PART 835-OCCUPATIONAL RADIATION PROTECTION

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Subpart A-General Provisions

§ 835.1 Scope.

(a) General. The rules in this part establish radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities.

(b) Exclusion. The requirements in this part do not apply to:

1. Activities that are regulated through a license by the Nuclear Regulatory Commission or a State under an Agreement with the Nuclear Regulatory Commission, including activities certified by the Nuclear Regulatory Commission under section 1701 of the Atomic Energy Act;
2. Activities conducted under the authority of the Director, Naval Nuclear Propulsion Program, as described in Pub. L. 98- 525;
3. Activities conducted under the Nuclear Explosives and Weapons Safety Program relating to the prevention of accidental or unauthorized nuclear detonations; or
4. Background radiation, radiation doses received as a patient for the purposes of medical diagnosis or therapy, or radiation doses received from voluntary participation in medical research programs.

§ 835.2 Definitions.

(a) As used in this part:

Airborne radioactive material or airborne radioactivity means radioactive material in any chemical or physical form that is dissolved, mixed, suspended, or otherwise entrained in

air.

Airborne radioactivity area means any area where the measured concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed 10 percent of the derived air concentration (DAC) values listed in appendix A or appendix C of this part.

ALARA means "As Low As is Reasonably Achievable", which is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this part, ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits of this part as is reasonably achievable.

Ambient air means the general air in the area of interest (e.g., the general room atmosphere), as distinct from a specific stream or volume of air that may have different properties.

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 (ICRP Publication 23) that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue. ALI values for intake by ingestion and inhalation of selected radionuclides are based on Table 1 of the U.S. Environmental Protection Agency's Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, published September 1988. This document is available from the National Technical Information Service, Springfield, VA.

Background means radiation from:

(i) Naturally occurring radioactive materials which have not been technologically enhanced;

(ii) Cosmic sources;

(iii) Global fallout as it exists in the environment (such as from the testing of nuclear explosive devices);

(iv) Radon and its progeny in concentrations or levels existing in buildings or the environment which have not been elevated as a result of current or prior activities; and

(v) Consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation.

Bioassay means the determination of kinds, quantities, or concentrations, and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis, and evaluation of radioactive materials excreted or removed from the human body.

Calibration means to adjust and/or determine either:

(i) The response or reading of an instrument relative to a standard (e.g., primary, secondary, or tertiary) or to a series of conventionally true values; or

(ii) The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value.

Contamination area means any area where contamination levels are greater than the values specified in appendix D of this part, but less than or equal to 100 times those levels.

Continuous air monitor (CAM) means an instrument that continuously samples and measures the levels of airborne radioactive materials on a "real-time" basis and has alarm capabilities at preset levels.

Contractor means any entity under contract with the Department of Energy with the responsibility to perform activities at a DOE site or facility.

Controlled area means any area to which access is managed in order to protect individuals from exposure to radiation and/or radioactive material. Individuals who enter only the controlled area without entering radiological areas are not expected to receive a total effective dose equivalent of more than 100 mrem (0.001 sievert) in a year.

Declared pregnant worker means a woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to the occupational exposure limits to the embryo/fetus as provided in § 835.206. This declaration may be revoked, in writing, at any time by the declared pregnant worker.

Derived air concentration (DAC) means, for the radionuclides listed in appendix A of this part, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2000 hours (assuming a breathing volume of 2400 m^3). For the radionuclides listed in appendix C of this part, the air immersion DACs were calculated for a continuous, non-shielded exposure via immersion in a semi-infinite atmospheric cloud. The value is based upon the derived airborne concentration found in Table 1 of the U.S. Environmental Protection Agency's Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, published September 1988. This document is available from the National Technical Information Service, Springfield, VA.

DOE activities means an activity taken for or by the DOE that has the potential to result in the occupational exposure of an individual to radiation or radioactive material. The activity may be, but is not limited to, design, construction, operation, or decommissioning. To the extent appropriate, the activity may involve a single DOE facility or operation or a combination of facilities and operations, possibly including an entire site.

Entrance or access point means any location through which an individual could gain access to areas controlled for the purposes of radiation protection. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

General employee means an individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or a visitor who performs work for or in conjunction with DOE or utilizes DOE facilities.

High contamination area means any area where contamination levels are greater than 100 times the values specified in appendix D of this part.

High radiation area means any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 sievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Individual means any human being.

Member of the public means an individual who is not occupationally exposed to radiation or radioactive material. An individual is not a "member of the public" during any period in which the individual receives occupational exposure.

Minor means an individual less than 18 years of age.

Monitoring means actions intended to detect and quantify radiological conditions.

Nonstochastic effects means effects due to radiation exposure for which the severity varies with the dose and for which a threshold normally exists (e.g., radiation-induced opacities within the lens of the eye).

Occupational exposure means an individual's exposure to ionizing radiation (external and internal) as a result of that individual's work assignment. Occupational exposure does not include planned special exposures, exposure received as a medical patient, background radiation, or voluntary participation in medical research programs.

Person means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency, any State or political subdivision of, or any political entity within a State, any foreign government or nation or other entity, and any legal successor, representative, agent or agency of the foregoing; provided that

person does not include the Department or the United States Nuclear Regulatory Commission.

Radiation means ionizing radiation: alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation as used in this part, does not include non-ionizing radiation, such as radio- or micro-waves, or visible, infrared, or ultraviolet light.

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

Radiological area means any area within a controlled area which must be posted as a "radiation area," "high radiation area," "very high radiation area," "contamination area," "high contamination area," or "airborne radioactivity area" in accordance with § 835.603.

Radiological worker means a general employee whose job assignment involves operation of radiation producing devices or working with radioactive materials, or who is likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year total effective dose equivalent.

Representative, as applied to the sampling of radioactive material, means sampling in such a manner that the sample closely approximates both the amount of activity and the physical and chemical properties of the material (e.g., particle size and solubility in the case of air sampling of the aerosol to which workers may be exposed).

Stochastic effects means malignant and hereditary diseases for which the probability of an effect occurring, rather than its severity, is regarded as a function of dose without a threshold for radiation protection purposes.

Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Very high radiation area means any area accessible to individuals in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

Year means the period of time beginning on or near January 1 used to determine compliance with the provisions of this part. The starting date of the year used to determine compliance may be changed provided that the change is made at the beginning

of the year and that no day is omitted or duplicated in consecutive years.

(b) As used in this part to describe various aspects of radiation dose:

Absorbed dose (D) means the energy absorbed by matter from ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

Collective dose means the sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person- sievert).

Committed dose equivalent (HT,50) means the dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

Committed effective dose equivalent (HE,50) means the sum of the committed dose equivalents to various tissues in the body (HT,50), each multiplied by the appropriate weighting factor (wT)-that is, HE,50 = SigmawTHT,50. Committed effective dose equivalent is expressed in units of rem (or sievert).

Cumulative total effective dose equivalent means the sum of the total effective dose equivalents recorded for an individual for each year of employment at a DOE or DOE contractor site or facility, effective January 1, 1989.

Deep dose equivalent means the dose equivalent derived from external radiation at a depth of 1 cm in tissue.

Dose equivalent (H) means the product of absorbed dose (D) in rad (or gray) in tissue, a quality factor (Q), and other modifying factors (N). Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

Effective dose equivalent (HE) means the summation of the products of the dose equivalent received by specified tissues of the body (HT) and the appropriate weighting factor (wT)-that is, HE = SigmawTHT. It includes the dose from radiation sources internal and/or external to the body. The effective dose equivalent is expressed in units of rem (or sievert).

External dose or exposure means that portion of the dose equivalent received from radiation sources (e.g., "external sources") outside the body.

Extremity means hands and arms below the elbow or feet and legs below the knee.

Internal dose or exposure means that portion of the dose equivalent received from

radioactive material taken into the body (e.g., "internal sources").

Lens of the eye dose equivalent means the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

Quality factor means the principal modifying factor used to calculate the dose equivalent from the absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate quality factor (Q).

(i) The quality factors to be used for determining dose equivalent in rem are shown below:

Quality Factors

Radiation type	Quality factor
X-rays, gamma rays, positrons, electrons (including tritium beta particles).	1
Neutrons, <= 10 keV	3
Neutrons, > 10 keV	10
Protons and singly-charged particles of unknown energy with rest mass greater than one atomic mass unit.	10
Alpha particles and multiple-charged particles (and particles of unknown charge) of unknown energy.	20

When spectral data are insufficient to identify the energy of the neutrons,

a quality factor of 10 shall be used.

(ii) When spectral data are sufficient to identify the energy of the neutrons, the following mean quality factor values may be used:

QUALITY FACTORS FOR NEUTRONS

[Mean quality factors, Q (maximum value in a 30-cm dosimetry phantom), and values of neutron flux density that deliver in 40 hours, a maximum dose equivalent of 100 mrem (0.001 sievert).]

Neutron energy (MeV)	Mean quality factor	Neutron flux density (cm -2s-1)
2.5 x 10^-8 thermal	2	680
1 x 10^-7	2	680
1 x 10^-6	2	560
1 x 10^-5	2	560
1 x 10^-4	2	580

1 x 10^-3	2	680
1 x 10^-2	2.5	700
1 x 10^-1	7.5	115
5 x 10^-1	11	27
1	11	19
2.5	9	20
5	8	16
7	7	17
10	6.5	17
14	7.5	12
20	8	11
40	7	10
60	5.5	11
1 x 10^2	4	14
2 x 10^2	3.5	13
3 x 10^2	3.5	11
4 x 10^2	3.5	10

Shallow dose equivalent means the dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

Total effective dose equivalent (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). For purposes of compliance with this part, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures.

Weighting factor (wT) means the fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The dose equivalent to tissue, T, is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue. The weighting factors are as follows:

Weighting Factors For Various Tissues

Organs or tissues, T	Weighting factor, wT
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder{1}	0.30

Whole body{2}	1.00

{1} "Remainder" means the five other organs or tissues with the highest dose (e.g., liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, and upper large intestine). The weighting factor for each remaining organ or tissue is 0.06.

{2} For the case of uniform external irradiation of the whole body, a weighting factor (wT) equal to 1 may be used in determination of the effective dose equivalent.

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

(c) Terms defined in the Atomic Energy Act and not defined in this part are used consistent with the meanings given in the Act.

(d) As used in this part, words in the singular also include the plural and words in the masculine gender also include the feminine and vice versa, as the case may be.

§ 835.3 General rule.

(a) No person or DOE personnel shall take or cause to be taken any action inconsistent with the requirements of:

1. This part; or
2. Any program, plan, schedule, or other process established by this part.

(b) With respect to a particular DOE activity, contractor management shall be responsible for compliance with the requirements of this part.

(c) Where there is no contractor for a DOE activity, DOE shall ensure implementation of and compliance with the requirements of this part.

(d) Nothing in this part shall be construed as limiting actions that may be necessary to protect health and safety.

§ 835.4 Radiological units.

Unless otherwise specified, the quantities used in the records required by this part shall be clearly indicated in special units of curie, rad, or rem, including multiples and subdivisions of these units. The SI units, becquerel (Bq), gray (Gy), and sievert (Sv), are only provided parenthetically in this part for reference with scientific standards. These SI units are not authorized for use in records required under this part.

Subpart B-Radiation Protection Programs

§ 835.101 Radiation protection programs.

(a) A DOE activity shall be conducted in compliance with a documented radiation protection program (RPP) as approved by the DOE.

(b) The DOE may direct or make modifications to a RPP.

(c) The content of each RPP shall be commensurate with the nature of the activities performed and shall include formal plans and measures for applying the as low as reasonably achievable (ALARA) process to occupational exposure.

(d) The RPP shall specify the existing and/or anticipated operational tasks that are intended to be within the scope of the RPP. Except as provided in § 835.101(i), any task outside the scope of a RPP shall not be initiated until an update of the RPP is approved by DOE.

(e) The content of the RPP shall address, but shall not necessarily be limited to, each requirement in this part.

(f) The RPP shall include plans, schedules, and other measures for achieving compliance with regulations of this part. Compliance with this part shall be achieved no later than January 1, 1996.

(g) The RPP for an existing activity shall be submitted to DOE no later than January 1, 1995.

(h) An update of the RPP shall be submitted to DOE:

1. Whenever a change or an addition to the RPP is made;
2. Prior to the initiation of a task not within the scope of the RPP; or
3. Within 180 days of the effective date of any modifications to this part.

(i) Changes, additions, or updates to the RPP may become effective without prior Department approval only if the changes do not decrease the effectiveness of the RPP and the RPP, as

changed, continues to meet the requirements of this part. Proposed changes that decrease the effectiveness of the RPP shall not be implemented without submittal to and approval by the Department.

(j) An initial RPP or an update shall be considered approved 180 days after its submission unless rejected by DOE at an earlier date.

§ 835.102 Internal audits.

Internal audits of all functional elements of the radiation protection program shall be conducted no less frequently than every 3 years and shall include program content and implementation.

Subpart C-Standards for Internal and External Exposure

§ 835.201 [Reserved]

§ 835.202 Occupational exposure limits for general employees.

(a) The occupational exposure to general employees resulting from DOE activities, other than planned special exposures under § 835.204 and emergency exposure situations under § 835.1302, shall be controlled so the following annual limits are not exceeded:

1. A total effective dose equivalent of 5 rems (0.05 sievert);
2. The sum of the deep dose equivalent for external exposures and the committed dose equivalent to any organ or tissue other than the lens of the eye of 50 rems (0.5 sievert);
3. A lens of the eye dose equivalent of 15 rems (0.15 sievert); and
4. A shallow dose equivalent of 50 rems (0.5 sievert) to the skin or to any extremity.

(b) All occupational exposure received during the current year shall be included when demonstrating compliance with § 835.202(a).

(c) Exposures from background, therapeutic and diagnostic medical radiation, and voluntary participation in medical research programs shall not be included in dose records or in the assessment of compliance with the occupational exposure limits.

§ 835.203 Combining internal and external dose equivalents

(a) The total effective dose equivalent during a year shall be determined by summing the effective dose equivalent from external exposures and the committed effective dose equivalent from intakes during the year. For purposes of compliance with this part, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures.

(b) Determinations of the effective dose equivalent shall be made using the weighting factor values provided in § 835.2.

(c) For the case of uniform external irradiation of the whole body, a weighting factor (wT) equal to 1 may be used in the determination of the effective dose equivalent.

§ 835.204 Planned special exposures.

(a) A planned special exposure may be authorized for a radiological worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in § 835.202(a), provided that each of the following conditions is satisfied:

1. The planned special exposure is considered only in an exceptional situation when alternatives that might prevent a radiological worker from exceeding the limit in § 835.202(a)(1) are unavailable or impractical;
2. The contractor management (and employer, if the employer is not the contractor) specifically requests the planned special exposure, in writing; and
3. Joint written approval from the appropriate DOE Headquarters program office and the Assistant Secretary for Environment, Safety and Health is received.

(b) Prior to requesting an individual to participate in an authorized planned special exposure, the individual's dose from all previous planned special exposures and all doses in excess of the occupational dose limits shall be determined.

(c) An individual shall not receive a planned special exposure that, in addition to the doses determined in § 835.204(b), would result in a dose exceeding the following:

1. A total effective dose equivalent of 5 rems (0.05 sievert) in the current year; and
2. A cumulative total effective dose equivalent of 25 rems (0.25 sievert).

(d) Prior to a planned special exposure, written consent shall be obtained from each individual involved. Each individual shall be:

1. Informed of the purpose of the planned operations and procedures to be used;
2. Informed of the estimated doses and associated potential risks and specific radiological conditions and other hazards which might be involved in performing the task; and
3. Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(e) Records of the conduct of a planned special exposure shall be maintained and a written report

submitted within 30 days after the planned special exposure to the approving organizations identified in § 835.204(a)(3).

(f) The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under § 835.202(a), but is to be included in records and reports required under this part.

§ 835.205 Determination of compliance for non-uniform exposure

(a) Non-uniform exposures of the skin from X-rays, beta radiation, and/or radioactive material on the skin are to be assessed as specified in this section.

(b) For purposes of demonstrating compliance with § 835.202(a)(4), assessments shall be conducted as follows:

1. Area of skin irradiated is 100 cm^2 or more. The non- uniform dose equivalent received during the year shall be averaged over the 100 cm^2 of the skin receiving the maximum dose, added to any uniform dose equivalent also received by the skin, and recorded as the shallow dose equivalent to any extremity or skin for the year.
2. Area of skin irradiated is 10 cm^2 or more, but is less than 100 cm^2 . The non-uniform dose equivalent (H) to the irradiated area received during the year shall be added to any uniform dose equivalent also received by the skin and recorded as the shallow dose equivalent to any extremity or skin for the year. H is the dose equivalent averaged over the 1 cm^2 of skin receiving the maximum absorbed dose, D, reduced by the fraction f, which is the irradiated area in cm^2 divided by 100 cm^2 (i.e., H=fD). In no case shall a value of f less than 0.1 be used.
3. Area of skin irradiated is less than 10 cm^2 . The non- uniform dose equivalent shall be averaged over the 1 cm ^2 of skin receiving the maximum dose. This dose equivalent shall:

    (i) Be recorded in the individual's occupational exposure history as a special entry; and

    (ii) Not be added to any other shallow dose equivalent to any extremity or skin recorded as the dose equivalent for the year.

§ 835.206 Limits for the embryo/fetus.

(a) The dose equivalent limit for the embryo/fetus from the period of conception to birth, as a result of occupational exposure of a declared pregnant worker, is 0.5 rem (0.005 sievert).

(b) Substantial variation above a uniform exposure rate that would satisfy the limits provided in § 835.206(a) shall be avoided.

(c) If the dose equivalent to the embryo/fetus is determined to have already exceeded 0.5 rem (0.005 sievert) by the time a worker declares her pregnancy, the declared pregnant worker shall not be assigned to tasks where additional occupational exposure is likely during the remaining gestation period.

§ 835.207 Limits for minors.

Any minor exposed to radiation and/or radioactive material during direct on-site access at a DOE site or facility shall not exceed 0.1 rem (0.001 sievert) total effective dose equivalent in a year.

§ 835.208 Limits for members of the public entering a controlled area.

Any member of the public exposed to radiation and/or radioactive material during direct on-site access at a DOE site or facility shall not exceed 0.1 rem (0.001 sievert) total effective dose equivalent in a year.

§ 835.209 Concentrations of radioactive material in air.

(a) The derived air concentration (DAC) values given in appendices A and C to this part shall be used in the control of occupational exposures to airborne radioactive material.

(b) With regard to inhalation exposures and external exposures from airborne radionuclides, compliance with this part shall be demonstrated through conformity with § 835.101 and § 835.202 which establishes the applicable regulatory limits.

(c) The estimation of internal dose shall be based on bioassay data rather than air concentration values unless bioassay data are:

1. unavailable;
2. inadequate; or
3. internal dose estimates based on representative air concentration values are demonstrated to be as or more accurate.

Subpart D-[Reserved]

Subpart E-Monitoring in the Workplace

§ 835.401 General requirements.

(a) Monitoring of individuals and areas shall be performed to:

1. Demonstrate compliance with the regulations in this part;
2. Document radiological conditions in the workplace;
3. Detect changes in radiological conditions;
4. Detect the gradual buildup of radioactive material in the workplace; and
5. Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure.

(b) Area monitoring in the workplace shall be routinely performed, as necessary, to identify and control potential sources of personnel exposure to radiation and/or radioactive material.

(c) Instruments used for monitoring and contamination control shall be:

1. Periodically maintained and calibrated on an established frequency of at least once per year;
2. Appropriate for the type(s), levels, and energies of the radiation(s) encountered;
3. Appropriate for existing environmental conditions; and
4. Routinely tested for operability.

§ 835.402 Individual monitoring.

(a) For the purpose of monitoring individual exposures to external radiation, personnel dosimetry shall be provided to and used by:

1. Radiological workers who, under typical conditions, are likely to receive one or more of the following:

    (i) An effective dose equivalent to the whole body of 0.1 rem (0.001 sievert) or more in a year;

    (ii) A shallow dose equivalent to the skin or to any extremity of 5 rems (0.05 sievert) or more in a year;

    (iii) A lens of the eye dose equivalent of 1.5 rems (0.015 sievert) or more in a

year;

(iv) A deep dose equivalent from external exposures to any organ or tissue other than the lens of the eye of 5 rems (0.05 sievert);

2. Declared pregnant workers who are likely to receive from external sources a dose equivalent to the embryo/fetus in excess of 10 percent of the applicable limit in § 835.206;
3. Minors and members of the public likely to receive, in 1 year, from external sources, a dose in excess of 50 percent of the applicable limits in § 835.207 or § 835.208, respectively; or
4. Individuals entering a high or very high radiation area.

(b) Personnel external dosimetry programs shall be adequate to demonstrate compliance with § 835.202, including routine dosimeter calibration and conformance with the requirements of the DOE Laboratory Accreditation Program for Personnel Dosimetry.

(c) For the purpose of monitoring individual exposures to internal radiation, internal dose evaluation programs (including routine bioassay programs) shall be conducted for:

1. Radiological workers who, under typical conditions, are likely to receive 0.1 rem (0.001 sievert) or more committed effective dose equivalent, and/or 5 rems (0.05 sievert) or more committed dose equivalent to any organ or tissue, from all occupational radionuclide intakes in a year;
2. Declared pregnant workers likely to receive an intake resulting in a dose equivalent to the embryo/fetus in excess of 10 percent of the limit stated in § 835.206; or
3. Minors and members of the public who are likely to receive, in 1 year, an intake resulting in a committed effective dose equivalent in excess of 50 percent of the limits stated in § 835.207 or § 835.208, respectively.

(d) Internal dose evaluation programs shall be adequate to demonstrate compliance with § 835.202.

§ 835.403 Area monitoring.

(a) Measurements of radioactivity concentrations in the ambient air of the workplace shall be performed as follows:

1. Air sampling shall be performed in occupied areas where, under typical conditions, an individual is likely to receive an annual intake of 2 percent or more of the specified ALI values. For a given radionuclide and lung retention class, the ALI is the product of the DAC listed in appendix A of this part and the constant 2.4x10^9 ml. Samples shall be taken as necessary to detect and evaluate the level or concentration of airborne radioactive material at work locations.
2. Real-time air monitoring, using continuous air monitors as defined in § 835.2, shall be

performed in normally occupied areas where an individual is likely to be exposed to a concentration of airborne radioactivity exceeding 1 DAC as specified in appendix A of this part or where there is a need to alert potentially exposed individuals to unexpected increases in airborne radioactivity levels.

3. For the airborne radioactive material that could be encountered, real-time air monitors shall have alarm capability and sufficient sensitivity to alert potentially exposed individuals that immediate action is necessary in order to minimize or terminate inhalation exposures.

(b) Monitoring of radiation in the workplace shall be performed using stationary (area) or portable radiation instruments, or a combination thereof. The instruments shall be readily available and shall be capable of measuring ambient radiation dose rates for the purpose of controlling radiation exposures.

§ 835.404 Radioactive contamination control and monitoring.

(a) Instruments and techniques used for radioactive contamination monitoring and control shall be adequate to ensure compliance with the requirements specified in this section.

(b) Appropriate controls shall be maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions.

(c) Any area in which contamination levels exceed the values specified in appendix D of this part shall be:

1. Posted in accordance with § 835.603; and
2. Controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable contamination levels.

(d) Areas with fixed contamination exceeding the total radioactivity values specified in appendix D of this part may be located outside of radiological areas provided the following conditions are met:

1. Removable contamination levels are below the levels specified in appendix D of this part;
2. Unrestricted access to the area is not likely to cause any individual to receive a total effective dose equivalent in excess of 0.1 rem (0.001 sievert) in a year;
3. The area is routinely monitored;
4. The area is clearly marked to alert personnel of the contaminated status;
5. Appropriate administrative procedures are established and exercised to maintain control of these areas; and
6. Dose rates do not exceed levels which would require posting in accordance with § 835.603.

(e) Entry control pursuant to § 835.501 and posting pursuant to § 835.603 are not required for areas with fixed contamination meeting the conditions of § 835.404(d).

(f) Appropriate monitoring to detect and prevent the spread of contamination shall be performed by individuals exiting radiological areas established to control removable contamination and/or airborne radioactivity.

(g) Protective clothing shall be required for entry to areas in which removable contamination exists at levels exceeding those specified in appendix D to this part.

Subpart F-Entry Control Program

§ 835.501 Radiological areas.

(a) Personnel entry control shall be maintained for each radiological area.

(b) The degree of control shall be commensurate with existing and potential radiological hazards within the area.

(c) One or more of the following methods shall be used to ensure control:

1. Signs and barricades;
2. Control devices on entrances;
3. Conspicuous visual and/or audible alarms;
4. Locked entrance ways; or
5. Administrative controls.

(d) Administrative procedures shall be written as necessary to demonstrate compliance with the provisions of this section. These administrative procedures shall include actions essential to ensure the effectiveness and operability of barricades, devices, alarms, and locks. Authorizations shall be required to perform specific work within the area and shall include specific radiation protection measures.

(e) No control(s) shall be installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions.

§ 835.502 High and very high radiation areas.

(a) High radiation areas. One or more of the following features shall be used for each entrance or access point to a high radiation area where radiation levels exist such that an individual could exceed a deep dose equivalent to the whole body of 1 rem (0.01 sievert) in any one hour at 30

centimeters from the source or from any surface that the radiation penetrates:

1. A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a high radiation area;
2. A device that functions automatically to prevent use or operation of the radiation source or field while personnel are in the area;
3. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry;
4. Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained;
5. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry;
6. A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.

(b) Very high radiation areas. In addition to the above requirements, additional measures shall be implemented to ensure individuals are not able to gain access to very high radiation areas when dose rates are in excess of the posting requirements of § 835.603(c).

(c) No control(s) shall be established in a high or very high radiation area that would prevent rapid evacuation of personnel.

Subpart G-Posting and Labeling

§ 835.601 General requirements.

(a) Working areas that require posting because of the presence, or potential presence, of radiation and/or radioactive material are delineated in the subsequent paragraphs of this section. Radioactive items or containers of radioactive materials, shall be individually labeled if adequate warning is not provided by control measures and required posting.

(b) DOE approved signs, labels, and radiation symbols shall be used to identify areas specified in this subpart.

(c) Required signs and labels shall have a yellow background. The radiation symbol shall be black or magenta.

(d) Signs required by this subpart shall be clear and conspicuously posted and may include radiological protection instructions.

(e) The posting requirements in this section may be modified to reflect the special considerations of DOE activities conducted at private residences. Such modifications shall provide the same level of protection to individuals as the existing provisions in this section.

§ 835.602 Controlled areas.

(a) Each access point to a controlled area (as defined in § 835.2) shall be posted, identifying it as a controlled area, whenever radioactive material and/or radiation fields which would require posting under § 835.603 may be present in the area.

(b) Signs used for this purpose may be selected by the contractor to avoid conflict with local security requirements.

§ 835.603 Radiological areas.

Each access point to a radiological area (as defined in § 835.2) shall be posted with conspicuous signs bearing the wording provided in this section.

(a) Radiation Area. The words "Caution, Radiation Area" shall be posted at any area accessible to individuals in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.005 rem (0.05 millisievert) in 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates.

(b) High Radiation Area. The words "Danger, High Radiation Area" shall be posted at any area accessible to individuals in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 sievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

(c) Very High Radiation Area. The words "Grave Danger, Very High Radiation Area" shall be posted at any area accessible to individuals in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from the radiation source or from any surface that the radiation penetrates.

(d) Airborne Radioactivity Area. The words "Caution, Airborne Radioactivity Area" shall be posted for any occupied area in which airborne radioactivity levels exceed, or are likely to exceed, 10 percent of the DAC value listed in appendix A or appendix C of this part.

(e) Contamination Area. The words "Caution, Contamination Area" shall be posted where contamination levels exceed values listed in appendix D of this part, but are less than or equal to 100 times those values.

(f) High Contamination Area. The words "Danger, High Contamination Area" shall be posted where contamination levels are greater than 100 times the values listed in appendix D of this

part.

Subpart H-Records

§ 835.701 General provisions.

(a) Records shall be maintained to document compliance with this part and with radiation protection programs required by § 835.101.

(b) Unless otherwise specified in this subpart, records shall be retained until final disposition is authorized by DOE.

§ 835.702 Individual monitoring records.

(a) Records shall be maintained to document doses received by all individuals for whom monitoring was required pursuant to § 835.402 and doses received during planned special exposures, accidents, and emergency conditions.

(b) The results of individual external and internal dose measurements that are performed, but are not required by § 835.402, shall be recorded. Recording of the non-uniform shallow dose equivalent to the skin caused by contamination on the skin (see § 835.205) is not required if the dose is less than 2 percent of the limit specified for the skin in § 835.202(a)(4).

(c) The records required by this section shall:

1. Be sufficient to evaluate compliance with § 835.202;
2. Be sufficient to provide dose information necessary to complete reports required by subpart I of this part and by Departmental requirements for occurrence reporting and processing;
3. Include the following quantities for external dose received during the year:

    (i) The effective dose equivalent from external sources of radiation (deep dose equivalent may be used as effective dose equivalent for external exposure);

    (ii) The lens of the eye dose equivalent;

    (iii) The shallow dose equivalent to the skin; and

    (iv) The shallow dose equivalent to the extremities.

4. Include the following quantities for internal dose resulting from intakes received during

the year:

(i) Committed effective dose equivalent;

(ii) Committed dose equivalent to any organ or tissue of concern; and

(iii) Estimated intake and identity of radionuclides.

5. Include the following quantities for the summation of the external and internal dose:

(i) Total effective dose equivalent in a year;

(ii) For any organ or tissue assigned an internal dose during the year, the sum of the deep dose equivalent from external exposures and the committed dose equivalent to that organ or tissue; and

(iii) Cumulative total effective dose equivalent received from external and internal sources while employed at the site or facility, since January 1, 1989.

6. Include the dose equivalent to the embryo/fetus of a declared pregnant worker.

(d) Documentation of all occupational exposure received during the current year shall be obtained when demonstrating compliance with § 835.202(a). In the absence of formal records of previous occupational exposure during the year, a written estimate signed by the individual may be accepted.

(e) Efforts shall be made to obtain records of prior years occupational internal and external exposure.

(f) The records specified in this section that are identified with a specific individual shall be readily available to that individual.

(g) Data necessary to allow future verification or reassessment of the recorded doses shall be recorded.

(h) All records required by this section shall be transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals.

§ 835.703 Monitoring and workplace records.

The following information shall be documented and maintained:

(a) Results of surveys for radiation and radioactive material in the workplace as required by §§ 835.401, 835.403, and 835.404;

(b) Results of surveys, measurements, and calculations used to determine individual occupational exposure from external and internal sources;

(c) Results of surveys for the release of material and equipment as required by § 835.1101(d); and

(d) Results of maintenance and calibration performed on:

1. Instruments used for area monitoring and contamination control as required by § 835.401; and
2. Devices used for individual monitoring as required by §§ 835.401 and 835.402.

§ 835.704 Administrative records.

(a) Training records shall be maintained, as necessary, to demonstrate compliance with §§ 835.901, 835.902, and 835.903.

(b) Actions taken to maintain occupational exposures as low as reasonably achievable, including the actions required for this purpose by § 835.101, as well as facility design and control actions required by §§ 835.1001, 835.1002, and 835.1003, shall be documented.

(c) Records shall be maintained to document the results of internal audits and other reviews of program content and implementation.

(d) Written declarations of pregnancy shall be maintained.

(e) Changes in equipment, techniques, and procedures used for monitoring in the workplace shall be documented.

Subpart I-Reports to Individuals

(a) Radiation exposure data for individuals monitored in accordance with § 835.402 shall be reported as specified in this section. The information shall include the data required under § 835.702(c). Each notification and report shall be in writing and include: the DOE site or facility name, the name of the individual, and the individual's social security number or employee number.

(b) Upon the request from an individual terminating employment, records of exposure shall be provided to that individual as soon as the data are available, but not later than 90 days after termination. A written estimate of the radiation dose received by that employee based on

available information shall be provided at the time of termination, if requested.

(c) Each DOE- or DOE-contractor-operated site or facility shall, on an annual basis, provide a radiation dose report to each individual monitored during the year at that site or facility in accordance with § 835.402.

(d) Detailed information concerning any individual's exposure shall be made available to the individual upon request of that individual, consistent with the provisions of the Privacy Act (5 U.S.C. 552a).

(e) When a DOE contractor is required to report to the Department, pursuant to Departmental requirements for occurrence reporting and processing, any exposure of an individual to radiation and/or radioactive material, or planned special exposure in accordance with § 835.204(e), the contractor shall also provide that individual with a report on his or her exposure data included therein. Such report shall be transmitted at a time not later than the transmittal to the Department.

Subpart J-Radiation Safety Training

(a) All general employees shall be trained in radiation safety prior to receiving occupational exposure during access to controlled areas at a DOE site or facility. Allowance may be made for previous DOE training on generic radiation safety topics (i.e., those not specific to a site or facility), provided the training was received at another DOE site or facility within the past 2 years. Documentation of the previous training shall clearly identify the individual's name, date of training, topics covered, and name of the certifying individual. The knowledge of radiation safety possessed by general employees shall be verified by examination.

(b) Retraining shall be provided when there is a significant change to radiation protection policies and procedures that affect general employees and shall be conducted at intervals not to exceed 2 years.

§ 835.902 Radiological workers.

Radiological worker training programs and retraining shall be established and conducted at intervals not to exceed 2 years to familiarize the worker with the fundamentals of radiation protection and the ALARA process. Training shall include both classroom and applied training. Training shall either precede assignment as a radiological worker or be concurrent with assignment as a radiological worker if the worker is accompanied by and under the direct supervision of a trained radiological worker. Radiological worker training not specific to a given site or facility may be waived provided that: This training has been received at another DOE site or facility within the past 2 years; there is provision of proof-of-training in the form of a certification document containing the individual's name, date of training, and specific topics covered; and an appropriate official has certified the training of the individual. The knowledge of radiation safety possessed by radiological workers shall be verified by examination prior to an unsupervised assignment. The training shall include procedures specific to an individual's job

assignment. The level of training is to be commensurate with each worker's assignment.

§ 835.903 Radiological control technicians.

Training and retraining programs for radiological control technicians shall be established and conducted at intervals not to exceed 2 years to familiarize technicians with the fundamentals of radiation protection and the proper procedures for maintaining exposures ALARA. This program shall include both classroom and applied training. The training shall either precede performance of tasks assigned to radiological control technicians or be concurrent with such task assignments if the individual is accompanied by and under the direct supervision of a trained individual. The required level of knowledge of radiation safety possessed by radiological control technicians shall be verified by examination to include demonstration prior to any unsupervised work assignment. The training program shall include procedures specific to the site or facility where the technician is assigned. The level of training shall be commensurate with the technician's assignment. Allowance may be made for previous DOE training on generic radiation safety topics (i.e., those not specific to a site or facility), provided the training was received within the past 2 years. Documentation of the previous training shall clearly identify the individual's name, date of training, topics covered, and name of the certifying individual.

Subpart K-Design and Control

§ 835.1001 Design and control.

(a) Measures shall be taken to maintain radiation exposure in controlled areas as low as is reasonably achievable through facility and equipment design and administrative control. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls and procedural requirements shall be employed only as supplemental methods to control radiation exposure.

(b) For specific activities where use of physical design features are demonstrated to be impractical, administrative controls and procedural requirements shall be used to maintain radiation exposures ALARA.

§ 835.1002 Facility design and modifications.

During the design of new facilities or modification of old facilities, the following objectives shall be adopted:

(a) Optimization methods shall be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.

(b) The design objective for controlling personnel exposure from external sources of radiation in

areas of continuous occupational occupancy (2000 hours per year) shall be to maintain exposure levels below an average of 0.5 mrem (5 microsieverts) per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards in § 835.202.

(c) Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used.

(d) The design or modification of a facility and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.

§ 835.1003 Control procedures.

(a) During routine operations, the combination of design features and administrative control procedures shall provide that:

1. The anticipated magnitude of the total effective dose equivalent shall not exceed 5 rems (0.05 sievert) in a year;
2. The anticipated magnitude of the committed dose equivalent to any organ or tissue, plus any deep dose equivalent from external exposure, shall not exceed 50 rems (0.5 sievert) in a year; and
3. Exposure levels are as low as reasonably achievable.

(b) Compliance with the requirements in paragraph (a) of this section shall be demonstrated by appropriate monitoring pursuant to the provisions of subpart E of this part.

Subpart L-Releases of Materials and Equipment From Radiological Areas

§ 835.1101 Releases of materials and equipment from radiological areas.

The following requirements apply for the release of materials and equipment from radiological areas for use in controlled areas:

(a) In radiological areas established to control surface or airborne radioactive material, material and equipment shall be treated as radioactive material and shall not be released from radiological areas to controlled areas if either of the following conditions exist:

1. Measurements of accessible surfaces show that either the total or removable contamination levels exceed the values specified in appendix D to this part; or
2. Prior use suggests that the contamination levels on inaccessible surfaces are likely to exceed the values specified in appendix D to this part.

(b) Material and equipment exceeding the total or removable contamination levels specified in appendix D to this part may be conditionally released for movement on-site from one radiological area for immediate placement in another radiological area only if appropriate monitoring and control procedures are established and exercised.

(c) Material and equipment with fixed contamination levels that exceed the limits specified in appendix D to this part may be released for use in controlled areas outside of the radiological areas with the following provisions:

1. Removable contamination levels are below the level specified in appendix D of this part; and
2. Materials shall be routinely monitored, clearly labeled, or tagged to alert personnel of the contaminated status; appropriate administrative procedures shall be established and exercised to maintain control of these items.

(d) The records for release of material and equipment shall describe the property, date on which the release survey was performed, identity of the individual who performed the survey, type and identification number of the survey instrument used, and results of the survey.

Subpart M-[Reserved]

Subpart N-Accidents and Emergencies

§ 835.1301 General provisions.

(a) A general employee whose occupational exposure has exceeded any of the limits specified in §§ 835.202 or 835.205 may be permitted to return to work in radiological areas during the current year providing that all of the following conditions are met:

1. Approval is first obtained from the contractor management and the Head of the responsible DOE field organization;
2. The individual receives counseling from radiological protection and medical personnel regarding the consequences of receiving additional occupational exposure during the year; and
3. The affected employee agrees to return to radiological work.

(b) All exposures exceeding the limits specified in §§ 835.202 or 835.205 shall be recorded in the affected individual's occupational exposure file and reported to the DOE in accordance with Departmental requirements for occurrence reporting and processing.

(c) When the conditions under which the emergency or accident exposures were received have

been eliminated, operating management shall notify the Head of the responsible DOE field organization.

(d) Operations after an emergency or accidental exposure in excess of the limits specified in §§ 835.202 or 835.205 may be resumed only with the approval of the DOE.

(e) Occurrence reports to DOE regarding emergencies and/or accidents shall be prepared and submitted in accordance with Departmental requirements for occurrence reporting and processing.

§ 835.1302 Emergency exposure situations.

(a) The risk of injury to those individuals involved in rescue and recovery operations shall be minimized.

(b) Operating management shall weigh actual and potential risks to rescue and recover individuals against the benefits to be gained.

(c) Rescue action that might involve substantial personal risk shall be performed by volunteers.

(d) The dose limits for individuals performing these operations are as follows:

Guidelines for Control of Emergency Exposures

Dose limit {1} (whole body)	Activity performed	Conditions
5 rems	All	.....
10 rems ...	Protecting major property ...	Where lower dose limit not practicable.
25 rems ...	Lifesaving or protection of	Where lower dose limit not

	large populations	practicable.
>25 rems	Lifesaving or protection of large populations	Only on a voluntary basis to personnel fully aware of the risks involved.

{1} The lens of the eye dose limit is three times the listed values. The shallow dose limit to the skin of the whole body and the extremities is ten times the listed values. These doses are in addition to and accounted for separately from the doses received under the limits in §§ 835.202 and 835.205.

(e) Each individual selected shall be trained in accordance with § 835.902 and briefed beforehand of the known or anticipated hazards to which the individual will be subjected.

§ 835.1303 [Reserved]

§ 835.1304 Nuclear accident dosimetry.

(a) Installations possessing sufficient quantities of fissile material to potentially constitute a critical mass, such that the excessive exposure of personnel to radiation from a nuclear accident is possible, shall provide nuclear accident dosimetry for those personnel.

(b) Nuclear accident dosimetry shall include the following:

1. A method to conduct initial screening of personnel involved in a nuclear accident to determine whether significant exposures to radiation occurred;
2. Methods and equipment for analysis of biological materials;
3. A system of fixed nuclear accident dosimeter units; and
4. Personal nuclear accident dosimeters worn by all personnel who enter locations in which installed criticality alarm systems are required.

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