

Occupational dose limits.

- (A) Except in the case of a planned special exposure pursuant to paragraph (F) of this rule, a licensee or registrant shall limit the occupational dose received by an individual adult, as follows:
- (1) An annual limit, which is the more limiting of:
 - (a) The total effective dose equivalent being equal to 0.05 sievert (five rem); or
 - (b) 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 0.5 sievert (fifty rem).
 - (2) The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:
 - (a) A lens dose equivalent of 0.15 sievert (fifteen rem), and
 - (b) A shallow-dose equivalent of 0.5 sievert (fifty rem) to the skin of the whole body or to the skin of any extremity.
 - (3) Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current calendar year and during the individual's lifetime in accordance with paragraph (F)(5) of this rule.
 - (4) When the external exposure is determined by measurement with an external personal monitoring device, the deep-dose equivalent must be used in place of the effective dose equivalent, unless the effective dose equivalent is determined by a dosimetry method approved by the director. The assigned deep-dose equivalent must be for the part of the body receiving the highest exposure.
 - (a) The assigned shallow-dose equivalent must be the dose averaged over the contiguous ten square centimeters of skin receiving the highest exposure. The deep-dose equivalent, lens-dose equivalent, and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable; or
 - (b) When a protective apron is worn while working with radiation-generating equipment and monitoring is conducted as specified in paragraph (C)(1) of rule 3701:1-38-14 of the Administrative Code, the effective dose equivalent for external radiation shall be determined as follows:
 - (i) When only one individual monitoring device is used and it is located at the neck outside the protective apron, the reported deep dose

equivalent value multiplied by 0.3 shall be the effective dose equivalent for external radiation; or

(ii) When two individual monitoring devices are worn, one under the protective apron at the waist and the other outside the protective apron at the neck, the effective dose equivalent for external radiation shall be assigned the value of the sum of the deep dose equivalent reported for the individual monitoring device located at the waist under the protective apron multiplied by 1.5 and the deep dose equivalent reported for the individual monitoring device located at the neck outside the protective apron multiplied by 0.04; or

(iii) Through the use of computational methods endorsed by the "American National Standards Institute", recommended by the "National Council on Radiation Protection and Measurements", or approved by the director.

(5) Derived air concentration (DAC) and annual limit on intake (ALI) values are specified in appendix C to this rule and may be used by the licensee to determine the individual's dose and to demonstrate compliance with the occupational dose limits. Appendices A and B are explanatory supplements to appendix C to this rule. Notwithstanding the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to ten milligrams in a week in consideration of chemical toxicity.

(6) In accordance with paragraph (E) of this rule, 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.

(B) Compliance with requirements for summation of external and internal doses shall be in accordance with the following:

(1) If the licensee is required to monitor under both paragraphs (B)(1) and (B)(2) of rule 3701:1-38-14 of the Administrative Code, the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee is required to monitor only under paragraph (B)(1) or only under paragraph (B)(2) of rule 3701:1-38-14 of the Administrative Code, 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 by meeting one of the conditions specified in paragraph (B)(2) of this rule and the conditions in paragraphs (B)(3) and (B)(4) of this rule. 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) 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, plus 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, or 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 per cent of the maximum weighted value of $H_{T,50}$, that is, $W_T H_{T,50}$, per unit intake for any organ or tissue.
- (3) 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 set forth in paragraph (A) of this rule.
- (4) 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 further evaluated or accounted for pursuant to this paragraph.
- (C) Determination of external dose from airborne radioactive material shall be in accordance with the following:
- (1) When determining the dose from airborne radioactive material, the licensee shall include the contribution to the deep dose equivalent, lens dose equivalent, and shallow dose equivalent from external exposure to the radioactive cloud as specified in appendix C to this rule, footnotes ^A and ^B.
 - (2) The licensee should not use airborne radioactivity measurements or DAC values 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 should be based upon measurements using instruments or individual monitoring devices.
- (D) Determination of internal exposure shall be in accordance with the following:
- (1) For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under paragraph (B) of rule 3701:1-38-14 of the Administrative Code, take suitable and timely measurements of:
 - (a) Concentrations of radioactive materials in air in work areas; or
 - (b) Quantities of radionuclides in the body; or
 - (c) Quantities of radionuclides excreted from the body; or

- (d) Combinations of these measurements.
- (2) Unless respiratory protective equipment is used, as provided in paragraph (C) of rule 3701:1-38-16 of the Administrative Code or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.
 - (3) When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual is known, the licensee may:
 - (a) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and
 - (b) Upon prior approval of the department, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material, for example, aerosol size distribution or density; and
 - (c) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide to the committed effective dose equivalent as specified in appendix A to this rule.
 - (4) If the licensee chooses to assess intakes of Class Y material using the measurements given in paragraph (D)(1)(b) or (D)(1)(c) of this rule in order to make additional measurements basic to the assessments, the licensee may delay the recording and reporting of the assessments for periods up to seven months, unless otherwise required by paragraph (B)(2) or (C) of rule 3701:1-38-21 of the Administrative Code.
 - (5) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours shall be either:
 - (a) The sum of the ratios of the concentration to the appropriate DAC value, that is, D, W, or Y, from appendix C to this rule for each radionuclide in the mixture; or
 - (b) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.
 - (6) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.
 - (7) When a mixture of radionuclides in air exists, a licensee may disregard certain radionuclides in the mixture if all of the following occur:
 - (a) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in paragraph (A) of this rule and in

complying with the monitoring requirements in paragraph (B) of rule 3701:1-38-14 of the Administrative Code;

- (b) The concentration of any radionuclide disregarded is less than ten percent of its DAC; and
 - (c) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed thirty percent.
- (8) When determining the committed effective dose equivalent, the licensee may consider the following:
- (a) In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of two thousand DAC-hours, results in a committed effective dose equivalent of 0.05 sievert (five rem), for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent; or
 - (b) For an ALI and the associated DAC determined by the nonstochastic organ dose limit of 0.5 sievert (fifty rem), the intake of radionuclides that would result in a committed effective dose equivalent of 0.05 sievert (five rem), that is, the stochastic ALI, is listed in parentheses in table I of appendix C to this rule. The licensee may, as a simplifying assumption, use the stochastic ALI to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALI, the licensee shall also demonstrate that the limit in paragraph (A)(1)(b) of this rule is met.
- (E) Determination of prior occupational dose shall be made in accordance with the following:
- (1) For each individual who is likely to receive an annual occupational dose requiring monitoring pursuant to paragraph (B) of rule 3701:1-38-14 of the Administrative Code, the licensee or registrant shall determine the occupational radiation dose received during the current year.
 - (2) Prior to permitting an individual to participate in a planned special exposure, the licensee shall determine:
 - (a) The internal and external doses from all previous planned special exposures; and
 - (b) All doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual.
 - (3) In complying with the requirements of paragraph (E)(1) or (E)(2) of this rule, a licensee or registrant may:
 - (a) Accept, as a record of the occupational dose that the individual received during the current year, a written signed statements from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount

of any occupational dose that the individual may have received during the current year;

- (b) Accept, as the record of lifetime cumulative radiation dose, a current department form entitled "lifetime occupational exposure history" or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant; and
 - (c) Obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, e-mail or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.
- (4) The licensee or registrant shall record the exposure history, as required by paragraph (A) of this rule, on a form provided by the department or other clear and legible record, of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing the exposure history form. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on the exposure history form indicating the periods of time for which data are not available.
- (5) If the licensee or registrant is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall assume:
- (a) In establishing administrative controls pursuant to paragraph (A)(6) of this rule for the current year, that the allowable dose limit for the individual is reduced by 12.5 millisievert (1.25 rem), for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and
 - (b) That the individual is not available for planned special exposures.
- (6) The licensee or registrant shall retain the records on the exposure history form until the department terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain records used in preparing the exposure history form for three years after the record is made.
- (F) A planned special exposure may be authorized by a licensee in accordance with this paragraph. A licensee may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in paragraph (A) of this rule provided that each of the following is satisfied:

- (1) The licensee authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the higher exposure are unavailable or impractical;
 - (2) The licensee and employer, if the employer is not the licensee, specifically authorizes the planned special exposure, in writing, before the exposure occurs;
 - (3) Before a planned special exposure, the licensee 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 ascertains prior doses as required by paragraph (E)(2) of this rule during the lifetime of the individual for each individual involved;
 - (5) The licensee 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 paragraph (A) of this rule in any calendar year; and
 - (b) Five times the annual dose limits specified in paragraph (A) of this rule during the individual's lifetime;
 - (6) The licensee maintains records of the conduct of a planned special exposure in accordance with paragraph (E) of rule 3701:1-38-20 of the Administrative Code and submits a written report in accordance with paragraph (D) of rule 3701:1-38-21 of the Administrative Code;
 - (7) The licensee 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 paragraph (A)(1) of this rule, but shall be included in evaluations required by paragraphs (F)(4) and (F)(5) of this rule.
- (G) Occupational dose limits for minors shall be ten per cent of the annual occupational dose limits specified for adult workers in paragraph (A) of this rule.
- (H) Dose equivalent to an embryo or fetus shall be in accordance with the following:

- (1) The licensee or registrant shall ensure that the dose equivalent to an embryo or fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed five millisievert (0.5 rem). Records shall be maintained in accordance with paragraph (I) of rule 3701:1-38-20 of the Administrative Code.
- (2) The licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (H)(1) of this rule.
- (3) The dose equivalent to the embryo or fetus is the sum of:
 - (a) The deep-dose equivalent to the declared pregnant woman; and
 - (b) The dose equivalent to the embryo or fetus resulting from radionuclides in the embryo or fetus and from radionuclides in the declared pregnant woman.
- (4) If the declared pregnant woman's exposure includes exposure from radiation generating equipment and a protective apron is worn, the dose equivalent to an embryo or fetus shall be taken as the sum of:
 - (a) The dose equivalent to the embryo or fetus from radionuclides in the embryo or fetus and radionuclides in the declared pregnant woman; and
 - (b) The dose equivalent that is most representative of the dose to the embryo or fetus from external radiation, that is, in the mother's lower torso region.
 - (i) If multiple measurements have not been made, assignment of the highest deep dose equivalent for the declared pregnant woman shall be the dose to the embryo or fetus, in accordance with paragraph (A)(4) of this rule; or
 - (ii) If multiple measurements have been made, assignment of the deep dose equivalent for the declared pregnant woman from the individual monitoring device which is most representative of the dose to the embryo or fetus shall be the dose to the embryo or fetus. Assignment of the highest deep dose equivalent for the declared pregnant woman to the embryo or fetus is not required unless that dose is also the most representative deep dose equivalent for the region of the embryo or fetus.
- (5) If by the time the woman declares pregnancy to the licensee or registrant, the dose equivalent to the embryo or fetus has exceeded five millisievert, or 0.5 rem, the licensee or registrant shall be deemed to be in compliance with paragraph (A) of this rule, provided that the additional dose equivalent to the embryo or fetus does not exceed 0.5 millisievert (0.05 rem), during the remainder of the pregnancy.

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