel monitoring devices that are exposed while not being worn by the assigned individual shall be processed and recorded as soon as possible. A replacement monitoring device shall be assigned to the individual immediately. A record of the circumstances of the exposure shall be retained.

(3) All personnel dosimeters, except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to any extremities, that require processing to determine the radiation dose and that are utilized by licensees or registrants to comply with subsection (1) of this section, with other applicable provisions of chapters 246-220 through 246-255 WAC, or with conditions specified in a licensee's license must be processed and evaluated by a dosimetry processor:

(a) Holding current personnel dosimetry accreditation from either the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (formerly known as the National Bureau of Standards) or the United States Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems (DOELAP); and

(b) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP or DOELAP program that most closely approximate the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

(4) For the purposes of this section "dosimetry processor" means an individual or an organization that processes and evaluates personnel monitoring devices in order to determine the radiation dose delivered to the device.

(5) Each licensee or registrant shall maintain records of doses received by all individuals for whom monitoring was required (~~((pursuant to))~~ under subsection (1) of this section, and records of doses received during planned special exposures, accidents, and emergency conditions. Assessments of dose equivalent and records made using units in effect before January 1, 1994, need not be changed. These records shall include, when applicable:

(a) The deep dose equivalent to the whole body, (~~((eye))~~ lens dose equivalent, shallow dose equivalent to the skin, and shallow dose equivalent to the extremities; and

(b) The total effective dose equivalent when required by WAC 246-221-015; and

(c) The total of the deep dose equivalent and the committed dose to the organ receiving the highest total dose (total organ dose equivalent).

(6) The licensee or registrant shall maintain the records specified in subsection (5) of this section on department Form RHF-5A, in accordance with the instructions provided (~~((thereon))~~ on the form, or in clear and legible records containing all the information required by Form RHF-5A; and shall update the information at least annually.

(7) Each licensee or registrant shall ensure that individuals, for whom they are required to monitor occupational doses in accordance with subsection (1) of this section, wear individual monitoring devices as follows:

(a) An individual monitoring device used for monitoring the dose to the whole body shall be worn at the unshielded or least shielded location of the whole body likely to receive the highest exposure. When a protective apron is worn, the location of the individual monitoring device is typically at the neck (collar).

(b) Any additional individual monitoring device used for monitoring the dose to an embryo/fetus of a declared pregnant woman, pursuant to WAC 246-221-055(1), shall be located at the waist under any protective apron being worn by the woman.

(c) An individual monitoring device used for monitoring the (~~((eye))~~ lens dose equivalent, to demonstrate compliance with WAC 246-221-010 (1)(b)(i), shall be located at the neck (collar), outside any protective apron being worn by the monitored individual, or at an unshielded location closer to the eye.

(d) An individual monitoring device used for monitoring the dose to the extremities, to demonstrate compliance with WAC 246-221-010 (1)(b)(ii), shall be worn on the extremity likely to receive the highest exposure. Each individual monitoring device shall be oriented to measure the highest dose to the extremity being monitored.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-100 Personnel monitoring for internal dose.** (1) Each licensee shall monitor, to determine compliance with WAC 246-221-040, the occupational intake of radioactive material by and assess the committed effective dose equivalent to:

(a) Adults likely to receive, in 1 year, an intake in excess of ten percent of the applicable ALI in Table I, Columns 1 and 2, of WAC 246-221-290; ~~((and))~~

(b) Minors ~~((and declared pregnant women))~~ likely to receive, in one year, a committed effective dose equivalent in excess of ~~((0.50))~~ 1 mSv ~~((0.05))~~ 0.1 rem; and

(c) Declared pregnant women likely to receive, during the entire pregnancy, a committed effective dose equivalent in excess of 1 mSv (0.1 rem).

(2) Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the department may incorporate license provisions or issue an order requiring a licensee or registrant to make available to the individual appropriate bioassay services and to furnish a copy of the reports of such services to the department.

(3) Each licensee shall maintain records of doses received by all individuals for whom monitoring was required pursuant to subsections (1) and (2) of this section, and records of doses received during planned special exposures, accidents, and emergency conditions. Assessments of dose equivalent and records made using units in effect before January 1, 1994, need not be changed. These records shall include, when applicable:

(a) The estimated intake or body burden of radionuclides; ~~((and))~~

(b) The committed effective dose equivalent assigned to the intake or body burden of radionuclides; ~~((and))~~

(c) The specific information used to calculate the committed effective dose equivalent pursuant to WAC 246-221-040; ~~((and))~~

(d) The total effective dose equivalent when required by WAC 246-221-015; and

(e) The total of the deep dose equivalent and the committed dose to the organ receiving the highest total dose (total organ dose equivalent).

(4) The licensee or registrant shall maintain the records specified in subsection (3) of this section on department Form RHF-5A, in accordance with the instructions provided (~~thereon~~) on the form, or in clear and legible records containing all the information required by Form RHF-5A; and shall update the information at least annually.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-110 Surveys.** (1) Each licensee or registrant shall make or cause to be made such surveys, as defined in WAC 246-220-010, as may be necessary for the licensee or registrant to establish compliance with these regulations and are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels, concentrations or quantities of radioactive material, and (~~the extent of~~) potential radiation hazards (~~that may be present~~). Records of such surveys shall be preserved as specified in WAC 246-221-230. Information on performing surveys may be found in the United States Nuclear Regulatory Commission's Regulatory Guide 8.23.

(2) The licensee shall ensure that instruments and equipment used for quantitative radiation measurements, for example, dose rate and effluent monitoring, are calibrated annually at intervals not to exceed thirteen months for the radiation measured.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

**WAC 246-221-113 Use of process, engineering or other controls.** (1) The licensee shall use, to the extent (~~practicable~~) practical, process or other engineering controls, such as, containment, decontamination, or ventilation, to control the concentrations of radioactive material in air.

(2) When it is not (~~practicable~~) practical to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee shall, consistent with maintaining the total effective dose equivalent ALARA, increase monitoring and limit intakes by one or more of the following means:

- (a) Control of access; (~~or~~)
- (b) Limitation of exposure times; (~~or~~)
- (c) Use of respiratory protection equipment; or
- (d) Other controls.

(3) If the licensee performs an ALARA analysis to determine whether or not respirators should be used, the licensee may consider safety factors other than radiological factors. The licensee should also consider the impact of respirator use on workers' industrial health and safety.

AMENDATORY SECTION (Amending WSR 98-13-034, filed 6/8/98, effective 7/9/98)

**WAC 246-221-117 Use of individual respiratory protection equipment.** ~~((+i))~~ If the licensee ~~((uses))~~ assigns or permits the use of respiratory protection equipment to limit ~~((intakes pursuant to WAC 246-221-113))~~ the intake of radioactive material:

~~((+a))~~ (1) The licensee shall use only respiratory protection equipment that is:

~~((+i))~~ (a) Tested and certified ((or had certification extended)) by the National Institute for Occupational Safety and Health ((and the Mine Safety and Health Administration)) (NIOSH);  
or

~~((+ii))~~ (b) Approved by the department on the basis of the licensee's submittal of an application for authorized use of other respiratory protection equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

~~((+b))~~ (2) The licensee shall implement and maintain a respiratory protection program that includes:

~~((+i))~~ (a) Air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate exposures;  
~~((and~~

~~+ii))~~ (b) Surveys and bioassays, as appropriate, to evaluate actual intakes; ((and

~~+iii))~~ (c) Testing of respirators for operability (user seal check for face sealing devices and functional check for others) immediately prior to each use; ((and

~~+iv))~~ (d) Written procedures regarding ~~((selection, fitting, issuance, maintenance, cleaning, repair, and testing of respirators, including testing for operability immediately prior to each use, supervision and training of personnel, monitoring, including air sampling and bioassays, and recordkeeping))~~:

(i) Monitoring, including air sampling and bioassays;

(ii) Supervision and training of respirator users;

(iii) Fit testing;

(iv) Respirator selection;

(v) Breathing air quality;

(vi) Inventory and control;

(vii) Storage, issuance, maintenance, repair, testing, and

quality assurance of respiratory protection equipment;

(viii) Recordkeeping; and

(ix) Limitations on periods of respirator use and relief from respirator use; ((and

(v)) (e) Determination by a physician ((prior to initial fitting of respirators, and either every twelve months thereafter or periodically at a frequency determined by a physician,)) that the individual user is medically fit to use ((the)) respiratory protection equipment;

(i) Before the initial fitting of a face sealing respirator;

(ii) Before the first field use of nonface sealing respirators; and

(iii) Either every twelve months thereafter, or periodically at a frequency determined by a physician; and

(f) Fit testing, with a fit factor greater than or equal to ten times the APF for negative pressure devices, and a fit factor greater than or equal to five hundred for any positive pressure, continuous flow, and pressure-demand devices, before the first field use of tight fitting, face sealing respirators, and periodically thereafter at a frequency not to exceed one year. Fit testing must be performed with the facepiece operating in the negative pressure mode.

((c) The licensee shall issue a written policy statement on respirator usage covering:

(i) The use of process or other engineering controls, instead of respirators; and

(ii) The routine, nonroutine, and emergency use of respirators; and

(iii) The length of periods of respirator use and relief from respirator use.

(d)) (3) The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require ((such)) relief.

((e) The licensee shall use equipment within the equipment manufacturer's expressed limitations for type and mode of use and shall provide proper visual, communication, and other special capabilities, such as adequate skin protection, when needed.

(2) When estimating exposure of individuals to airborne radioactive materials, the licensee may make allowance for respiratory protection equipment used to limit intakes pursuant to WAC 246-221-113, provided that the following conditions, in addition to those in subsection (1) of this section, are satisfied:

(a) The licensee selects respiratory protection equipment that provides a protection factor, specified in WAC 246-221-285, greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in WAC 246-221-290, Table I, Column 3. However, if the selection of respiratory protection equipment with a protection factor greater than the peak concentration is inconsistent with the goal specified in WAC 246-221-113 of keeping

~~the total effective dose equivalent ALARA, the licensee may select respiratory protection equipment with a lower protection factor provided that such a selection would result in a total effective dose equivalent that is ALARA. The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in air, during each period of uninterrupted use, by the protection factor. If the exposure is later found to be greater than initially estimated, the corrected value shall be used; if the exposure is later found to be less than initially estimated, the corrected value may be used.~~

~~(b) The licensee shall obtain authorization from the department before assigning respiratory protection factors in excess of those specified in WAC 246-221-285. The department may authorize a licensee to use higher protection factors on receipt of an application that:~~

~~(i) Describes the situation for which a need exists for higher protection factors, and~~

~~(ii) Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.~~

~~(3) In an emergency, the licensee shall use as emergency equipment only respiratory protection equipment that has been specifically certified or had certification extended for emergency use by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration.~~

~~(4) Unless already authorized by license condition, the licensee shall notify the department in writing at least thirty days before the date that respiratory protection equipment is first used pursuant to either subsection (1) or (2) of this section.)~~

(4) The licensee shall also consider limitations appropriate to the type and mode of use. When selecting respiratory devices the licensee shall provide for vision correction, adequate communication, low temperature work environments, and the concurrent use of other safety or radiological protection equipment. The licensee shall use equipment in such a way as not to interfere with the proper operation of the respirator.

(5) Standby rescue persons are required whenever one-piece atmosphere-supplying suits, or any combination of supplied air respiratory protection device and personnel protective equipment are used from which an unaided individual would have difficulty extricating himself or herself. The standby persons must be equipped with respiratory protection devices or other apparatus appropriate for the potential hazards. The standby rescue persons shall observe or otherwise maintain continuous communication with the workers (visual, voice, signal line, telephone, radio, or other suitable means), and be immediately available to assist them in case of a failure of the air supply or for any other reason that requires relief from distress. A sufficient number of standby rescue persons must be immediately available to assist all users of this type of equipment and to provide effective emergency rescue if needed.

(6) Atmosphere-supplying respirators must be supplied with

respirable air of grade D quality or better as defined by the Compressed Gas Association in publication G-7.1, "Commodity Specification for Air," 1997 and included in the regulations of the Occupational Safety and Health Administration (29 CFR 1910.134 (i)(1)(ii)(A) through (E)). Grade D quality air criteria include:

(a) Oxygen content (v/v) of 19.5-23.5%;

(b) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

(c) Carbon monoxide (CO) content of 10 ppm or less;

(d) Carbon dioxide content of 1,000 ppm or less; and

(e) Lack of noticeable odor.

(7) The licensee shall ensure that no objects, materials or substances, such as facial hair, or any conditions that interfere with the face-to-facepiece seal or valve function, and that are under the control of the respirator wearer, are present between the skin of the wearer's face and the sealing surface of a tight-fitting respirator facepiece.

(8) In estimating the dose to individuals from intake of airborne radioactive materials, the concentration of radioactive material in the air that is inhaled when respirators are worn is initially assumed to be the ambient concentration in air without respiratory protection, divided by the assigned protection factor. If the dose is later found to be greater than the estimated dose, the corrected value must be used. If the dose is later found to be less than the estimated dose, the corrected value may be used.

(9) The department may impose restrictions in addition to the provisions of this section, WAC 246-221-113 and 246-221-285, in order to:

(a) Ensure that the respiratory protection program of the licensee is adequate to limit doses to individuals from intakes of airborne radioactive materials consistent with maintaining total effective dose equivalent ALARA; and

(b) Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

(10) The licensee shall obtain authorization from the department before using assigned protection factors in excess of those specified in WAC 246-221-285. The department may authorize a licensee to use higher assigned protection factors on receipt of an application that:

(a) Describes the situation for which a need exists for higher protection factors; and

(b) Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

**WAC 246-221-230 Records important to radiation safety.** (1) Each licensee or registrant shall make and retain records of activities, program reviews, measurements, and calculations which may be necessary to determine the extent of occupational and public exposure from sources of radiation under the control of the licensee or registrant.

(2) Each record required by this section shall be legible throughout the specified retention period.

(3) Each licensee or registrant shall use the SI units: Becquerel, gray, sievert and coulomb per kilogram, or the special units: Curie, rad, rem, and roentgen, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by these regulations.

(4) The licensee or registrant shall make a clear distinction among the quantities entered on the records required by these regulations such as, total effective dose equivalent, total organ dose equivalent, shallow dose equivalent, ((eye)) lens dose equivalent, deep dose equivalent, or committed effective dose equivalent.

(5) Records which must be maintained ((pursuant to)) under this part shall be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by department regulations. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Electronic media data storage systems shall incorporate standard or universally recognized security measures. Records, such as letters, drawings, and specifications, shall include all pertinent information, such as stamps, initials, and signatures.

(6) The licensee shall maintain adequate safeguards against tampering with and loss of records.

(7) The licensee or registrant shall retain the following required records until the department terminates each pertinent license or registration requiring the record, and upon termination of the license or registration, the licensee or registrant shall store for at least thirty years:

(a) Records of prior occupational dose and exposure history as recorded on department Form RHF-4 or RHF-4A, or equivalent;

(b) Records on department Form RHF-5 or RHF-5A, or equivalent, of doses received by all individuals for whom monitoring was required pursuant to WAC 246-221-090 and 246-221-100;

(c) Records of doses received during planned special exposures, accidents, and emergency conditions;

(d) The specific information used to calculate the committed effective dose equivalent pursuant to WAC 246-221-040(3);

(e) Records of the results of surveys to determine the dose from external sources of radiation used, in the absence of or in

combination with individual monitoring data, in the assessment of individual dose equivalents;

(f) Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose;

(g) Records showing the results of air sampling, surveys, and bioassays required pursuant to WAC 246-221-117 (1)(b)(i) and (ii);

(h) Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

(8) The licensee or registrant shall retain the following records until the department terminates the pertinent license or registration requiring the record:

(a) Records of waste disposal made under the provisions of WAC 246-221-180, 246-221-190, 246-221-210 and 246-221-220, chapter 246-249 WAC, and any burials in soil as previously authorized;

(b) Records of dose to individual members of the public as required by WAC 246-221-060(4);

(c) Records of the provisions of the radiation protection program as required by WAC 246-221-005.

(9) The licensee or registrant shall retain the following records for three years after the record is made:

(a) Records of testing entry control devices for very high radiation areas as required by WAC 246-221-106(3);

(b) Records used in preparing department Form RHF-4 or RHF-4A;

(c) Records showing the results of general surveys required by WAC 246-221-110 and package surveys required by WAC 246-221-160;

(d) Records of calibrations required by WAC 246-221-110;

(e) Records of program audits and other reviews of the content and implementation of the radiation protection program required by WAC 246-221-005;

(f) Records of waste disposal by decay in storage.

(10) If there is a conflict between the department's regulations in this part, license condition, or other written department approval or authorization pertaining to the retention period for the same type of record, the retention period specified in the regulations in this part for such records shall apply unless the department, (~~pursuant to~~) under WAC 246-220-050, has granted a specific exemption from the record retention requirements specified in the regulations in this part.

(11) The discontinuance or curtailment of activities does not relieve the licensee or registrant of responsibility for retaining all records required by this section.

AMENDATORY SECTION (Amending WSR 98-13-037, filed 6/8/98, effective 7/9/98)

**WAC 246-221-250 Notification of incidents. (1) Immediate**

**notification.** Notwithstanding other requirements for notification, each licensee and/or registrant shall immediately (as soon as possible but no later than four hours after discovery of an incident) notify the State Department of Health, Division of Radiation Protection, P.O. Box 47827, Olympia, Washington 98504-7827, by telephone (206/682-5327) and confirming letter, telegram, mailgram, or facsimile of any incident involving any radiation source which may have caused or threatens to cause:

(a) An individual to receive:

(i) A total effective dose equivalent of 0.25 Sv (25 rem) or more; ((or))

(ii) ((An-eye)) A lens dose equivalent of 0.75 Sv (75 rem) or more; or

(iii) A shallow dose equivalent to the skin or extremities or a total organ dose equivalent of 2.5 Sv (250 rem) or more; ((or))

(b) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for twenty-four hours, the individual could have received an intake five times the occupational ALI. This provision does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures; or

(c) The loss of ability to take immediate protective actions necessary to avoid exposure to sources of radiation or releases of radioactive material that could exceed regulatory limits. Events which could cause such a loss of ability include fires, explosions, toxic gas releases, etc.

(2) **Twenty-four hour notification.** Each licensee and/or registrant shall within twenty-four hours of discovery of the event, notify the State Department of Health, Division of Radiation Protection, P.O. Box 47827, Olympia, Washington 98504-7827, by telephone (206/682-5327) and confirming letter, telegram, mailgram, or facsimile of any incident involving any radiation source possessed which may have caused or threatens to cause:

(a) An individual to receive, in a period of twenty-four hours:

(i) A total effective dose equivalent exceeding 0.05 Sv (5 rem); ((or))

(ii) ((An-eye)) A lens dose equivalent exceeding 0.15 Sv (15 rem); or

(iii) A shallow dose equivalent to the skin or extremities or a total organ dose equivalent exceeding 0.5 Sv (50 rem); ((or))

(b) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for twenty-four hours, the individual could have received an intake in excess of one occupational ALI. This provision does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures; ((or))

(c) An unplanned contamination incident that:

(i) Requires access to the contaminated area, by workers or the general public, to be restricted for more than twenty-four hours by imposing additional radiological controls or by prohibiting entry into the area;

(ii) Involves a quantity of material greater than five times the lowest annual limit on intake specified in WAC 246-221-290; and

(iii) Has access to the area restricted for a reason other than to allow radionuclides with a half-life of less than twenty-four hours to decay prior to decontamination; ~~((or))~~

(d) Equipment failure or inability to function as designed when:

(i) The equipment is required by regulation or license condition to prevent releases exceeding regulatory limits, to prevent exposures to radiation and radioactive material exceeding regulatory limits or to mitigate the consequences of an accident;

(ii) The equipment is required to be available and operable at the time it becomes disabled or fails to function; and

(iii) No redundant equipment is available and operable to perform the required safety functions; ~~((or))~~

(e) An unplanned medical treatment at a medical facility of an individual with spreadable radioactive contamination on the individual's clothing or body; or

(f) An unplanned fire or explosion damaging any radioactive material or any device, container or equipment containing radioactive material when:

(i) The quantity of radioactive material involved is greater than five times the lowest annual limit on intake specified in WAC 246-221-290; and

(ii) The damage affects the integrity of the radioactive material or its container.

(3) For each occurrence requiring notification pursuant to this section, a prompt investigation of the situation shall be initiated by the licensee/registrant. A written report of the findings of the investigation shall be sent to the department within thirty days.

(4) The licensee or registrant shall prepare each report filed with the department ~~((pursuant to))~~ under this section so that names of individuals who have received exposure to sources of radiation are stated in a separate and detachable portion of the report.

Any report filed with the department ~~((pursuant to))~~ under this section shall contain the information described in WAC 246-221-260 (2) and (3).

(5) The provisions of this section do not apply to doses that result from planned special exposures, provided such doses are within the limits for planned special exposures and are reported pursuant to WAC 246-221-265.

(6) Telephone notifications that do not involve immediate or twenty-four hour notification ~~((shall not be made to the emergency number (Seattle 206/682-5327). Routine calls))~~ should be made to the Olympia office (360 236-3300).

(7) Telephone notification required under this section shall include, to the extent that the information is available at the time of notification:

(a) The caller's name and call-back telephone number;

(b) A description of the incident including date and time;

(c) The exact location of the incident;

- (d) The radionuclides, quantities, and chemical and physical forms of the radioactive materials involved; and
- (e) Any personnel radiation exposure data available.

AMENDATORY SECTION (Amending WSR 94-01-073, filed 12/9/93, effective 1/9/94)

WAC 246-221-285 Assigned protection factors for respirators.  
 ((1) ~~The licensee may use the following information in the selection of respiratory protective equipment to be used only where the contaminants have been identified and the concentration, or possible concentrations, are known.~~

Protection Factors <sup>1</sup>		Tested & Certified Equipment		
Description <sup>2</sup>	Modes <sup>3</sup>	Particu- lates only	Particu- lates; gases; vapors <sup>5</sup>	NIOSH & MSHA <sup>4</sup> tests for permissibility

I. AIR-PURIFYING RESPIRATORS<sup>6</sup>

Facepiece, half-mask <sup>7</sup>	NP	10		30 CFR II,
Facepiece, full	NP	50		Subpart K.
Facepiece, half-mask, full, or hood	PP	1000		

II. ATMOSPHERE-SUPPLYING RESPIRATORS

1. Air-line respirator

Facepiece, half-mask	CF		1000	
Facepiece, half-mask	D		5	
Facepiece, full	CF		2000	
Facepiece, full	D		5	30 CFR II,
Facepiece, full	PD		2000	Subpart J.
Hood <sup>8</sup>	CF			
Suit <sup>9,10</sup>	CF			

2. Self-contained  
 —breathing apparatus  
 —(SCBA)

Facepiece, full	D		50	
Facepiece, full	PD		10,000 <sup>11</sup>	30 CFR II,
Facepiece, full	RD		50	Subpart H.
Facepiece, full	RP		5000 <sup>12</sup>	

III. COMBINATION RESPIRATORS

Protection Factors <sup>1</sup>	Tested & Certified Equipment		
Description <sup>2</sup>	Modes <sup>3</sup>	Particulate only	Particulate gases; vapors <sup>5</sup>
			MSHA <sup>4</sup> tests for permissibility
Any combination of air-purifying and atmosphere-supplying respirators	Protection factor for type and mode of operation as listed above	30 CFR 11, Sec. 11.63(f)	

#### FOOTNOTES

1. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment, usually inside the facepiece, under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

The protection factors apply:

a. Only for individuals trained in using respirators and wearing properly fitted respirators that are used and maintained under supervision in a well-planned respiratory protective program.

b. For air-purifying respirators only when high efficiency particulate filters; above 99.97% removal efficiency by thermally generated 0.3 µm diethyl phthalate (DEHP) test or equivalent; are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor-respiratory hazards.

c. No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

d. For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration certification described in 30 CFR 11. Oxygen and air shall not be used in the same apparatus.

2. Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. Hoods and suits are excepted.

3. The mode symbols are defined as follows:

C \_\_\_\_\_ E \_\_\_\_\_

continuous flow

D \_\_\_\_\_

demand

N \_\_\_\_\_ P \_\_\_\_\_

negative pressure, that is, negative phase during inhalation

P \_\_\_\_\_ D \_\_\_\_\_

pressure demand, that is, always positive pressure

P \_\_\_\_\_ P \_\_\_\_\_

positive pressure

R \_\_\_\_\_ D \_\_\_\_\_

demand, recirculating or closed circuit

R \_\_\_\_\_ P \_\_\_\_\_

pressure demand, recirculating or closed circuit

~~4~~ NIOSH & MSHA are the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration.

~~5~~ Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of less than two is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for respiratory protective equipment is five, the effective protection factor for tritium is about 1.4, with protection factors of ten, the effective factor for tritium oxide is about 1.7, and with protection factors of one hundred or more, the effective factor for tritium oxide is about 1.9. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote 9 concerning supplied-air suits.

~~6~~ Canisters and cartridges shall not be used beyond service-life limitations.

~~7~~ Under-chin type only. This type of respirator is not satisfactory for use where it might be possible, if an accident or emergency were to occur, for the ambient airborne concentrations to reach instantaneous values greater than ten times the pertinent values in Table 1, Column 3 of WAC 246-221-290. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask is to be tested for fit prior to use, each time it is donned.

~~8~~ Equipment shall be operated in a manner that ensures that proper air flow rates are maintained. A protection factor of no more than one thousand may be utilized for tested and certified supplied-air hoods when a minimum air flow of six cubic feet per minute ( $0.17 \text{ m}^3/\text{min}$ ) is maintained and calibrated air line pressure gauges or flow measuring devices are used. A protection factor of up to two thousand may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment; this rate is greater than six cubic feet per minute ( $0.17 \text{ m}^3/\text{min}$ ) and calibrated air line pressure gauges or flow measuring devices are used.

The design of the supplied-air hood or helmet, with a minimum flow of six cubic feet per minute ( $0.17 \text{ m}^3/\text{min}$ ) of air, may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands over head. This aspiration may be overcome if a short cap or the extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres. See footnote 9.

~~9~~ Appropriate protection factors shall be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with a respirator or other apparatus appropriate for the potential hazards and communications equipment whenever supplied-air suits are used.

~~1~~ No approval schedules are currently available for this equipment. Equipment is to be evaluated by testing or on the basis of reliable test information.

~~1~~ This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure, such as skin absorption, must be taken into account in such circumstances.

~~1~~ Quantitative fit testing shall be performed on each individual, and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer.

~~(2) The licensee may use protection factors for respirators~~

~~approved by the United States Bureau of Mines and the National Institute for Occupational Safety and Health, according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, to the extent that they do not exceed the protection factors listed in the table given in subsection (1) of this section. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances should take into account applicable approvals of the United States Bureau of Mines and the National Institute for Occupational Safety and Health.~~

~~(3) The licensee should also be aware that the concentration values in Table I, Column 3 of WAC 246-221-290 are based on internal dose due to inhalation, and that radioactive contaminants may present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.)~~

	<u>Operating mode</u>	<u>Assigned Protection Factors</u>
<u>I. Air-Purifying Respirators (Particulate<sup>b</sup> only):</u>		
<u>Filtering facepiece disposable<sup>d</sup></u>	<u>Negative Pressure . . . . .</u>	<u>(<sup>d</sup>)</u>
<u>Facepiece, half<sup>e</sup> . . . . .</u>	<u>Negative Pressure . . . . .</u>	<u>10</u>
<u>Facepiece, full . . . . .</u>	<u>Negative Pressure . . . . .</u>	<u>100</u>
<u>Facepiece, half . . . . .</u>	<u>Powered air-purifying respirators</u>	<u>50</u>
<u>Facepiece, full . . . . .</u>	<u>Powered air-purifying respirators</u>	<u>1000</u>
<u>Helmet/hood . . . . .</u>	<u>Powered air-purifying respirators</u>	<u>1000</u>
<u>Facepiece, loose-fitting . . . . .</u>	<u>Powered air-purifying respirators</u>	<u>25</u>
<u>II. Atmosphere-Supplying Respirators (Particulate, gases and vapors<sup>f</sup>):</u>		
<u>1. Air-line respirator:</u>		
<u>Facepiece, half . . . . .</u>	<u>Demand . . . . .</u>	<u>10</u>
<u>Facepiece, half . . . . .</u>	<u>Continuous Flow . . . . .</u>	<u>50</u>
<u>Facepiece, half . . . . .</u>	<u>Pressure Demand . . . . .</u>	<u>50</u>
<u>Facepiece, full . . . . .</u>	<u>Demand . . . . .</u>	<u>100</u>
<u>Facepiece, full . . . . .</u>	<u>Continuous Flow . . . . .</u>	<u>1000</u>
<u>Facepiece, full . . . . .</u>	<u>Pressure Demand . . . . .</u>	<u>1000</u>
<u>Helmet/hood . . . . .</u>	<u>Continuous Flow . . . . .</u>	<u>1000</u>
<u>Facepiece, loose-fitting . . . . .</u>	<u>Continuous Flow . . . . .</u>	<u>25</u>
<u>Suit . . . . .</u>	<u>Continuous Flow . . . . .</u>	<u>(<sup>g</sup>)</u>
<u>2. Self-contained breathing apparatus (SCBA):</u>		
<u>Facepiece, full . . . . .</u>	<u>Demand . . . . .</u>	<u><sup>h</sup>100</u>
<u>Facepiece, full . . . . .</u>	<u>Pressure Demand . . . . .</u>	<u><sup>h</sup>10,000</u>
<u>Facepiece, full . . . . .</u>	<u>Demand, Recirculating . . . . .</u>	<u><sup>h</sup>100</u>
<u>Facepiece, full . . . . .</u>	<u>Positive Pressure Recirculating . . . . .</u>	<u><sup>h</sup>10,000</u>
<u>III. Combination Respirators:</u>		

Any combination of air-purifying and atmosphere-supplying respirators.

Assigned protection factor for type and mode of operation as listed above.

- <sup>a</sup> These assigned protection factors apply only in a respiratory protection program that meets the requirements of this chapter. They are applicable only to airborne radiological hazards and may not be appropriate to circumstances when chemical or other respiratory hazards exist instead of, or in addition to, radioactive hazards. Selection and use of respirators for these circumstances must also comply with Department of Labor regulations. Radioactive contaminants for which the concentration values in Table 1, Column 3 of WAC 246-221-290, Appendix A, are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.
- <sup>b</sup> Air-purifying respirators with APF <100 must be equipped with particulate filters that are at least 95 percent efficient. Air-purifying respirators with APF = 100 must be equipped with particulate filters that are at least 99 percent efficient. Air-purifying respirators with APFs >100 must be equipped with particulate filters that are at least 99.97 percent efficient.
- <sup>c</sup> The licensee may apply to the department for the use of an APF greater than 1 for sorbent cartridges as protection against airborne radioactive gases and vapors (e.g., radioiodine).
- <sup>d</sup> Licensees may permit individuals to use this type of respirator who have not been medically screened or fit tested on the device provided that no credit be taken for their use in estimating intake or dose. It is also recognized that it is difficult to perform an effective positive or negative pressure preuse user seal check on this type of device. All other respiratory protection program requirements listed in WAC 246-221-117 apply. An assigned protection factor has not been assigned for these devices. However, an APF equal to 10 may be used if the licensee can demonstrate a fit factor of at least 100 by use of a validated or evaluated, qualitative or quantitative fit test.
- <sup>e</sup> Under-chin type only. No distinction is made in this section between elastomeric half-masks with replaceable cartridges and those designed with the filter medium as an integral part of the facepiece (e.g., disposable or reusable disposable). Both types are acceptable so long as the seal area of the latter contains some substantial type of seal-enhancing material such as rubber or plastic, the two or more suspension straps are adjustable, the filter medium is at least 95 percent efficient and all other requirements of this part are met.
- <sup>f</sup> The assigned protection factors for gases and vapors are not applicable to radioactive contaminants that present an absorption or submersion hazard. For tritium oxide vapor, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of 3 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. Exposure to radioactive noble gases is not considered a significant respiratory hazard, and protective actions for these contaminants should be based on external (submersion) dose considerations.
- <sup>g</sup> No NIOSH approval schedule is currently available for atmosphere-supplying suits. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements, with the exception of fit testing, are met (i.e., WAC 246-221-117).
- <sup>h</sup> The licensee should implement institutional controls to assure that these devices are not used in areas immediately dangerous to life or health (IDLH).
- <sup>i</sup> This type of respirator may be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances. This device may not be used by any individual who experiences perceptible outward leakage of breathing gas while wearing the device.

AMENDATORY SECTION (Amending Order 121, filed 12/27/90, effective 1/31/91)

**WAC 246-244-070 Radiation survey instruments.** (1) The licensee or registrant shall maintain and use sufficient calibrated and operable radiation survey instruments at each field station and temporary job site to make physical radiation surveys as required. Instrumentation shall be capable of measuring (~~(0.1 milliroentgen)~~) 0.001 mSv (0.1 millirem) per hour through at least (~~(100 milliroentgens)~~) 0.5 mSv (50 millirem) per hour.

(2) Each radiation survey instrument shall be calibrated:

(a) At intervals not to exceed six months and after each instrument servicing;

(b) At energies and radiation levels appropriate for use;

(c) At two points located approximately one-third and two-thirds at full scale on each scale (for logarithmic scale, at midrange of each decade, and at two points of at least one decade); and

(d) Such that accuracy within  $\pm 20$  percent of the true radiation levels can be demonstrated on each scale.

(3) Each licensee shall have available additional calibrated and operable radiation detection instruments capable of detecting radiation and contamination levels that could be encountered during well-logging operations or during the event of an accident, e.g., an alpha meter in case of Am-241 source rupture, a contamination meter and probe, and a high level meter capable of detecting radiation levels up to at least one roentgen per hour. The licensee may own such instruments or may make prior arrangements to obtain them expeditiously from a second party as necessary.

(4) Calibration records shall be maintained for a period of at least three years for inspection by the department.