DEPARTMENT OF ENERGY

10 CFR Parts 820 and 835

[Docket No. EH–RM–02–835]

RIN 1901–AA95

Procedural Rules for DOE Nuclear Activities and Occupational Radiation Protection

AGENCY: Department of Energy.

ACTION: Proposed rule and opportunity for public comment.

SUMMARY: The Department of Energy (DOE or the Department) proposes to amend its Procedural Rules for DOE Nuclear Activities, and its Occupational Radiation Protection requirements. The proposed amendments to the Procedural Rules for DOE Nuclear Activities would update its provisions to take into account the establishment of the National Nuclear Security Administration (NNSA). The proposed amendments to the Occupational Radiation Protection requirements would update its provisions to take into account lessons learned since the initial adoption of these regulations, input from the Defense Nuclear Facilities Safety Board (DNFSB) and members of the public, new recommendations from the International Commission on Radiological Protection (ICRP), and the establishment of the NNSA.

DATES: Public comments on the proposed rule must be received on or before October 10, 2006. A public hearing will be held on September 21, 2006 at the DOE Auditorium, located on 19901 Germantown Road, Germantown, Maryland. The hearing will be held from 9 a.m. to 12 noon and, if needed, from 1 p.m. to 4 p.m. All meeting attendees will be required to show a photo identification to access the DOE Germantown property and Auditorium. Motor vehicles will also be inspected when entering the DOE property.

Requests to speak at the public hearing should be mailed to Mr. Peter O'Connell, Office of Worker Protection Policy and Programs, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585. You may also e-mail your request to speak to *Peter.O'Connell@eh.doe.gov* or telephone Mr. O'Connell at (301) 903–5641. Requests to speak must be received by September 7, 2006 for the Germantown, Maryland hearing. Each presentation is limited to no more than 10 minutes to ensure that all persons have an opportunity to speak.

ADDRESSES: You may submit comments, identified by Docket Number EH–RM–02–835 and/or RIN 1901–AA–95, by any of the following methods:

- *Federal eRulemaking Portal: http//www.regulations.gov.* Follow the instructions for submitting comments.
- *E-mail: Peter.O'Connell@eh.doe.gov.* Include Docket Number EH–RM–02–835 and/or RIN 1901–AA–95 in the subject line of the message.
- *Mail:* Mr. Peter O'Connell, Office of Worker Protection Policy and Programs (EH–52), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585.

Copies of the public hearing transcript, written comments, and any other docket material may be reviewed and copied between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays, at the U.S. Department of Energy Freedom of Information Reading Room, Room 1E–190, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586–3142. The docket material for this rulemaking will be filed under ''EH–RM–02–835.''

The public hearing for this rulemaking will be held at the following address: DOE Auditorium, 19901 Germantown Road, Germantown, Maryland 20874–1290.

We encourage all interested persons to email a copy of their written comments, if possible, to avoid delays that have occurred in processing mail addressed to the Department. However, we request that you send one signed copy of your comments for the record.

Copies of any docket material may be reviewed and copied between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays, at the U.S. Department of Energy Freedom of Information Reading Room, Room 1E–190, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586–3142. The docket material for this rulemaking will be filed under ''EH–RM–02–835.''

FOR FURTHER INFORMATION CONTACT: For further information concerning public participation in this rulemaking proceeding, see Section VI of this notice of proposed rulemaking (Opportunity for Public Comment).

SUPPLEMENTARY INFORMATION:

I. Introduction and Background for Proposed Changes to 10 CFR Part 820

A. What is the Purpose and History of 10 CFR Part 820?

Part 820 sets forth the procedural rules relating to DOE nuclear safety requirements. Among other things, 10 CFR part 820 sets forth the process for granting exemptions from nuclear safety requirements and the process for issuing civil penalties for violations of nuclear safety requirements. DOE proposed 10 CFR part 820 on December 9, 1991 (56 FR 64290) and issued a clarification on May 15, 1992 (57 FR 20796). DOE published 10 CFR part 820 as a final rule on August 17, 1993 (58 FR 43680) and amended it on October 8, 1997 (62 FR 52479) and on March 22, 2000 (65 FR 15218).

B. Why is DOE Proposing Changes to 10 CFR Part 820?

The legislation that established the NNSA contained several provisions that affect 10 CFR part 820. In particular, non-NNSA personnel (other than the Secretary and Deputy Secretary) are prohibited from giving direction to NNSA contractors. In addition, several Assistant Secretaries and the Deputy Assistant Secretary for Naval Reactors were converted into NNSA Deputy Administrators. Since the establishment of the NNSA, 10 CFR part 820 has been applied in a manner consistent with these provisions. The proposed changes would revise 10 CFR part 820 to reflect these provisions explicitly.

C. In General, What are the Proposed Changes to 10 CFR Part 820?

The proposed changes to 10 CFR part 820 would: (1) Revise references to the Deputy Assistant Secretary for Naval Programs to reflect conversion of the Deputy Assistant Secretary into a Deputy Administrator; (2) include NNSA Administrator and Deputy Administrators in the definition of Secretarial Officer; (3) clarify that, with respect to NNSA contractors, the Secretarial Officer primarily responsible for environment, safety and health matters is the NNSA Deputy Administrator with such responsibility; (4) formalize the use of enforcement letters; and (5) make explicit the role of NNSA in giving direction to NNSA contractors pursuant to 10 CFR part 820.

II. Summary of Changes to 10 CFR Part 820

A. What are the Proposed Changes with Respect to References to the Deputy Assistant Secretary for Naval Reactors?

The NNSA Act converted the Deputy Assistant Secretary for Naval Reactors into the Deputy Administrator for Naval Reactors. DOE is proposing to revise 820.1(c) by replacing the phrase ''Assistant Secretary for Naval Reactors'' with ''Deputy Administrator for Naval Reactors.'' DOE also is proposing to delete the last sentence in the definition of ''Secretarial Officer'' because the inclusion of ''Deputy Administrator'' in the first sentence makes the last sentence unnecessary. In addition, DOE is proposing to update the citation for the Naval Nuclear Propulsion Program to include Public Law 106–65. No substantive change in the treatment of the Office of Naval Reactors under 10 CFR part 820 is being proposed.

B. What are the Proposed Changes in the Definition of ''Secretarial Officer''?

The NNSA Act converted several Assistant Secretaries into Deputy Administrators. DOE is proposing to include the phrase ''Deputy Administrator'', in addition to the phrase ''NNSA Administrator'', in the definition of ''Secretarial Officer'' to reflect this change. In addition, DOE is proposing to add a sentence to the definition of ''Secretarial Officer'' to make clear that, with respect to NNSA activities, the Secretarial Officer primarily responsible for environment, safety and health matters is the NNSA Administrator or NNSA Deputy Administrator with such responsibilities.

C. What Are the Proposed Changes Relating to Investigations?

DOE is proposing to add two new subsections to 820.21 to codify current practices. Proposed 820.21(g) would recognize the use of enforcement letters to communicate expectations during an investigation into a possible violation of a nuclear safety requirement. Proposed 820.21(h) would recognize that the Director may sign, issue and serve subpoenas during an investigation.

D. What Is the Proposed Change Relating to Direction of NNSA Contractors?

The NNSA Act provides at 50 U.S.C. 2410(b) that non-NNSA personnel (other than the Secretary and Deputy Secretary) are prohibited from giving direction to NNSA contractors. Since the establishment of the NNSA, the NNSA and other elements of DOE, including the Office of Enforcement, have worked together to ensure 10 CFR part 820 operated in a manner consistent with section 2410(b). DOE is proposing a new section (820.13) to codify current practices and make clear that NNSA is responsible for signing, issuing and serving actions that give direction to NNSA contractors.

E. What Changes Are Being Proposed to the Appendix on Enforcement Policy?

DOE is proposing to update the Appendix on Enforcement Policy to reflect the proposed changes to 10 CFR part 820.

III. Introduction and Background for Proposed Changes to 10 CFR Part 835

A. What Is the Purpose and History of 10 CFR Part 835?

10 CFR part 835 sets forth the nuclear safety requirements that provide radiological protection for DOE workers and members of the public. DOE proposed 10 CFR part 835 on December 9, 1991 (56 FR 64334) and published it as final on December 14, 1993, (58 FR 65458). DOE amended 10 CFR part 835 on November 4, 1998, (63 FR 59662).

B. Why Is DOE Proposing Changes to 10 CFR Part 835?

DOE is proposing changes for a number of reasons. In some cases, an analysis of the operating experience with 10 CFR part 835 indicates DOE's needs can be met more effectively if there is a change. In other cases, the Defense Nuclear Facilities Safety Board or members of the public have suggested changes. In addition, the International Commission on Radiological Protection (ICRP) has issued newer recommendations on areas covered by 10 CFR part 835.

C. In General, What Are the Proposed Changes to 10 CFR Part 835?

The proposed changes to 10 CFR part 835 would: (1) Clarify which requirements in 10 CFR part 835 apply to radioactive material transportation, (2) exclude from the scope of 10 CFR part 835 material, equipment and real property approved for release in accordance with DOE approved authorized limits which have been approved by a Secretarial Officer in consultation with the Office of the Assistant Secretary for Environment, Safety and Health, (3) update the dosimetric models and dose terms to be consistent with newer recommendations from ICRP, including use of updated tissue and radiation weighting factors and updated derived air concentration values, (4) establish derived air concentration values for tritiated

particulate aerosols and organically bound tritium, (5) lower the upper limit on the amount of material which need not be labeled, (6) allow use of thresholds for recording occupational exposures, (7) establish derived air concentration default values for radionuclides not listed in the rule, (8) clarifies the role of NNSA to approve planned special exposures and approve dosimetry monitoring programs that are substantially equivalent to those accredited by the DOE Laboratory Accreditation Program (DOELAP), (9) establish strontium-90 contamination limits based on the percentage of strontium-90 in contamination consisting of mixed fission products, and (10) revise values in Appendix E to be consistent with newer dosimetric models and add values for tritiated particulates and organically bound tritium.

IV. Summary of Changes to 10 CFR Part 835

A. What are the Proposed Changes to the Scope of 10 CFR Part 835?

1. *Material, Equipment and Real Property Exclusion.* DOE proposes to amend § 835.1 (Scope) by inserting a new paragraph (b)(6) which would exclude radioactive material on or within material, equipment and real property that is approved for release when the radiological conditions of the material, equipment and real property have been documented to comply, pursuant to DOE Order 5400.5, Radiation Protection of the Public and the Environment, with the criteria for release set forth in a DOE authorized limit which has been approved by a Secretarial Officer in consultation with the Office of the Assistant Secretary for Environment, Safety and Health. As DOE moves to a more risk based approach to radiological protection, inconsistencies may arise between DOE's occupational radiation protection requirements, which are prescribed for a specified radiological hazard, and DOE's environmental radiation protection requirements, which may be applied based on an assessment of risk. Under DOE Order 5400.5, real property on a DOE site and material and equipment from a DOE site may be released for unrestricted or restricted use by members of the public in accordance with a process to determine the risk to an individual from the residual radioactive material remaining on or within the material, equipment or property. Such material, equipment or property may sometimes contain contaminated surfaces which exceed the surface contamination levels in 10 CFR part 835 appendix D. The appendix D values trigger application of occupational radiological control for contaminated areas. Accordingly, under the current requirements, even though DOE may have determined that this material, equipment or property poses a minimal risk to individuals, if DOE activities are still associated with the material, equipment or property, certain radiological controls in 10 CFR part 835, such as those for access control, posting and training must be applied to portions of this material, equipment or property.

To eliminate this potential inconsistency, DOE proposes a new section 835.1(b)(6) that would exclude from the scope of 10 CFR part 835 radioactive material on or within material, equipment and real property which has been approved by DOE for release. This exclusion would only apply when the radiological conditions of the material, equipment and property, and the method for meeting the conditions, have been documented to comply with criteria for release specified in a DOE authorized limit for that material, equipment and property, and the criteria have been approved by a Secretarial Officer in consultation with the Office of the Assistant Secretary for Environment, Safety and Health. DOE recognizes that, depending on the potential exposure, this level of approval may be higher than that required by DOE Order 5400.5. However, this level of approval is consistent with other provisions of 10 CFR part 835 for which there are alternative means of compliance, such as alternatives to the DOELAP, use of planned special exposures, and exemption from specified provisions of 10 CFR part 835. The requirement for consultation with the Office of the Assistant Secretary for Environment, Safety and Health would be satisfied by providing copies of a Secretarial Officer's approved authorized limits and supporting documentation to the cognizant office within the Office of the Assistant Secretary for Environment, Safety and Health (currently the Office of Air, Water and Radiation Protection Policy and Guidance (EH–41)) for review and comment. EH–41 will coordinate the review and comment with EH–52. After comments have been resolved, the consultation process is complete. The intent for this proposed change is to allow for the exclusion to apply even for material, equipment or property which has not yet been released from DOE control.

2. *Radioactive Material Transportation.* DOE proposes to revise section 835.1 to clarify which requirements in 10 CFR part 835 apply to the transportation of radioactive material by or on behalf of the DOE. Specifically, existing 835.1(b)(4) would be deleted and replaced by a new 835.1(d) that would state clearly that subparts F (Entry Control Program) and G (Posting and Labeling) do not apply to radioactive material transportation conducted by a DOE individual or DOE contractor, when the radioactive material is under the continuous observation and control of an individual who is knowledgeable of and implements required exposure control measures. This proposed change is not intended to affect the existing situation where the requirements in the other subparts of 10 CFR part 835 do apply to radioactive material transportation.

DOE does not intend Part 835 to apply to transportation by the U.S. Postal Service or a commercial carrier, such as Fedex or UPS, that transport radioactive material as part of their normal operations. A company or subsidiary of a corporation that operates a DOE facility would not be considered a commercial carrier—even if such an organization transports radioactive material as part of their contractual agreement with DOE. This position is consistent with NRC practice. See, for example, 10 CFR 30.13, 40.12, and 70.12. DOE is requesting comments as to whether there should be an explicit exclusion of these carriers.

DOE also is proposing editorial changes to the definition of ''radioactive material transportation'' in § 835.2(a). These proposed changes are not intended to affect the existing scope of this definition, which excludes activities related to transportation such as the preparation of material or packagings for transportation, storage of material awaiting transportation, or application of markings and labels required for transportation.

B. What are the Proposed Changes to the Definitions in 10 CFR Part 835?

DOE proposes to change most of the dosimetric terms used in 10 CFR part 835 to reflect the recommendations for assessing dose and associated terminology from ICRP Publications 60 and 68. DOE proposes this change mainly because these recommendations are based on updated scientific models and more accurately reflect the occupational doses to workers than the models currently used by DOE, i.e., the models used in developing Radiation Protection Guidance to Federal agencies for Occupational Exposures (Environmental Protection Agency, 52 FR 2822, January 27, 1987) which are based upon 1977 recommendations from the ICRP. DOE notes that other

Federal agencies, including the Environmental Protection Agency (EPA), the Food and Drug Administration, and the National Institute of Occupational Safety and Health (NIOSH), have already adopted the current ICRP recommendations in recent guidance documents and requirements. NIOSH uses the newer recommendations in performing DOE worker dose assessments under the Energy Employees Occupational Illness Compensation Program Act of 2000, which is contained in the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law 106–398). The EPA has adopted the recommendations in Federal Guidance Report Number 13, Cancer Risk Coefficients for Environmental Exposure to Radionuclides. In addition, recommendations published by the National Council on Radiation Protection and Measurements (NCRP) for the past several years, as well as several standards issued by the American National Standards Institute, have used the newer dosimetric quantities and units endorsed by the ICRP.

Consistent with the current rule, internal doses would still be calculated based on a 50 year committed dose. The following ''cross-walk'' is provided to show the new terms DOE proposes in this rulemaking and the current definitions of terms that would be replaced:

Current dosimetric definitions	Proposed dosimetric definitions
Committed effective dose equivalent.	Committed effective dose.
Committed dose equivalent.	Committed equivalent dose.
Cumulative total effective dose equivalent.	Cumulative total effective dose.
Deep dose equivalent	Deep equivalent dose.
Dose equivalent	Equivalent dose.
Effective dose equivalent.	Effective dose.
Lens of the eye dose equivalent.	Lens of the eye equivalent dose.
Quality factor	Radiation weighting factor.
Shallow dose equivalent.	Shallow equivalent dose.
Weighting factor	Tissue weighting factor.
Total effective dose equivalent.	Total effective dose.

Note: Throughout the text of the proposed rule, the above terms would be revised.

In addition, the following definitions would be revised: Annual limit on intake, Derived air concentration, Radiation area, Radiological worker, Dose, External dose or exposure, and Internal dose or exposure. Also, consistent with ICRP Publication 60, the table of weighting factors for neutrons would no longer list a column for neutron flux density.

DOE recognizes that the proposed changes to most of the dosimetric terms used in 10 CFR part 835 to reflect the recommendations for assessing dose and associated terminology from ICRP Publications 60 and 68 will require revising many site documents and the updating of training materials. Although, in June 2004, the ICRP released a draft of updated recommendations, which include some adjustment of Tissue Weighting Factors and Radiation Weighting Factors, DOE believes that this is still an opportune time to make these changes rather than waiting for the draft recommendations to be finalized. It may be several years before the ICRP will finalize and issue the revised recommendations and accompanying dose conversion factors. DOE evaluated the effect of the proposed revisions to Tissue Weighting Factors on derivation of dose conversion factors. The evaluation found, for radionuclides of most interest to DOE, that the ICRP proposed Tissue Weighting Factors revisions would have minimal impact on the secondary limits derived using the Tissue Weighting Factors (i.e., the Derived Air Concentrations and Sealed Radioactive Source Accountability values). Any future need by DOE to revise weighting factors should have minimal administrative impact for such activities as revising procedures and training materials. It is envisioned that, over time, updated recommendations to make revisions to dosimetry calculation models will periodically be made by national and international consensus groups. Given that fact, and the significant financial and resource impact, DOE recognizes that historical doses, recorded and reported to individuals prior to the effective implementation date of this proposed amendment, should still be considered to be the official dose of record. Barring some other unforeseen reason, e.g., discovery of a site or vendor specific miscalculation in assigned doses, DOE would not require the updating of historical doses to reflect these changes. DOE considered several options for this proposed change including:

- Allowing sites to choose either converting to the newer dosimetric terminology and Tissue and Radiation Weighting Factors or remaining with the existing terminology and Tissue and Radiation Weighting Factors;
- Not specifying in the Rule a specific set of Tissue and Radiation Weighting Factors, but requiring sites to specify in their DOE approved Radiation Protection Program the weighting factors to be used and the technical basis for that determination;
- Updating the Tissue and Radiation Weighting Factors to reflect the newer research without revising the dose terminology;
- Updating the Tissue and Radiation Weighting Factors to reflect the newer research and revising the dose terminology; and
- Converting to the newer dosimetric terminology and Tissue and Radiation Weighting Factors and not updating the Derived Air Concentration values (Appendices A and B to part 835) and Appendix E to part 835 values.

DOE considers the best approach to convert all terminology and methodology, including the appendix A, B and E to part 835 values, to reflect ICRP Publications 60 and 68. However, DOE solicits comments on these different options.

DOE recognizes that the dosimetric changes will result in the need to update numerous site documents and proposes a three year implementation schedule to alleviate the burden of making the changes (i.e., many of the changes can be made during the regularly scheduled document updating processing). An extended implementation date also would recognize that the benefit of updating documents to reflect the dosimetric changes may not justify the cost at sites nearing closure. For closure sites which are scheduled to continue operation beyond the implementation date for the proposed changes, the exemption process in 10 CFR part 820 may be used to request relief, if appropriate. DOE requests input on any other constructive ways to reduce the costs of implementing this proposed change.

As discussed in other sections of this preamble, the definitions of ''authorized limit'' and ''real property'' would be added and the definition of ''radioactive material transportation'' would be revised.

C. What Is the Proposed Change to Radiological Units in 10 CFR Part 835?

DOE proposes to revise the text of § 835.4 to allow use of additional units, such as dpm, mass units, uCi/cc, and dpm/100cm^2, in records required by this part. The original intent of this provision was to preclude the exclusive use of the SI units of becquerel, gray and sievert. The intent was not to preclude use of other conventional units, such as the ones previously listed. This

proposed change would achieve the original intent.

D. What Is the Effect of the Proposed Change on Radiation Protection Programs?

DOE is proposing to add a new sentence at the end of § 835.101(f) that would read ''Unless otherwise specified in this part, compliance with the amendment to this part published on August 10, 2006, [DATE OF PUBLICATION IN THE FR] shall be achieved no later than [DATE 3 YEARS FOLLOWING THE EFFECTIVE DATE OF THE FINAL RULE].'' DOE is proposing to require compliance with the amended requirements of this part to be achieved no later than three years after the effective date of this amendment. The reasons for an extended implementation date are the same as those discussed in connection with the proposed changes to the dosimetric terms.

E. What Is the Proposed Change in the General Requirements for Monitoring Individuals and Areas in 10 CFR Part 835?

DOE proposes to amend § 835.401(a)(5) by revising the text ''engineering and process controls'' to read ''engineering and administrative controls''. This change is proposed in order to make the use of the terms consistent with DOE Policy 450.4 ''Safety Management System Policy''. DOE considers the terms to be equivalent.

F. What Is the Proposed Change in the Monitoring of Packages Containing Radioactive Material in 10 CFR Part 835?

Certain DOE sites have stated that the requirement in § 835.405(c)(2) to perform a measurement of radiation levels was unclear. Under this provision, a measurement of radiation levels is required for receipt of packages of radioactive material ''unless the package contains less than a Type A quantity (as defined at 10 CFR 71.4) of radioactive material''. The definition of a Type A quantity in 10 CFR 71.4 is a quantity of radioactive material which does not exceed a value provided in a specified table. Any quantity of radioactive material less than or equal to the value provided in the table is a Type A quantity. For example, if the table lists a quantity of 16 Curies (Ci) for an isotope, any quantity of that isotope up to and including 16 Ci is a Type A quantity. DOE received statements that the only quantity less than a Type A quantity would be a zero quantity or a negative quantity.

The intent of the requirement has always been that a measurement of the radiation level is required for receipt of packages containing more than a Type A quantity. Title 10 CFR 71.4 defines a Type B quantity as a quantity of radioactive material which exceeds a Type A quantity. Accordingly, to clarify the requirement, DOE proposes to amend § 835.405(c)(2) by changing ''unless the package contains less than a Type A quantity'' to ''if the package contains a Type B quantity''.

G. What Is the Proposed Change in the Exception for Labeling Requirements in 10 CFR Part 835?

DOE proposes to establish an upper limit of 0.1 Ci for a quantity of radioactive material which would be excepted from the labeling requirement in § 835.606(a)(2). After the establishment of the radioactive material labeling requirements in the 1998 amendment to 10 CFR part 835, it was noted that the exception to labeling requirements for radioactive materials appeared excessive for certain isotopes. DOE exempts from labeling items and containers if a quantity of radioactive material is less than one tenth of the values specified in appendix E of 10 CFR part 835. For some isotopes this quantity is significant. For example, a container of tritiated water does not need to be labeled ''Caution, Radioactive Material'' as long as there is less than 16 Ci of tritiated water in the container. While the basis for this exception, as discussed in the preamble to the 1998 amendment to 10 CFR part 835, is technically defensible, DOE believes that it is prudent to establish an upper limit for the labeling exception. The approach DOE is proposing is similar to that taken by the NRC, with the exception that the NRC upper limit is 0.001 Ci. DOE believes that the 0.1 Ci upper limit would provide an acceptable level of protection, based on the exposure scenario discussed in the preamble to the 1998 amendment (63 FR 59662), and still provides for sufficient operational flexibility in not being overly restrictive in the labeling requirements.

H. What Are the Proposed Changes in the Individual Monitoring Records Requirements in 10 CFR Part 835?

DOE proposes to revise § 835.702(b) to give sites the option of not assessing and recording any internal dose monitoring result estimated to be less than 10 millirem committed equivalent dose. This change is proposed in response to concerns that, under the current requirements, there is no threshold of positive internal dose monitoring result which need not be assessed and a dose recorded. DOE believes that this flexibility will be of most benefit for routine bioassay results from tritium and uranium operations. In particular for tritium, current requirements for recording internal doses may be considered to be overly burdensome. For tritium, positive bioassay results could result in needing to determine and record doses that are less than one millirem. The proposed revision allows some relief from needing to perform a dose assessment and to record these very small doses. This may most easily be achieved through the development and use of default values, below which no further dose assessment or recording is required. Establishing a dose threshold for any single bioassay and/or air monitoring result makes the DOE requirements consistent with nationally accepted standards as discussed in American National Standard for Design of Internal Dosimetry Programs (ANSI/HPS N13.39–2000). The provision still requires the maintenance of bioassay and/or air monitoring results in case they are needed by DOE in the future.

DOE's policy has been that the current monitoring threshold of 100 millirem should not be interpreted as an objective for internal dose monitoring (*i.e.*, DOE fully recognizes that routine internal dose monitoring is not capable of detecting doses at the monitoring threshold for some radionuclides). Consistent with that policy, these proposed threshold values for assessing internal dose should not be construed as the establishment of thresholds for internal dose monitoring.

The proposed revision would provide flexibility for assessing and recording doses for any single bioassay and/or air monitoring result and also includes an annual limit for doses that need not be assessed or recorded based on 50 percent of the applicable monitoring threshold at §§ 835.402(c)(1) through (4). DOE recognizes that sites wishing to invoke the flexibility offered by this proposed change would need to develop and implement a program to track bioassay results to ensure that dose constraints are not exceeded without recording the doses. DOE will provide guidance on acceptable implementation methods.

I. What Are the Proposed Changes to Radiation Safety Training?

DOE proposes to amend § 835.901(b) by adding the text ''applied training,'' after ''by successful completion of.'' The training and applied training is to be commensurate with the hazards in the area and the required controls. DOE already requires, in § 835.901(c), that

each individual demonstrate knowledge of the radiation safety training topics by successful completion of an examination and performance demonstrations. The current requirement for performance demonstration implies that the training will include practical factors or ''applied training''. Accordingly, DOE considers the proposed change to be only editorial.

DOE is considering options for adding a provision for retention testing. DOE has provided, and still maintains several guidance documents which address retention testing. These include:

- DOE G 441.1–12, Radiation Safety Training Implementation Guide
- DOE–STD–1098–99, Radiological Control
- DOE–HDBK–1131–98, General Employee Radiological Training
- DOE–HDBK–1130–98, Radiological Worker Training

In particular, DOE–HDBK–1131–98 includes an attachment ''Evaluating the Effectiveness of Radiological Training.'' This attachment discusses a recommended approach to implementing a retention testing program. DOE is soliciting comments on including, in 10 CFR part 835, a requirement for retention testing.

In addition, DOE is soliciting comments on adding a provision, in subpart J, for radiological control technician (RCT) training. Currently, 10 CFR part 835 requires individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of 10 CFR part 835 to have the appropriate education, training, and skills. This provision applies to RCTs. To assist sites in meeting this requirement, DOE has provided, and continues to maintain, several guidance documents discussing the training, retraining and qualifications of RCTs. These include:

- DOE G 441.1–1, Management and Administration of Radiation Protection Programs Implementation Guide
- DOE–STD–1098–99, Radiological Control
- DOE STD–1107–97, Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities
- DOE–DBK–1122–99, Radiological Control Technician Training.

All of the above provide guidance on DOE's expectations for the appropriate level of training, retraining, testing and qualification of RCTs. DOE is soliciting comments on including, in 10 CFR part 835, requirements for RCT of training, retraining, testing and qualification.

J. What Are the Proposed Changes in the Design and Control Requirements in 10 CFR Part 835?

DOE proposes to amend § 835.1001(a) by replacing the text ''physical design features and administrative control'' with ''engineering and administrative controls''. DOE also proposes to amend § 835.1001(b) by replacing the text ''physical design features'' with ''engineering controls'' and proposes to amend § 835.1003 by replacing the text ''physical design features and administrative controls'' with ''engineering and administrative controls''. These changes are proposed in order to make the use of the terms consistent with DOE Policy 450.4 ''Safety Management System Policy''. DOE considers the terms to be equivalent.

K. What Are the Proposed Changes in the General Provisions to Emergency Exposure Situations in 10 CFR Part 835?

DOE proposes to amend the general provisions to emergency exposure situations to clarify that the resumption of operations, pursuant to § 835.1301(d), only applies to operations which have been suspended as a result of a dose in excess of the limits specified in section § 835.202. DOE considers the proposed change to be only editorial.

L. What Are the Changes to the DAC Values, Introductory Paragraph, and Footnotes in Appendix A to 10 CFR Part 835?

One of the options discussed earlier in this preamble is the adoption of the system of dosimetry for intake of radioactive materials set forth in more recent ICRP Publications. Because provisions pertaining to the control of internal dose reference appendix A, DOE proposes to modify the derived air concentration values contained in appendix A to reflect the previously mentioned ICRP publications. The salient changes would be:

- The use of updated dose per unit intake conversion factors specified in ICRP Publication 68 instead of the dose per unit intake conversion factors in the EPA Federal Guidance Report Number 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, which is the basis for the current appendix A values. ICRP Publication 68 lists committed effective dose coefficients which are used in deriving the derived air concentration limit based on the stochastic limit of 5 rem. In order to determine if the non-stochastic (organ) limit of 50 rem to any organ or tissue is more limiting, DOE used the ICRP computer program, The ICRP Database of Dose Coefficients: Workers and Members of the Public, ISBN 0 08 043 8768. As in the current set of derived air concentration values, the more limiting value (stochastic or non-stochastic) is used.
- The use of the ICRP Publication 66 classification of radioactive material by absorption rate [F(fast), M(medium), and S(slow)] instead of by lung clearance classes [D(days), W(weeks), and Y(years)] as specified in ICRP Publication 30.
- The use of default particle size distribution of 5 μm instead of a default particle size distribution of 1 μ if the actual particle size distribution is not known.

These proposed changes are explained in the introduction to appendix A.

In addition to the changes in the dosimetric models used to calculate the DACs in appendix A, several other changes to this appendix are proposed. One proposed change is to establish derived air concentration values for tritiated particulate aerosols, insoluble organically bound tritium and default values for radionuclides not listed in the appendix.

Subsequent to the November 4, 1998, amendment to 10 CFR part 835, Occupational Radiation Protection (63 FR 59662), the Department and its contractors have been researching and developing appropriate guidance for individual exposure to tritiated particulate aerosols and insoluble organically bound tritium. In 1999, the DOE Office of Worker Protection Policy and Programs (EH–52) issued Radiological Control Technical Position RCTP 99–02, Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Tritiated Particulate Aerosols and Organically-Bound Tritium, which provided guidance on use of acceptable air concentration values. In 2004 EH–52 also published a technical standard, Radiological Control Programs for Special Tritium Compounds, DOE–HDBK–1184–2004, which provides additional guidance on use of acceptable air concentration values. The ICRP publications do not list dose coefficients for tritiated particulate aerosols and do not specifically address insoluble organically bound tritium. Therefore, DOE proposes including derived air concentration values for these substances based on the methodology described in DOE–HDBK–1184–2004, adjusted to use the ICRP 60 dosimetric quantities. This handbook is available for review at: *http://*

www.eh.doe.gov/radiation/ts.html and the Freedom of Information Reading Room.

Appendix A to 10 CFR part 835 does not include default values for radionuclides not listed in the appendices. Consistent with the NRC practice, DOE proposes to establish default values for radionuclides not listed in appendix A. One default value would apply for any isotope not already listed with a decay mode other than alpha emission or spontaneous fission and with a radioactive half-life greater than two hours. The default value would be the most restrictive applicable derived air concentration value already listed in appendix A for that type of decay, *i.e.*, 1.E–10 μCi/ml (4 Bq/m^3). The second default value would apply for any isotope not already listed with a decay mode of alpha emission or spontaneous fission, or any mixture for which the identity or the concentration of any radionuclide in the mixture is not known. The default value would likewise be the most restrictive applicable derived air concentration value already listed in appendix A, *i.e.*, 2.E–13 μCi/ml (8.E–03 Bq/m^3).

M. What Are the Proposed Changes to the DAC Values, Introductory Paragraph, and Footnotes in Appendix C to 10 CFR Part 835?

DOE proposes to amend appendix C to 10 CFR part 835 by changing the term ''contaminated atmospheric cloud'' to ''cloud of airborne radioactive material''. DOE considers this change to be only editorial. Consistent with DOE's proposal to adopt the system of dosimetry for intake of radioactive materials set forth in more recent ICRP publications, DOE proposes to replace the air immersion derived air concentration values in appendix C with new values which were determined using ICRP Publication 68 methodology. Specifically, the proposed values are derived from the dose conversion factors in Annex D of ICRP publication 68 and assumes 250 days (50 weeks times 5 days per week) exposure per year to get an effective dose of 5 rem in a year. Consistent with the NRC, DOE also proposes to establish a default value for any single radionuclide not listed in the appendix. The default value would apply for any isotope not already listed with a decay mode other than alpha emission or spontaneous fission and with a radioactive half-life less than two hours. The derived air concentration would be the most restrictive value already listed, *i.e.*, 6.E–06 μCi/ml (2.E+04 Bq/m^3).

N. What Are the Proposed Changes to the Text and Footnotes in Appendix D to 10 CFR Part 835?

Several changes to appendix D are proposed in order to codify guidance issued by the Department in Radiological Control Technical Positions (RCTP) and to enhance the clarity of this section. In 10 Code of Federal Regulations Part 835 Appendix D—Surface Radioactivity Values, RCTP 96–02, DOE provided guidance on the application of footnote 5 to this appendix that addresses surface contamination values for mixed fission products containing Sr-90. Based on this guidance, DOE proposes to revise appendix D as follows: In the second group of nuclides (total surface radioactivity value—1000 dpm/100 cm^2; removable surface radioactivity value—200 dpm/100 cm^2) the parenthetical phrase ''including mixed fission products where the Sr-90 fraction is 90 percent or more of the total activity'' would be inserted. A new group would be added to appendix D (between the existing second and third groups) that consists of mixed fission products where the Sr-90 fraction is more than 50 percent but less than 90 percent of the total activity. For this new group, the total surface radioactivity value would be 3000 dpm/100 cm^2 and the removable surface radioactivity value would be 600 dpm/100 cm^2. In the group of beta-gamma emitters (total surface radioactivity value—5000 dpm/100 cm^2; removable surface radioactivity value—1000 dpm/100 cm^2) the term ''Sr-90 and others'' would be replaced by the word ''those''.

In addition, DOE proposes to clarify footnote seven to Appendix D by replacing the term ''(alpha)'' with the sentence ''These limits only apply to the alpha emitters within the respective decay series.

DOE is not proposing changes to the surface radioactivity values in Appendix D at this time. DOE is aware of newly developed surface radioactivity criteria (see American National Standard—Surface and Volume Radioactivity Standards for Clearance (ANSI/HPS N13.12–1999)), for the release of property and other items, which are more clearly based on potential risks than the surface contamination values in appendix D. However, to maintain a consistent application in the use of surface radioactivity values for both protection of workers and for protection of the public and the environment, DOE intends to continue evaluation of appendix D surface contamination values as a coordinated project that addresses both occupational and environmental aspects of this topic.

DOE–HDBK–1184–2004 recommends applying the 10 CFR part 835 subpart L provisions when the contamination levels from insoluble tritiated particles fixed to a surface exceed the removable tritium limit. DOE is soliciting comments on the need to revise the rule to reflect this recommendation.

O. What Are the Proposed Changes to the Text and Footnote in Appendix E to 10 CFR Part 835?

As discussed earlier, DOE proposes to adopt the system of dosimetry for intake of radioactive materials set forth in more recent ICRP Publications. The appendix E values would be revised using the ICRP 60 methodology and using the same exposure scenarios as were discussed in the 1998 amendment to 10 CFR part 835. In summary, the values would be based on the more limiting of the quantity of radioactive material which results in either an external or internal whole body dose, from either inhalation or ingestion, of 100 millirem. The external exposure scenario assumes a photon exposure for 12 hours a day for 365 days with the source distance being at 1 meter. The internal exposure scenario assumes an instantaneous intake of 0.001% of the material by an individual. Consistent with the other proposed changes, appendix E values have been recalculated to reflect the previously mentioned ICRP publications.

DOE also proposes to add a footnote to appendix E that any type of tritiated particulate aerosol or organically-bound tritiated compound has a value of 10 Ci. This proposed change would be made to keep appendix E consistent with the proposed change to appendix A which includes the addition of tritiated compounds. The value of 10 Ci was derived using the same method as the other proposed values in appendix E, *i.e.*, they are based on the exposure scenario discussed in the preamble to the 1998 amendment. Specifically, the inhalation exposure scenario used to derive the 10 Ci value assumes a 100 mrem dose from a Type S hafnium tritide particle (the most restrictive tritiated particulate aerosol or organically-bound tritiated compound) with a release fraction to be inhaled of 0.001%. A dose conversion value of 2.6 E-10 Sv/Bq, using the methodology from Radiological Control Programs for Special Tritium Compounds, DOE–HDBK–1184–2004, adjusted to using the ICRP 60 dosimetric quantities, was used.

In addition, the appendix E value for Californium-252, which decays by

spontaneous fission emitting neutrons, would be lower if the external exposure assumption was for neutron instead of photon exposure. Accordingly, DOE calculated the proposed appendix E value for Californium-252 by substituting a neutron exposure for the photon exposure in the external exposure scenario using values from Reference Neutron Radiations—Part 1: Characteristics and Methods of Production, ISO/CD, 8529–1.

P. For These Proposed Changes in 10 CFR Part 835, Does DOE Plan To Issue Guidance Documents?

The primary implementation guides which define DOE's expectations for the existing rule are the DOE G 441.1 series of 13 Implementation Guides for use with 10 CFR part 835. All of these guides are available through the DOE directives Web page on ''*http://www.directives.doe.gov/serieslist.html*''.

DOE plans on updating these 13 guides to reflect the amended requirements. DOE also plans to review and, as necessary, incorporate the DOE Radiological Control Technical Positions issued by the DOE Office of Worker Protection Policy and Programs into the Implementation Guides. DOE Technical Standards developed by the DOE Office of Worker Protection Policy and Programs will be updated as part of their routine five year reaffirmation process. In particular, these Technical Standards include: DOE–STD–1098–99 Radiological Control, DOE–STD–1121–98 Internal Dosimetry and the series of handbook relating to radiation protection training.

Q. Would a Contractor Need To Submit Any Documents for DOE Approval?

Section 835.101(g) requires contractors to update their Radiation Protection Program (RPP) and submit it to the DOE within 180 days of the effective date of any modifications to part 835. In accordance with 10 CFR 835.101(f), the RPP shall include plans, schedules, and other measures for achieving compliance no later than three years following the effective date of the amendment. DOE has issued guidance on submittal of RPPs in DOE G 441.1–1A, Management and Administration of Radiation Protection Programs.

V. Procedural Requirements

A. Review Under the National Environmental Policy Act

DOE has reviewed these proposed amendments to 10 CFR parts 820 and 835 under the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality's regulations (40 CFR parts 1500–08), and DOE's implementing regulations (10 CFR part 1021). Categorical Exclusion A5 in Appendix A to Subpart D of 10 CFR part 1021 (rulemaking that amends an existing rule without changing the environmental effect of the amended rule) applies to this rulemaking. Accordingly, DOE has not prepared an environmental impact statement or an environmental assessment pursuant to NEPA.

B. Review Under Executive Order 12866

This proposed rule has been determined not to be a ''significant regulatory action'' within the scope of section 3(f) of the Executive Order 12866, ''Regulatory Planning and Review'' (58 FR 51735, October 4, 1993. Accordingly, this proposed rule was not reviewed under the Executive Order by the Office of Information and Regulatory Affairs in the Office of Management and Budget.

C. Review Under Regulatory Flexibility Act

The Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*, requires that a Federal agency prepare a regulatory flexibility analysis for any rule for which the agency is required to publish a general notice of proposed rulemaking. The requirement to prepare an analysis does not apply, however, if the agency certifies that a rule will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process (68 FR 7990). DOE has made its procedures and policies available on the Office of General Counsel's Web site: *http://www.gc.doe.gov*.

The impact of the changes to 10 CFR part 820 are primarily for DOE's administration of its enforcement program. The impact of the changes to 10 CFR part 835 are primarily with respect to large management and operating contractors. Subcontractors and suppliers are expected to satisfy the provisions of 10 CFR part 835 primarily through the programs and procedures established by prime contractors. The impacts to small entities with respect to changes to 10 CFR parts 820 and 835 are expected to be minor and the costs of compliance are reimbursable under contracts with DOE. On this basis, DOE certifies that this rule will not have a significant economic impact on a substantial number of small entities and, therefore, no analysis has been prepared.

D. Review Under the Paperwork Reduction Act of 1995

The information collection provisions of this proposed rule are not substantially different from those contained in DOE contracts with DOE prime contractors covered by this proposed rule. The information collection was previously approved by the Office of Management and Budget (OMB) and assigned OMB Control No. 1910–0300. Accordingly, no additional Office of Management and Budget clearance is required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*).

E. Review Under Executive Order 13132

Executive Order 13132 (64 FR 43255, August 10, 1999), requires agencies to develop an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have ''federalism implications.'' Policies that have federalism implications are defined in the Executive Order to include regulations that have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. DOE has examined the proposed changes to 10 CFR parts 820 and 835 and determined that they do not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among various levels of government. No further action is required by Executive Order 13132.

F. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995, 2 U.S.C. 1531 *et seq.*, requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate in an agency rule that may result in the expenditure by State, local, and tribal governments, in the aggregate or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year.

This proposed rule would amend 10 CFR parts 820 and 835. The 10 CFR part 835 changes would apply only to activities conducted by or for DOE

involving individual exposure to ionizing radiation. Any costs resulting from implementation of DOE's management, operation, and enforcement of its nuclear safety program are ultimately borne by the Federal Government. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply.

G. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3 of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (February 7, 1996), imposes on Executive agencies the general duty to eliminate drafting errors and ambiguity, write regulations to minimize litigation, provide a clear legal standard for affected conduct rather than a general standard, and promote simplification and burden reduction. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met. DOE has completed the required review and determined that, to the extent permitted by law, this notice of proposed rulemaking to amend 10 CFR parts 820 and 835 meets the relevant standards of Executive Order 12988.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. The proposed amendments to 10 CFR parts 820 and 835 would not impact on the autonomy or integrity of the family institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Statement.

I. Review under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use'' (66 FR 28355, May 22, 2001) requires Federal agencies to prepare and submit to the Office of Information and Regulatory Affairs in the Office of Management and Budget a Statement of Energy Effects for any significant energy action. Today's proposed rule is not a significant energy action, as that term is defined in the Executive Order. Accordingly, DOE has not prepared a Statement of Energy Effects.

J. Review Under the Treasury and General Government Appropriations Act, 2001

The Treasury and General Government Appropriation Act, 2001 (44 U.S. C. 3516, note) provides for agencies to review most dissemination of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB'S guidelines were published at 67 FR 8452 (February 22, 2002), and DOE's guidelines were published at 67 FR 62446 (October 7, 2002). DOE has reviewed today's notice under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Approval of the Office of the Secretary of Energy

The Office of the Secretary has approved the issuance of this notice of proposed rulemaking.

VI. Opportunity for Public Comment

A. Written Comments

Interested persons are invited to participate in this proceeding by submitting data, views, or comments on this proposed rule. Three copies of written comments should be submitted to the address indicated in the **ADDRESSES** section of this notice of proposed rulemaking. Comments should be identified on the outside of the envelope and on the comments themselves with the designated ''Docket No. EH–RM–02–835'' or ''RIN 1901–AA95.'' All comments received on or before the date specified at the beginning of this notice will be considered before final action is taken in this rulemaking. Because of recent delays in the delivery of mail to DOE, we recommend that comments also be sent by email to the address given at the beginning of this notice of proposed rulemaking.

All submitted comments will be available for public inspection as part of the administrative record for this rulemaking in the DOE Freedom of Information Reading Room at the address given in the **ADDRESSES** section of this notice of proposed rulemaking.

Pursuant to the provisions of 10 CFR 1004.11, anyone submitting information or data that he or she believes to be confidential and exempt by law from public disclosure should submit one complete copy of the document, as well as two copies, if possible, from which the information has been deleted. DOE will make its determination as to the confidentiality of the information and treat it accordingly.

B. Public Hearing

A public hearing will be held at the time, date, and location indicated in the **DATES** and **ADDRESSES** sections of this notice. DOE invites any person who has an interest in the proposed rule, or who is a representative of a group or class of persons that has an interest, to make a request for an opportunity to make an oral presentation at the hearing. Requests to speak should be sent to the mailing address or e-mail address or made by calling the telephone number given in the **DATES** section of this notice. Requests must be received by the time specified in the **DATES** section of this notice. The person making the request should provide a daytime telephone number. Each person selected to speak at a public hearing will be notified as to his or her approximate speaking time. DOE reserves the right to select persons to be heard at each hearing, to schedule their presentations, and to establish procedures governing the conduct of the hearing. The length of each presentation will be limited to 10 minutes, unless the hearing officer determines that the number of persons requesting to speak permits longer presentation times.

A departmental official will be designated to preside at the hearing. The hearing will not be a judicial or a trial-type hearing but will be conducted in accordance with 5 U.S.C. 553 and section 501 of the Department of Energy Organization Act, 42 U.S.C. 7191. Only those persons conducting the hearing may ask questions. At the conclusion of all initial oral statements, each person will be given the opportunity to make a rebuttal statement. The rebuttal statements will be given in the same order as the initial statements. Any further procedural rules needed for the proper conduct of the hearing will be announced by the Presiding Officer at the hearing.

DOE will retain the record of the full hearing, including the transcript, and make it available for inspection and copying in the DOE Freedom of Information Reading Room at the address provided in the **ADDRESSES** section of this notice. Transcripts may be purchased from the court reporter.

If DOE must cancel the hearing, every effort will be made to publish an advance notice of such cancellation in the **Federal Register**. Notice of cancellation also will be given to all persons scheduled to speak at the hearing. The hearing date may be canceled in the event no public testimony has been scheduled in advance.

List of Subjects

10 CFR Part 820

Administrative practice and procedure, Federal buildings and facilities, Government contracts, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Nuclear safety, Penalties, Public health, and Radiation protection.

10 CFR Part 835

Federal buildings and facilities, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Nuclear safety, Occupational safety and health, Radiation protection, and Reporting and recordkeeping requirements.

Issued in Washington, DC on July 6, 2006.

C. Russell H. Shearer,

Acting Assistant Secretary for Environment, Safety and Health.

For the reasons set forth in the preamble, Parts 820 and 835 of Chapter III, Title 10, of the Code of Federal Regulations are proposed to be amended as set forth below.

PART 820—PROCEDURAL RULES FOR DOE NUCLEAR ACTIVITIES

1. The authority citation for part 820 is revised to read as follows:

Authority: 42 U.S.C. 2201; 2282(a); 7191; 28 U.S.C. 2461 note; 50 U.S.C. 2410.

2. In § 820.1 paragraph (c) is revised to read as follows:

§ 820.1 Purpose and Scope.

* * * * *

(c) *Exclusion.* Activities and facilities covered under E.O. 12344, 42 U.S.C. 7158 note, pertaining to Naval nuclear propulsion are excluded from the requirements of subparts D and E of this part regarding interpretations and exemptions related to this part. The Deputy Administrator for Naval Reactors or his designee will be responsible for formulating, issuing, and maintaining appropriate records of interpretations and exemptions for these facilities and activities.

3. In § 820.2 revise the definitions for ''Director'', and ''Secretarial Officer'', and add a new definition for ''NNSA'', in alphabetical order to read as follows:

§ 820.2 Definitions.

* * * * *

Director means a DOE Official to whom the Secretary has assigned the authority to investigate the nature and extent of compliance with the requirements of this part. With regard to activities and facilities covered under E.O. 12344, 42 U.S.C. 7158 note, pertaining to Naval nuclear propulsion, the Director shall mean the Deputy Administrator for Naval Reactors or his designee.

* * * * *

NNSA means the National Nuclear Security Administration.

* * * * *

Secretarial Officer means the Assistant Secretary, NNSA Administrator, Deputy Administrator, Program Office Director, or equivalent DOE official who has primary line management responsibility for a contractor.

* * * * *

4. Section 820.13 is added to read as follows:

§ 820.13 Direction to NNSA contractors.

(a) Notwithstanding any other provision of this part, and pursuant to section 3220 of Public Law 106–65, as amended, the NNSA Administrator, rather than the Director, signs, issues and serves the following actions that direct NNSA contractors:

(1) Subpoenas;

(2) Orders to compel attendance;

(3) Disclosures of information or documents obtained during an investigation or inspection;

(4) Preliminary notices of violations; and

(5) Final notices of violations.

(b) The NNSA Administrator shall act after consideration of the Director's recommendation.

5. In § 820.21, paragraphs (g) and (h) are added to read as follows:

§ 820.21 Investigations.

* * * * *

(g) The Director may issue enforcement letters that communicate DOE's expectations with respect to any aspect of the requirements of DOE's Nuclear Safety Requirements, including identification and reporting of issues, corrective actions, and implementation of the DOE's Nuclear Safety Requirements, provided that an enforcement letter may not create the basis for any legally enforceable requirement pursuant to this part.

(h) The Director may sign, issue and serve subpoenas.

6. In Appendix A to part 820, revise sections IV and VIII to read as follows:

Appendix A to Part 820—General Statement of Enforcement Policy

* * * * *

IV. Responsibilities

(a) The Director, as the principal enforcement officer of the DOE, has been delegated the authority to:

(1) Conduct enforcement inspections, investigations, and conferences;

(2) Issue Notices of Violations and proposed civil penalties, Enforcement Letters, Consent Orders, and subpoenas; and

(3) Issue orders to compel attendance and disclosure of information or documents obtained during an investigation or inspection.

(b) The NNSA Administrator, pursuant to section 3212 of Public Law 106–65, as amended, has responsibility for environment, safety and health operations within NNSA and is authorized to sign, issue and serve the following actions that direct NNSA contractors:

(1) Subpoenas;

(2) Orders to compel attendance;

(3) Disclosure of information or documents obtained during an investigation or inspection;

(4) Preliminary Notices of Violations; and

(5) Final Notices of Violations.

The NNSA Administrator acts after consideration of the Director's recommendation.

* * * * *

VIII. Enforcement Letter

(a) In cases where DOE has decided not to conduct an investigation or inspection or issue a Preliminary Notice of Violation (PNOV), DOE may send an Enforcement Letter to the contractor, signed by the Director. Enforcement Letters issued to NNSA contractors will be coordinated with the Deputy Administrator of the NNSA with primary responsibility for environment, safety and health matters prior to issuance. The Enforcement Letter is intended to communicate the basis of the decision not to pursue enforcement action for a noncompliance. The Enforcement Letter is intended to inform contractors of the desired level of worker safety and health performance. It may be used when DOE concludes the specific noncompliance at issue is not of the level of significance warranted to conduct an investigation or inspection or for issuance of a PNOV. Even where a noncompliance may be significant, the Enforcement Letter recognizes that the contractor's actions may have attenuated the need for enforcement action. The Enforcement Letter will typically recognize how the contractor handled the circumstances surrounding the noncompliance, address additional areas requiring the contractor's attention, and address DOE's expectations for corrective action.

(b) In general, Enforcement Letters communicate DOE's expectations with respect to any aspect of the requirements of this part, including identification and reporting of issues, corrective actions, and implementation of the contractor's safety and health program. DOE might, for example, wish to recognize some action of the contractor that is of particular benefit to worker safety and health that is a candidate for emulation by other contractors. On the other hand, DOE may wish to bring a program shortcoming to the attention of the contractor that, but for the lack of worker safety and health significance of the immediate issue, might have resulted in the issuance of a PNOV. An Enforcement Letter is not an enforcement action.

(c) With respect to many noncompliances, DOE may decide not to send an Enforcement Letter. When DOE decides that a contractor has appropriately corrected a noncompliance or that the significance of the noncompliance is sufficiently low, it may close out its review simply through an annotation in the DOE Noncompliance Tracking System (NTS). A closeout of a noncompliance with or without an Enforcement Letter may only take place after DOE has confirmed that corrective actions have been completed. Closeout of any NNSA contractor noncompliance will be coordinated with NNSA prior to closeout.

* * * * *

PART 835—OCCUPATIONAL RADIATION PROTECTION

7. The authority citation for part 835 is revised to read as follows:

Authority: 42 U.S.C. 2201; 7191; 50 U.S.C. 2410.

8. Section 835.1 is amended:

a. In the introductory text of paragraph (b), remove the word ''discussed'' and add in its place ''provided''.

b. Paragraph (b)(2) is revised.

c. Paragraph (b)(4) is removed.

d. Paragraph (b)(5) is redesignated as (b)(4) and the word ''or'' at the end of the paragraph is removed.

e. Paragraph (b)(6) is redesignated as (b)(5) and the period at the end of the paragraph is removed and ''; or'' is added in its place.

f. A new paragraph (b)(6) is added.

g. Paragraph (c) is revised.

h. A new paragraph (d) is added.

The revisions and additions specified above read as follows:

§ 835.1 Scope.

* * * * *

(b) * * *

(2) Activities conducted under the authority of the Deputy Administrator for Naval Reactors, as described in Public Law 98–525 and 106–65;

* * * * *

(6) Radioactive material on or within material, equipment and real property which is approved for release when the radiological conditions of the material, equipment and real property have been documented to comply with the criteria for release set forth in a DOE authorized limit which has been approved by a Secretarial Officer in consultation with the Office of the Assistant Secretary for Environment, Safety and Health.

(c) Occupational doses received as a result of excluded activities listed in paragraphs (b)(1) through (b)(4) and (b)(6) of this section, shall be included to the extent practicable when determining compliance with the occupational dose limits at §§ 835.202 and 835.207, and with the limits for the embryo/fetus at § 835.206. Occupational doses resulting from authorized emergency exposures and planned special exposures shall not be considered when determining compliance with the dose limits at §§ 835.202 and 835.207.

(d) The requirements in subparts F and G of this part do not apply to radioactive material transportation, provided the radioactive material is under the continuous observation and control of an individual who is knowledgeable of and implements required exposure control measures.

9. Section 835.2 is revised to read as follows:

§ 835.2 Definitions.

(a) As used in this part:

Accountable sealed radioactive source means a sealed radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than the corresponding value provided in appendix E of this part.

Airborne radioactive material or airborne radioactivity means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

Airborne radioactivity area means any area, accessible to individuals, where:

(1) The concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in appendix A or appendix C of this part; or

(2) An individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.

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.

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 of 5 rems (0.05 sievert) or a committed equivalent dose 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 International Commission on Radiological Protection Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers*, published July, 1994 (ISBN 0 08 042651 4). This document is available from Elsevier Science Inc., Tarrytown, NY.

Authorized limit means a limit on the concentration of residual radioactive material on the surfaces or within the property that has been derived consistent with DOE directives including the as low as is reasonably achievable (ALARA) process requirements, given the anticipated use of the property and has been authorized by DOE to permit the release of the property from DOE radiological control.

Background means radiation from:

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

(2) Cosmic sources;

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

(4) 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

(5) 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:

(1) 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

(2) 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, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in appendix D of this part, but do not exceed 100 times those values.

Controlled area means any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material.

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 dose 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 cloud of radioactive material. The values are based upon International Commission on Radiological Protection Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers*, published July, 1994 (ISBN 0 08 042651 4). This document is available from Elsevier Science Inc., Tarrytown, NY.

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 DAC for each radionuclide) and the time of exposure to that radionuclide, in hours.

DOE activity means an activity taken for or by DOE in a DOE operation or facility 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 or multiple DOE sites.

Entrance or access point means any location through which an individual could gain access to areas controlled for the purpose 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 an individual who performs work for or in conjunction with DOE or utilizes DOE facilities.

High contamination area means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination 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 equivalent dose 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 a general employee. An individual is not a ''member of the public'' during any period in which the individual receives an occupational dose.

Minor means an individual less than 18 years of age.

Monitoring means the measurement of radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses and the use of the results of these measurements to evaluate radiological hazards or potential and actual doses resulting from exposures to ionizing radiation.

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 dose means an individual's ionizing radiation dose (external and internal) as a result of that individual's work assignment. Occupational dose does not include doses received as a medical patient or doses resulting from background radiation or participation as a subject 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 equivalent dose 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.

Radioactive material area means any area within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in appendix E of this part.

Radioactive material transportation means the movement of radioactive material by aircraft, rail, vessel, or highway vehicle. Radioactive material transportation does not include preparation of material or packagings for transportation, storage of material awaiting transportation, or application of markings and labels required for transportation.

Radiological area means any area within a controlled area defined in this section as a ''radiation area,'' ''high radiation area,'' ''very high radiation area,'' ''contamination area,'' ''high contamination area,'' or ''airborne radioactivity area.''

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.

Real property means land and anything permanently affixed to the land such as buildings, fences and those things attached to the buildings, such as light fixtures, plumbing and heating fixtures, or other such items that would be personal property if not attached.

Real-time air monitoring means measurement of the concentrations or quantities of airborne radioactive materials on a continuous basis.

Respiratory protective device means an apparatus, such as a respirator, worn by an individual for the purpose of reducing the individual's intake of airborne radioactive materials.

Sealed radioactive source means a radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. Sealed radioactive sources do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators.

Source leak test means a test to determine if a sealed radioactive source is leaking radioactive material.

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.

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.

Week means a period of seven consecutive days.

Year means the period of time beginning on or near January 1 and ending on or near December 31 of that same year used to determine compliance with the provisions of this part. The starting and ending 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 average energy absorbed by matter from ionizing radiation per unit mass of irradiated material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

Committed effective dose (E_{50}) means the sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (w_T)—that is, $\sigma_{50} = \Sigma w_T H_{T,50}$. Committed effective dose is expressed in units of rem (or sievert).

Committed equivalent dose ($H_{T,50}$) means the equivalent dose 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 equivalent dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

Cumulative total effective dose means the sum of all total effective dose values recorded for an individual plus, for occupational exposures received before the implementation date of this amendment, the sum of all total effective dose equivalent (as defined in the November 4, 1998 amendment to this rule) values recorded for an individual, where available, for each year occupational dose was received, beginning January 1, 1989.

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

Dose is a general term for absorbed dose, equivalent dose, effective dose, committed equivalent dose, committed effective dose, or total effective dose as defined in this part.

Effective dose (E) means the summation of the products of the equivalent dose received by specified tissues or organs of the body (H_T) and the appropriate tissue weighting factor (w_T)—that is, $E = \Sigma w_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with this part, deep equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of rem (or sievert).

Equivalent dose (H_T) means the product of average absorbed dose ($D_{T,R}$) in rad (or gray) in a tissue or organ and a radiation weighting factor (w_R). Equivalent dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

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

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

Internal dose or exposure means that portion of the equivalent dose received from radioactive material taken into the body (i.e., ''internal sources'').

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

Radiation weighting factor (w_R) means the modifying factor used to calculate the equivalent dose from the average tissue or organ absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate radiation weighting factor. The radiation weighting factors to be used for determining equivalent dose in rem are as follows:

RADIATION WEIGHTING FACTORS [1], w_R

Type and energy range	Radiation weighting factor
Photons, electrons and muons, all energies [2]	1
Neutrons, energy < 10 keV [3]	5
Neutrons, energy 10 keV to 100 keV [3]	10
Neutrons, energy > 100 keV to 2 MeV [3]	20
Neutrons, energy > 2 MeV to 20 MeV [3]	10
Neutrons, energy > 20 MeV [3]	5
Protons, other than recoil protons, energy > 2 MeV	5
Alpha particles, fission fragments, heavy nuclei	20

[1] All values relate to the radiation incident on the body or, for internal sources, emitted from the source.

[2] Excluding Auger electrons emitted from nuclei bound to DNA.

[3] When spectral data are insufficient to identify the energy of the neutrons, a radiation weighting factor of 20 shall be used.

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

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

TISSUE WEIGHTING FACTORS FOR VARIOUS ORGANS AND TISSUES

Organs or tissues, T	Tissue weighting factor, w_T
Gonads	0.20
Red bone marrow	0.12
Colon	0.12
Lungs	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Esophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surfaces	0.01
Remainder [1]	0.05
Whole body [2]	1.00

[1] ''Remainder'' means the following additional tissues and organs: adrenal glands, brain, extrathoracic airways, upper large intestine, small intestine, kidney, muscle, pancreas, spleen, thymus, and uterus. In those cases in which a single one of the remainder tissues or organs receives an equivalent dose in excess of the highest dose in any of the twelve organs or tissues for which a tissue weighting factor is specified, a tissue weighting factor of 0.025 shall be applied to that tissue or organ and a tissue weighting factor of 0.025 to the average dose in the rest of the remainder.

[2] For the case of uniform external irradiation of the whole body, a tissue weighting factor (w_T) equal to 1 may be used in determination of the effective dose.

Total effective dose (TED) means the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures).

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 or in 10 CFR part 820 and not defined in this part are used consistent with the meanings given in the Act or in 10 CFR part 820.

10. Section 835.4 is revised to read as follows:

§ 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, roentgen, or rem, including multiples and subdivisions of these units, or other conventional units, such as, dpm, dpm/100 cm^2 or mass units. The SI units, becquerel (Bq), gray (Gy), and sievert (Sv), may be provided parenthetically in this part for reference with scientific standards.

11. Section 835.101 is amended by revising paragraph (f) to read as follows:

§ 835.101 Radiation protection programs.

* * * * *

(f) The RPP shall include plans, schedules, and other measures for achieving compliance with regulations of this part. Unless otherwise specified in this part, compliance with the amendments to this part published on [DATE OF PUBLICATION IN THE FR] shall be achieved no later than [DATE 3 YEARS FOLLOWING THE EFFECTIVE DATE OF THE FINAL RULE].

* * * * *

12. Section 835.202 is amended by revising paragraphs (a)(1) through (a)(4) to read as follows:

§ 835.202 Occupational dose limits for general employees.

(a) * * *

(1) A total effective dose of 5 rems (0.05 sievert);

(2) The sum of the deep equivalent dose for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rems (0.5 sievert);

(3) A lens of the eye equivalent dose of 15 rems (0.15 sievert); and

(4) The sum of the shallow equivalent dose for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rems (0.5 sievert).

* * * * *

13. Section 835.203 is revised to read as follows:

§ 835.203 Combining internal and external equivalent doses.

(a) The total effective dose during a year shall be determined by summing the effective dose from external exposures and the committed effective dose from intakes during the year.

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

14. In § 835.205 paragraphs (b)(1), (b)(2), (b)(3) introductory text, and (b)(3)(ii) are revised to read as follows:

§ 835.205 Determination of compliance for non-uniform exposure of the skin.

* * * * *

(b) * * *

(1) *Area of skin irradiated is 100 cm^2 or more.* The non-uniform equivalent dose received during the year shall be averaged over the 100 cm^2 of the skin receiving the maximum dose, added to any uniform equivalent dose also received by the skin, and recorded as the shallow equivalent dose 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 equivalent dose (H) to the irradiated area received during the year shall be added to any uniform equivalent dose also received by the skin and recorded as the shallow equivalent dose to any extremity or skin for the year. H is the equivalent dose 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 equivalent dose shall be averaged over the 1 cm^2 of skin receiving the maximum dose. This equivalent dose shall:

* * * * *

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

15. In § 835.206, paragraphs (a) and (c) are revised to read as follows:

§ 835.206 Limits for the embryo/fetus.

(a) The equivalent dose 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).

* * * * *

(c) If the equivalent dose 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.

16. Section 835.207 is revised to read as follows:

§ 835.207 Occupational dose limits for minors.

The equivalent dose limits for minors occupationally exposed to radiation and/or radioactive materials at a DOE activity are 0.1 rem (0.001 sievert) total effective dose in a year and 10% of the occupational dose limits specified at § 835.202(a)(3) and (a)(4).

17. Section 835.208 is revised to read as follows:

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

The total effective dose limit for members of the public exposed to radiation and/or radioactive material during access to a controlled area is 0.1 rem (0.001 sievert) in a year.

18. In § 835.401, paragraph (a)(5) is revised to read as follows:

§ 835.401 General requirements.

(a) * * *

(5) Verify the effectiveness of engineering and administrative controls in containing radioactive material and reducing radiation exposure; and

* * * * *

19. Section 835.402 is amended:

a. Paragraphs (a)(1)(i), (ii), and (iii) are revised.

b. Paragraph (a)(2) is revised.

c. Paragraphs (c)(1) and (c)(2) are revised.

The revisions read as follows:

§ 835.402 Individual monitoring.

(a) * * *

(1) * * *

(i) An effective dose of 0.1 rem (0.001 sievert) or more in a year;

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

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

(2) Declared pregnant workers who are likely to receive from external sources an equivalent dose to the embryo/fetus in excess of 10 percent of the applicable limit at § 835.206(a);

* * * * *

(c) * * *

(1) Radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 sievert) or more from all occupational radionuclide intakes in a year;

(2) Declared pregnant workers likely to receive an intake or intakes resulting

in a equivalent dose to the embryo/fetus in excess of 10 percent of the limit stated at § 835.206(a);

* * * * *

§ 835.405 [Amended]

20. Section 835.405 is amended in paragraph (c)(2) by removing ''unless the package contains less than a Type A'' and adding in its place ''if the package contains a Type B''.

§ 835.502 [Amended]

21. Section 835.502 is amended in paragraph (a)(2) and paragraph (b) introductory text by removing the word ''dose'' before ''equivalent'' and adding it after ''equivalent''.

§ 835.602 [Amended]

22. Section 835.602 is amended in paragraph (a) by removing the word ''equivalent''.

§ 835.606 [Amended]

23. Section 835.606 is amended in paragraph (a)(2) by adding ''and less than 0.1 Ci'' after the word ''part'' and before the punctuation.

24. Section 835.702 is amended:

a. Paragraph (a) is revised.

b. Paragraph (b) is revised.

c. Paragraphs (c)(3)(i), (ii), (iii) and (iv) are revised.

d. Paragraphs (c)(4)(i) and (ii) are revised.

e. Paragraph (c)(5)(i), (ii) and (iii) are revised.

f. Paragraph (c)(6) is revised.

The revisions read as follows:

§ 835.702 Individual monitoring records.

(a) Except as authorized by § 835.702(b), records shall be maintained to document doses received by all individuals for whom monitoring was conducted and to document doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of § 835.402, and authorized emergency exposures.

(b) Recording of the non-uniform shallow equivalent dose to the skin is not required if the dose is less than 2 percent of the limit specified for the skin at § 835.202(a)(4). Any internal dose estimated to be less than 10 millirem committed equivalent dose need not be recorded, if the bioassay and/or air monitoring results used to make the estimate are maintained in accordance with § 835.703(b) and the unrecorded internal dose estimated for any individual in a year does not exceed 50 percent of the applicable monitoring threshold at § 835.402(c).

(c) * * *

(3) * * *

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

(ii) The lens of the eye equivalent dose;

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

(iv) The shallow equivalent dose to the extremities.

(4) * * *

(i) Committed effective dose;

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

(iii) * * *

(5) * * *

(i) Total effective dose in a year;

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

(iii) Cumulative total effective dose.

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

* * * * *

25. Section 835.901 is amended by revising paragraph (b) introductory text:

§ 835.901 Radiation safety training.

* * * * *

(b) Each individual shall demonstrate knowledge of the radiation safety training topics established in § 835.901(c), commensurate with the hazards in the area and required controls, by successful completion of applied training, an examination and performance demonstrations:

* * * * *

§ 835.1001 [Amended]

26. Section 835.1001 is amended:

a. In paragraph (a), first sentence, remove ''physical design features and administrative control'' and add in its place ''engineering and administrative controls.''

b. In paragraph (b), remove ''physical design features is'' and add in its place ''engineering controls are''.

§ 835.1003 [Amended]

27. Section 835.1003 is amended in the introductory text by removing ''physical design features and administrative controls'' and add in its place ''engineering and administrative controls''.

§ 835.1301 [Amended]

28. In § 835.1301, paragraph (d) is amended by removing ''after a dose was received'' and adding in its place ''which have been suspended as a result of a dose''.

29. Appendix A to part 835 is revised to read as follows:

Appendix A to Part 835—Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities

The data presented in this appendix A are to be used for controlling individual internal doses in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403, and identifying and posting airborne radioactivity areas in accordance with § 835.603(d).

The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

The derived air concentrations (DAC) for limiting radiation exposures through inhalation of radionuclides by workers are listed in this appendix. The values are based on either a stochastic (committed effective dose) dose limit of 5 rems (0.05 Sv) or a nonstochastic (organ) dose limit of 50 rems (0.5 Sv) per year, whichever is more limiting.

Note: the 15 rems (0.15 Sv) dose limit for the lens of the eye does not appear as a critical organ dose limit.

The columns in this appendix contain the following information: (1) Radionuclide; (2) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of μCi/ml; (3) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of Bq/m^3; (4) an indication of whether or not the DAC for each class is controlled by the stochastic (effective dose) or nonstochastic (tissue) dose. The material types (F, M, and S) have been established to describe the absorption rate of the materials from the respiratory tract into the blood. The range of half-times for the absorption rates correspond to: Type F, 100% at 10 minute; Type M, 10% at 10 minute and 90% at 140 day; and Type S 0.1% at 10 minute and 99.9% at 7000 day. The DACs are listed by radionuclide, in order of increasing atomic mass, and are based on the assumption that the particle size distribution of 5 μm is used. For situations where the particle size distribution is known to differ significantly from 5 μm, appropriate corrections may be made to both the estimated dose to workers and the DACs.

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
H-3 (Water) [2]	2.E−05	2.E−05	2.E−05	7.E+05	7.E+05	7.E+05	St/St/St
H-3 (Elemental) [2]	2.E−01	2.E−01	2.E−01	9.E+09	9.E+09	9.E+09	St/St/St
Tritiated Particulate Aerosol and Organically Bound H-3 (Insoluble) [4].	1.E−05	6.E−06	2.E−06	3.E+05	2.E+05	8.E+04	St/St/St
Organically Bound H-3 (Soluble)	1.E−05	1.E−05	1.E−05	5.E+05	5.E+05	5.E+05	St/St/St
Be-7	–	1.E−05	1.E−05	–	4.E+05	4.E+05	/St/St
Be-10	–	8.E−08	2.E−08	–	3.E+03	1.E+03	/St/St
C-11 (Vapor) [2]	–	1.E−04	–	–	6.E+06	–	/St/
C-11 (CO) [2]	4.E−04	4.E−04	4.E−04	1.E+07	1.E+07	1.E+07	St/St/St
C-11 (CO_2) [2]	2.E−04	2.E−04	2.E−04	9.E+06	9.E+06	9.E+06	St/St/St
C-14 (Vapor) [2]	–	9.E−07	–	–	3.E+04	–	/St/
C-14 (CO) [2]	7.E−04	7.E−04	7.E−04	2.E+07	2.E+07	2.E+07	St/St/St
C-14 (CO_2) [2]	8.E−05	8.E−05	8.E−05	3.E+06	3.E+06	3.E+06	St/St/St
F-18	4.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Na-22	2.E−07	–	–	1.E+04	–	–	E/ /
Na-24	4.E−07	–	–	1.E+04	–	–	ET/ /
Mg-28	3.E−07	3.E−07	–	1.E+04	1.E+04	–	ET/St/
Al-26	4.E−08	4.E−08	–	1.E+03	1.E+03	–	St/St/
Si-31	9.E−06	5.E−06	5.E−06	3.E+05	1.E+05	1.E+05	ET/St/St
Si-32	1.E−07	5.E−08	1.E−08	5.E+03	2.E+03	3.E+02	St/St/St
P-32	5.E−07	1.E−07	–	1.E+04	7.E+03	–	St/St/
P-33	4.E−06	4.E−07	–	1.E+05	1.E+04	–	St/St/
S-35 (Vapor)	–	4.E−06	–	–	1.E+05	–	/St/
S-35	7.E−06	5.E−07	–	2.E+05	1.E+04	–	St/St/
Cl-36	1.E−06	1.E−07	–	4.E+04	4.E+03	–	St/St/
Cl-38	7.E−06	5.E−06	–	2.E+05	2.E+05	–	ET/ET/
Cl-39	2.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
K-40	1.E−07	–	–	6.E+03	–	–	St/ /
K-42	2.E−06	–	–	1.E+05	–	–	E/ /
K-43	9.E−07	–	–	3.E+04	–	–	ET/ /
K-44	8.E−06	–	–	2.E+05	–	–	ET/ /
K-45	9.E−06	–	–	3.E+05	–	–	ET/ /
Ca-41	–	2.E−06	–	–	8.E+04	–	/BS/
Ca-45	–	2.E−07	–	–	9.E+03	–	/St/
Ca-47	–	2.E−07	–	–	9.E+03	–	/St/
Sc-43	–	–	2.E−06	–	–	7.E+04	/ /ET
Sc-44m	–	–	2.E−07	–	–	1.E+04	/ /St
Sc-44	–	–	1.E−06	–	–	4.E+04	/ /ET
Sc-46	–	–	1.E−07	–	–	4.E+03	/ /St
Sc-47	–	–	7.E−07	–	–	2.E+04	/ /St
Sc-48	–	–	2.E−07	–	–	1.E+04	/ /ET
Sc-49	–	–	8.E−06	–	–	3.E+05	/ /ET
Ti-44	7.E−09	2.E−08	9.E−09	2.E+02	7.E+02	3.E+02	St/St/St
Ti-45	3.E−06	2.E−06	2.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
V-47	8.E−06	6.E−06	–	3.E+05	2.E+05	–	ET/ET/
V-48	2.E−07	2.E−07	–	9.E+03	7.E+03	–	ET/St/
V-49	1.E−05	2.E−05	–	7.E+05	9.E+05	–	BS/St/
Cr-48	2.E−06	2.E−06	2.E−06	8.E+04	8.E+04	8.E+04	ET/ET/ET
Cr-49	7.E−06	5.E−06	5.E−06	2.E+05	2.E+05	2.E+05	ET/ET/ET
Cr-51	1.E−05	1.E−05	1.E−05	6.E+05	6.E+05	5.E+05	St/St/St
Mn-51	7.E−06	5.E−06	–	2.E+05	2.E+05	–	ET/ET/
Mn-52m	7.E−06	5.E−06	–	2.E+05	2.E+05	–	ET/ET/
Mn-52	2.E−07	2.E−07	–	8.E+03	8.E+03	–	ET/ET/
Mn-53	5.E−06	1.E−05	–	2.E+05	5.E+05	–	BS/St/
Mn-54	5.E−07	4.E−07	–	1.E+04	1.E+04	–	St/St/
Mn-56	2.E−06	2.E−06	–	9.E+04	8.E+04	–	ET/ET/
Fe-52	6.E−07	5.E−07	–	2.E+04	2.E+04	–	ET/E/
Fe-55	6.E−07	1.E−06	–	2.E+04	6.E+04	–	St/St/
Fe-59	1.E−07	1.E−07	–	6.E+03	6.E+03	–	St/St/
Fe-60	1.E−09	4.E−09	–	6.E+01	1.E+02	–	St/St/
Co-55	–	5.E−07	5.E−07	–	2.E+04	2.E+04	/ET/ET
Co-56	–	1.E−07	1.E−07	–	5.E+03	4.E+03	/St/St
Co-57	–	1.E−06	9.E−07	–	5.E+04	3.E+04	/St/St
Co-58m	–	3.E−05	3.E−05	–	1.E+06	1.E+06	/St/St
Co-58	–	4.E−07	3.E−07	–	1.E+04	1.E+04	/St/St
Co-60m	–	4.E−04	4.E−04	–	1.E+07	1.E+07	/St/St
Co-60	–	7.E−08	3.E−08	–	2.E+03	1.E+03	/St/St
Co-61	–	6.E−06	6.E−06	–	2.E+05	2.E+05	/ET/ET
Co-62m	–	7.E−06	6.E−06	–	2.E+05	2.E+05	/ET/ET
Ni-56 (Inorg)	4.E−07	4.E−07	–	1.E+04	1.E+04	–	ET/ET/

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Ni-56 (Carbonyl)	–	4.E – 07	–	–	1.E+04	–	/St/
Ni-57 (Inorg)	5.E – 07	5.E – 07	–	2.E+04	2.E+04	–	ET/ET/
Ni-57 (Carbonyl)	–	7.E – 07	–	–	2.E+04	–	/ET/
Ni-59 (Inorg)	2.E – 06	5.E – 06	–	9.E+04	2.E+05	–	St/St/
Ni-59 (Carbonyl)	–	6.E – 07	–	–	2.E+04	–	/St/
Ni-63 (Inorg)	1.E – 06	1.E – 06	–	4.E+04	6.E+04	–	St/St/
Ni-63 (Carbonyl)	–	2.E – 07	–	–	1.E+04	–	/St/
Ni-65 (Inorg)	5.E – 06	4.E – 06	–	1.E+05	1.E+05	–	ET/ET/
Ni-65 (Carbonyl)	–	8.E – 07	–	–	3.E+04	–	/ET/
Ni-66 (Inorg)	7.E – 07	2.E – 07	–	2.E+04	1.E+04	–	St/St/
Ni-66 (Carbonyl)	–	2.E – 07	–	–	1.E+04	–	/ET/
Cu-60	5.E – 06	4.E – 06	4.E – 06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Cu-61	3.E – 06	3.E – 06	3.E – 06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Cu-64	4.E – 06	3.E – 06	3.E – 06	1.E+05	1.E+05	1.E+05	ET/E/E
Cu-67	2.E – 06	1.E – 06	9.E – 07	8.E+04	3.E+04	3.E+04	ET/St/St
Zn-62	–	–	8.E – 07	–	–	3.E+04	/ /St
Zn-63	–	–	5.E – 06	–	–	2.E+05	/ /ET
Zn-65	–	–	2.E – 07	–	–	7.E+03	/ /St
Zn-69m	–	–	1.E – 06	–	–	6.E+04	/ /St
Zn-69	–	–	7.E – 06	–	–	2.E+05	/ /ET
Zn-71m	–	–	1.E – 06	–	–	5.E+04	/ /ET
Zn-72	–	–	3.E – 07	–	–	1.E+04	/ /St
Ga-65	1.E – 05	9.E – 06	–	4.E+05	3.E+05	–	ET/ET/
Ga-66	8.E – 07	7.E – 07	–	3.E+04	2.E+04	–	ET/St/
Ga-67	3.E – 06	2.E – 06	–	1.E+05	7.E+04	–	ET/St/
Ga-68	6.E – 06	4.E – 06	–	2.E+05	1.E+05	–	ET/ET/
Ga-70	1.E – 05	1.E – 05	–	6.E+05	4.E+05	–	ET/ET/
Ga-72	5.E – 07	5.E – 07	–	2.E+04	2.E+04	–	ET/ET/
Ga-73	4.E – 06	2.E – 06	–	1.E+05	1.E+05	–	ET/St/
Ge-66	2.E – 06	2.E – 06	–	9.E+04	9.E+04	–	ET/ET/
Ge-67	1.E – 05	7.E – 06	–	3.E+05	2.E+05	–	ET/ET/
Ge-68	6.E – 07	7.E – 08	–	2.E+04	2.E+03	–	ET/St/
Ge-69	1.E – 06	1.E – 06	–	3.E+04	3.E+04	–	ET/ET/
Ge-71	5.E – 05	5.E – 05	–	2.E+06	1.E+06	–	ET/E/
Ge-75	1.E – 05	7.E – 06	–	4.E+05	2.E+05	–	ET/ET/
Ge-77	1.E – 06	1.E – 06	–	4.E+04	4.E+04	–	ET/ET/
Ge-78	3.E – 06	3.E – 06	–	1.E+05	1.E+05	–	ET/ET/
As-69	–	9.E – 06	–	–	3.E+05	–	/ET/
As-70	–	2.E – 06	–	–	8.E+04	–	/ET/
As-71	–	1.E – 06	–	–	4.E+04	–	/St/
As-72	–	4.E – 07	–	–	1.E+04	–	/St/
As-73	–	8.E – 07	–	–	3.E+04	–	/St/
As-74	–	3.E – 07	–	–	1.E+04	–	/St/
As-76	–	6.E – 07	–	–	2.E+04	–	/St/
As-77	–	1.E – 06	–	–	4.E+04	–	/St/
As-78	–	3.E – 06	–	–	1.E+05	–	/ET/
Se-70	2.E – 06	2.E – 06	–	1.E+05	9.E+04	–	ET/ET/
Se-73m	1.E – 05	1.E – 05	–	5.E+05	4.E+05	–	ET/ET/
Se-73	1.E – 06	1.E – 06	–	6.E+04	5.E+04	–	ET/ET/
Se-75	4.E – 07	3.E – 07	–	1.E+04	1.E+04	–	St/St/
Se-79	3.E – 07	1.E – 07	–	1.E+04	6.E+03	–	K/St/
Se-81m	1.E – 05	6.E – 06	–	3.E+05	2.E+05	–	ET/ET/
Se-81	1.E – 05	1.E – 05	–	6.E+05	4.E+05	–	ET/ET/
Se-83	6.E – 06	5.E – 06	–	2.E+05	1.E+05	–	ET/ET/
Br-74m	3.E – 06	2.E – 06	–	1.E+05	1.E+05	–	ET/ET/
Br-74	4.E – 06	4.E – 06	–	1.E+05	1.E+05	–	ET/ET/
Br-75	4.E – 06	3.E – 06	–	1.E+05	1.E+05	–	ET/ET/
Br-76	5.E – 07	5.E – 07	–	2.E+04	2.E+04	–	ET/ET/
Br-77	2.E – 06	2.E – 06	–	7.E+04	7.E+04	–	ET/ET/
Br-80m	6.E – 06	5.E – 06	–	2.E+05	2.E+05	–	ET/St/
Br-80	3.E – 05	2.E – 05	–	1.E+06	7.E+05	–	ET/ET/
Br-82	3.E – 07	3.E – 07	–	1.E+04	1.E+04	–	ET/ET/
Br-83	9.E – 06	6.E – 06	–	3.E+05	2.E+05	–	ET/ET/
Br-84	7.E – 06	5.E – 06	–	2.E+05	2.E+05	–	ET/ET/
Rb-79	8.E – 06	–	–	2.E+05	–	–	ET/ /
Rb-81m	1.E – 05	–	–	6.E+05	–	–	ET/ /
Rb-81	2.E – 06	–	–	1.E+05	–	–	ET/ /
Rb-82m	8.E – 07	–	–	3.E+04	–	–	ET/ /
Rb-83	5.E – 07	–	–	2.E+04	–	–	St/ /
Rb-84	3.E – 07	–	–	1.E+04	–	–	St/ /

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Rb-86	4.E−07	–	–	1.E+04	–	–	St/ /
Rb-87	7.E−07	–	–	2.E+04	–	–	St/ /
Rb-88	1.E−05	–	–	5.E+05	–	–	ET/ /
Rb-89	1.E−05	–	–	3.E+05	–	–	ET/ /
Sr-80	3.E−06	–	2.E−06	1.E+05	–	9.E+04	ET/ /St
Sr-81	7.E−06	–	5.E−06	2.E+05	–	2.E+05	ET/ /ET
Sr-82	1.E−07	–	7.E−08	6.E+03	–	2.E+03	St/ /St
Sr-83	1.E−06	–	9.E−07	3.E+04	–	3.E+04	ET/ /ET
Sr-85m	4.E−05	–	3.E−05	1.E+06	–	1.E+06	ET/ /ET
Sr-85	1.E−06	–	8.E−07	3.E+04	–	3.E+04	St/ /St
Sr-87m	1.E−05	–	9.E−06	4.E+05	–	3.E+05	ET/ /ET
Sr-89	4.E−07	–	1.E−07	1.E+04	–	3.E+03	St/ /St
Sr-90	1.E−08	–	7.E−	4.E+02	–	2.E+02	BS/ /St
Sr-91	1.E−06	–	9.E−07	5.E+04	–	3.E+04	ET/ /St
Sr-92	2.E−06	–	1.E−06	8.E+04	–	6.E+04	ET/ /St
Y-86m	–	7.E−06	6.E−06	–	2.E+05	2.E+05	/ET/ET
Y-86	–	4.E−07	4.E−07	–	1.E+04	1.E+04	/ET/ET
Y-87	–	9.E−07	8.E−07	–	3.E+04	3.E+04	/ET/ET
Y-88	–	1.E−07	1.E−07	–	6.E+03	6.E+03	/St/St
Y-90m	–	4.E−06	4.E−06	–	1.E+05	1.E+05	/St/St
Y-90	–	3.E−07	3.E−07	–	1.E+04	1.E+04	/St/St
Y-91m	–	2.E−05	2.E−05	–	7.E+05	7.E+05	/ET/ET
Y-91	–	1.E−07	9.E−08	–	4.E+03	3.E+03	/St/St
Y-92	–	2.E−06	2.E−06	–	7.E+04	7.E+04	/St/St
Y-93	–	9.E−07	9.E−07	–	3.E+04	3.E+04	/St/St
Y-94	–	8.E−06	8.E−06	–	3.E+05	3.E+05	/ET/ET
Y-95	–	1.E−05	1.E−05	–	4.E+05	4.E+05	/ET/ET
Zr-86	5.E−07	5.E−07	5.E−07	2.E+04	2.E+04	2.E+04	T/ET/ET
Zr-88	1.E−07	3.E−07	3.E−07	5.E+03	1.E+04	1.E+04	St/St/St
Zr-89	6.E−07	6.E−07	6.E−07	2.E+04	2.E+04	2.E+04	ET/ET/ET
Zr-93	3.E−09	1.E−08	1.E−07	1.E+02	6.E+02	5.E+03	BS/BS/BS
Zr-95	9.E−08	1.E−07	1.E−07	3.E+03	5.E+03	4.E+03	BS/St/St
Zr-97	7.E−07	4.E−07	4.E−07	2.E+04	1.E+04	1.E+04	ET/St/St
Nb-88	–	5.E−06	5.E−06	–	1.E+05	1.E+05	/ET/ET
Nb-89 (66 min)	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/ET/ET
Nb-89 (122 min)	–	2.E−06	2.E−06	–	1.E+05	1.E+05	/ET/ET min)
Nb-90	–	3.E−07	3.E−07	–	1.E+04	1.E+04	/ET/ET
Nb-93m	–	1.E−06	6.E−07	–	7.E+04	2.E+04	/St/St
Nb-94	–	7.E−08	2.E−08	–	2.E+03	8.E+02	/St/St
Nb-95m	–	7.E−07	6.E−07	–	2.E+04	2.E+04	/St/St
Nb-95	–	4.E−07	4.E−07	–	1.E+04	1.E+04	/St/St
Nb-96	–	4.E−07	4.E−07	–	1.E+04	1.E+04	/ET/ET
Nb-97	–	5.E−06	5.E−06	–	1.E+05	1.E+05	/ET/ET
Nb-98	–	3.E−06	3.E−06	–	1.E+05	.E+05	/ET/ET
Mo-90	8.E−07	–	7.E−07	3.E+04	–	2.E+04	ET/ /ET
Mo-93m	1.E−06	–	1.E−06	3.E+04	–	3.E+04	ET/ /ET
Mo-93	2.E−07	–	4.E−07	7.E+03	–	1.E+04	BS/ /St
Mo-99	1.E−06	–	5.E−07	5.E+04	–	1.E+04	E/ /St
Mo-101	8.E−06	–	6.E−06	3.E+05	–	2.E+05	ET/ /ET
Tc-93m	8.E−06	7.E−06	–	3.E+05	2.E+05	–	ET/ET/
Tc-93	3.E−06	3.E−06	–	1.E+05	1.E+05	–	ET/ET/
Tc-94m	5.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
Tc-94	1.E−06	1.E−06	–	4.E+04	3.E+04	–	ET/ET/
Tc-95m	8.E−07	6.E−07	–	3.E+04	2.E+04	–	ET/St/
Tc-95	1.E−06	1.E−06	–	5.E+04	5.E+04	–	ET/ET/
Tc-96m	2.E−05	2.E−05	–	1.E+06	1.E+06	–	ET/ET/
Tc-96	3.E−07	3.E−07	–	1.E+04	1.E+04	–	ET/ET/
Tc-97m	1.E−06	2.E−07	–	5.E+04	7.E+03	–	St/St/
Tc-97	4.E−06	3.E−06	–	1.E+05	1.E+05	–	ET/St/
Tc-98	3.E−07	9.E−08	–	1.E+04	3.E+03	–	St/St/
Tc-99m	1.E−05	1.E−05	–	5.E+05	4.E+05	–	ET/ET/
Tc-99	1.E−06	1.E−07	–	5.E+04	6.E+03	–	St/St/
Tc-101	1.E−05	1.E−05	–	6.E+05	4.E+05	–	ET/ET/
Tc-104	9.E−06	7.E−06	–	3.E+05	2.E+05	–	ET/ET/
Ru-94	5.E−06	5.E−06	5.E−06	2.E+05	1.E+05	1.E+05	ET/ET/ET
Ru-97	2.E−06	2.E−06	2.E−06	8.E+04	8.E+04	8.E+04	ET/ET/ET
Ru-103	8.E−07	2.E−07	2.E−07	3.E+04	1.E+04	9.E+03	St/St/St
Ru-105	2.E−06	2.E−06	2.E−06	9.E+04	8.E+04	8.E+04	ET/ET/ET
Ru-106	5.E−08	3.E−08	1.E−08	2.E+03	1.E+03	5.E+02	St/St/St

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Rh-99m	3.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Rh-99	8.E−07	6.E−07	6.E−07	3.E+04	2.E+04	2.E+04	ET/St/St
Rh-100	5.E−07	5.E−07	5.E−07	1.E+04	1.E+04	1.E+04	ET/ET/ET
Rh-101m	1.E−06	1.E−06	1.E−06	6.E+04	6.E+04	6.E+04	ET/ET/ET
Rh-101	3.E−07	3.E−07	1.E−07	1.E+04	1.E+04	6.E+03	St/St/St
Rh-102m	2.E−07	2.E−07	1.E−07	1.E+04	7.E+03	4.E+03	St/St/St
Rh-102	6.E−08	1.E−07	6.E−08	2.E+03	4.E+03	2.E+03	St/St/St
Rh-103m	4.E−04	2.E−04	2.E−04	1.E+07	8.E+06	8.E+06	St/St/St
Rh-105	3.E−06	1.E−06	1.E−06	1.E+05	5.E+04	4.E+04	ET/St/St
Rh-106m	1.E−06	1.E−06	1.E−06	6.E+04	5.E+04	5.E+04	ET/ET/ET
Rh-107	1.E−05	9.E−06	9.E−06	5.E+05	3.E+05	3.E+05	ET/ET/ET
Pd-100	5.E−07	5.E−07	5.E−07	2.E+04	2.E+04	2.E+04	ET/ET/ET
Pd-101	3.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Pd-103	4.E−06	1.E−06	1.E−06	1.E+05	6.E+04	7.E+04	E/St/St
Pd-107	1.E−05	1.E−05	1.E−06	5.E+05	4.E+05	7.E+04	K/St/St
Pd-109	2.E−06	1.E−06	1.E−06	9.E+04	4.E+04	4.E+04	St/St/St
Ag-102	9.E−06	7.E−06	7.E−06	3.E+05	2.E+05	2.E+05	ET/ET/ET
Ag-103	8.E−06	7.E−06	7.E−06	3.E+05	2.E+05	2.E+05	ET/ET/ET
Ag-104m	8.E−06	6.E−06	6.E−06	2.E+05	2.E+05	2.E+05	ET/ET/ET
Ag-104	3.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Ag-105	7.E−07	8.E−07	7.E−07	2.E+04	2.E+04	2.E+04	St/St/St
Ag-106m	2.E−07	2.E−07	2.E−07	9.E+03	9.E+03	9.E+03	ET/ET/ET
Ag-106	1.E−05	1.E−05	1.E−05	5.E+05	4.E+05	4.E+05	ET/ET/ET
Ag-108m	7.E−08	1.E−07	2.E−08	2.E+03	4.E+03	1.E+03	St/St/St
Ag-110m	8.E−08	9.E−08	7.E−08	3.E+03	3.E+03	2.E+03	St/St/St
Ag-111	9.E−07	3.E−07	3.E−07	3.E+04	1.E+04	1.E+04	St/St/St
Ag-112	4.E−06	2.E−06	2.E−06	1.E+05	8.E+04	8.E+04	E/St/St
Ag-115	1.E−05	8.E−06	8.E−06	4.E+05	3.E+05	3.E+05	ET/ET/ET
Cd-104	4.E−06	4.E−06	4.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Cd-107	5.E−06	5.E−06	4.E−06	2.E+05	1.E+05	1.E+05	ET/ET/ET
Cd-109	2.E−08	9.E−08	1.E−07	9.E+02	3.E+03	4.E+03	K/K/St
Cd-113m	1.E−09	6.E–09	1.E−08	6.E+01	2.E+02	6.E+02	K/K/K
Cd-113	1.E−09	5.E−09	1.E−08	5.E+01	2.E+02	5.E+02	K/K/K
Cd-115m	3.E−08	1.E−07	1.E−07	1.E+03	3.E+03	3.E+03	K/St/St
Cd-115	9.E−07	4.E−07	4.E−07	3.E+04	1.E+04	1.E+04	K/St/St
Cd-117m	1.E−06	1.E−06	1.E−06	4.E+04	4.E+04	4.E+04	ET/ET/ET
Cd-117	2.E−06	2.E−06	2.E−06	8.E+04	7.E+04	7.E+04	ET/ET/ET
In-109	4.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
In-110 (69 min)	5.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
In-110 (5 h)	9.E−07	9.E−07	–	3.E+04	3.E+04	–	ET/ET/
In-111	1.E−06	1.E−06	–	5.E+04	5.E+04	–	ET/ET/
In-112	2.E−05	1.E−05	–	9.E+05	6.E+05	–	ET/ET/
In-113m	1.E−05	1.E−05	–	4.E+05	3.E+05	–	ET/ET/
In-114m	5.E−08	9.E−08	–	1.E+03	3.E+03	–	St/St/
In-115m	6.E−06	5.E−06	–	2.E+05	2.E+05	–	ET/ET/
In-115	1.E−09	5.E−09	–	4.E+01	1.E+02	–	St/St/
In-116m	4.E−06	3.E−06	–	1.E+05	1.E+05	–	ET/ET/
In-117m	5.E−06	4.E−06	–	2.E+05	1.E+05	–	ET/ET/
In-117	7.E−06	5.E−06	–	2.E+05	2.E+05	–	ET/ET/
In-119m	1.E−05	1.E−05	–	6.E+05	4.E+05	–	ET/ET/
Sn-110	1.E−06	1.E−06	–	6.E+04	6.E+04	–	ET/ET/
Sn-111	1.E−05	1.E−05	–	6.E+05	5.E+05	–	ET/ET/
Sn-113	7.E−07	2.E−07	–	2.E+04	1.E+04	–	St/St/
Sn-117m	8.E−07	2.E−07	–	3.E+04	9.E+03	–	BS/St/
Sn-119m	1.E−06	3.E−07	–	5.E+04	1.E+04	–	St/St/
Sn-121m	5.E−07	1.E−07	–	2.E+04	6.E+03	–	St/St/
Sn-121	4.E−06	2.E−06	–	1.E+05	7.E+04	–	ET/St/
Sn-123m	1.E−05	7.E−06	–	4.E+05	2.E+05	–	ET/ET/
Sn-123	3.E−07	1.E−07	–	1.E+04	3.E+03	–	St/St/
Sn-125	4.E−07	2.E−07	–	1.E+04	7.E+03	–	St/St/
Sn-126	4.E−08	3.E−08	–	1.E+03	1.E+03	–	St/St/
Sn-127	2.E−06	2.E−06	–	9.E+04	7.E+04	–	ET/ET/
Sn-128	2.E−06	2.E−06	–	1.E+05	8.E+04	–	ET/ET/
Sb-115	1.E−05	1.E−05	–	5.E+05	4.E+05	–	ET/ET/
Sb-116m	3.E−06	2.E−06	–	1.E+05	1.E+05	–	ET/ET/
Sb-116	1.E−05	1.E−05	–	4.E+05	3.E+05	–	ET/ET/
Sb-117	1.E−05	1.E−05	–	4.E+05	3.E+05	–	ET/ET/
Sb-118m	1.E−06	1.E−06	–	4.E+04	4.E+04	–	ET/ET/
Sb-119	6.E−06	6.E−06	–	2.E+05	2.E+05	–	ET/ET/
Sb-120 (16 min)	2.E−05	2.E−05	–	1.E+06	7.E+05	–	ET/ET/

Radionuclide	Material type [3] μCi/ml			Material type [3] Bq/m [3]			Stochastic or organ [1] (F/M/S)
	F	M	S	F	M	S	
Sb-120 (6 d)	3.E−07	3.E−07	–	1.E+04	1.E+04	–	ET/ET/
Sb-122	8.E−07	4.E−07	–	3.E+04	1.E+04	–	St/St/
Sb-124m	4.E−05	3.E−05	–	1.E+06	1.E+06	–	ET/ET/
Sb-124	2.E−07	1.E−07	–	1.E+04	4.E+03	–	St/St/
Sb-125	2.E−07	1.E−07	–	7.E+03	6.E+03	–	BS/St/
Sb-126m	1.E−05	7.E−06	–	3.E+05	2.E+05	–	ET/ET/
Sb-126	2.E−07	1.E−07	–	9.E+03	6.E+03	–	ET/St/
Sb-127	7.E−07	3.E−07	–	2.E+04	1.E+04	–	E/St/
Sb-128 (9 h)	5.E−07	5.E−07	–	2.E+04	2.E+04	–	ET/ET/
Sb-128 (10 min)	1.E−05	9.E−06	–	4.E+05	3.E+05	–	ET/ET/
Sb-129	1.E−06	1.E−06	–	6.E+04	5.E+04	–	ET/ET/
Sb-130	3.E−06	2.E−06	–	1.E+05	1.E+05	–	ET/ET/
Sb-131	6.E−06	4.E−06	–	2.E+05	1.E+05	–	ET/ET/
Te-116 (Vapor)	–	6.E−06	–	–	2.E+05	–	/St/
Te-116	2.E−06	2.E−06	–	8.E+04	7.E+04	–	ET/ET/
Te-121m (Vapor)	–	4.E−08	–	–	1.E+03	–	/BS/
Te-121m	1.E−07	1.E−07	–	4.E+03	5.E+03	–	BS/St/
Te-121 (Vapor)	–	1.E−06	–	–	4.E+04	–	/St/
Te-121	1.E−06	1.E−06	–	3.E+04	3.E+04	–	ET/ET/
Te-123m (Vapor)	–	5.E−08	–	–	2.E+03	–	/BS/
Te-123m	1.E−07	1.E−07	–	4.E+03	6.E+03	–	BS/St/
Te-123 (Vapor)	–	1.E−08	–	–	4.E+02	–	/BS/
Te-123	2.E−08	5.E−08	–	1.E+03	1.E+03	–	BS/BS/
Te-125m (Vapor)	–	1.E−07	–	–	3.E+03	–	/BS/
Te-125m	2.E−07	1.E−07	–	9.E+03	7.E+03	–	BS/St/
Te-127m (Vapor)	–	6.E−08	–	–	2.E+03	–	/BS/
Te-127m	1.E−07	9.E−08	–	5.E+03	3.E+03	–	BS/St/
Te-127 (Vapor)	–	7.E−06	–	–	2.E+05	–	/St/
Te-127	5.E−06	3.E−06	–	2.E+05	1.E+05	–	ET/St/
Te-129m (Vapor)	–	1.E−07	–	–	5.E+03	–	/St/
Te-129m	3.E−07	1.E−07	–	1.E+04	3.E+03	–	St/St/
Te-129 (Vapor)	–	1.E−05	–	–	5.E+05	–	/St/
Te-129	1.E−05	7.E−06	–	4.E+05	2.E+05	–	ET/ET/
Te-131m (Vapor)	–	1.E−07	–	–	5.E+03	–	/T/
Te-131m	3.E−07	3.E−07	–	1.E+04	1.E+04	–	T/St/
Te-131 (Vapor)	–	6.E−06	–	–	2.E+05	–	/T/
Te-131	1.E−05	7.E−06	–	4.E+05	2.E+05	–	ET/ET/
Te-132 (Vapor)	–	7.E−08	–	–	2.E+03	–	/T/
Te-132	1.E−07	1.E−07	–	6.E+03	6.E+03	–	T/St/
Te-133m (Vapor)	–	1.E−06	–	–	6.E+04	–	/T/
Te-133m	3.E−06	2.E−06	–	1.E+05	1.E+05	–	T/ET/
Te-133 (Vapor)	–	7.E−06	–	–	2.E+05	–	/T/
Te-133	1.E−05	9.E−06	–	4.E+05	3.E+05	–	ET/ET/
Te-134 (Vapor)	–	6.E−06	–	–	2.E+05	–	/St/
Te-134	3.E−06	2.E−06	–	1.E+05	1.E+05	–	ET/ET/
I-120m (Methyl)	4.E−06	–	–	1.E+05	–	–	T/ /
I-120m (Vapor)	–	3.E−06	–	–	1.E+05	–	/St/
I-120m	2.E−06	–	–	8.E+04	–	–	ET/ /
I-120 (Methyl)	1.E−06	–	–	6.E+04	–	–	T/ /
I-120 (Vapor)	–	1.E−06	–	–	5.E+04	–	/T/
I-120	2.E−06	–	–	1.E+05	–	–	E/ /
I-121 (Methyl)	5.E−06	–	–	2.E+05	–	–	T/ /
I-121 (Vapor)	–	4.E−06	–	–	1.E+05	–	/T/
I-121	8.E−06	–	–	3.E+05	–	–	T/ /
I-123 (Methyl)	1.E−06	–	–	7.E+04	–	–	T/ /
I-123 (Vapor)	–	1.E−06	–	–	5.E+04	–	/T/
I-123	2.E−06	–	–	1.E+05	–	–	T/ /
I-124 (Methyl)	3.E−08	–	–	1.E+03	–	–	T/ /
I-124 (Vapor)	–	2.E−08	–	–	9.E+02	–	/T/
I-124	4.E−08	–	–	1.E+03	–	–	T/ /
I-125 (Methyl)	2.E−08	–	–	9.E+02	–	–	T/ /
I-125 (Vapor)	–	2.E−08	–	–	7.E+02	–	/T/
I-125	3.E−08	–	–	1.E+03	–	–	T/ /
I-126 (Methyl)	1.E−08	–	–	5.E+02	–	–	T/ /
I-126 (Vapor)	–	1.E−08	–	–	4.E+02	–	/T/
I-126	2.E−08	–	–	7.E+02	–	–	T/ /
I-128 (Methyl)	3.E−05	–	–	1.E+06	–	–	T/ /
I-128 (Vapor)	–	8.E−06	–	–	3.E+05	–	/St/
I-128	1.E−05	–	–	6.E+05	–	–	ET/ /
I-129 (Methyl)	3.E−09	–	–	1.E+02	–	–	T/ /

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
I-129 (Vapor)	–	2.E−09	–	–	1.E+02	–	/T/
I-129	5.E−09	–	–	2.E+02	–	–	T/ /
I-130 (Methyl)	2.E−07	–	–	7.E+03	–	–	T/ /
I-130 (Vapor)	–	1.E−07	–	–	6.E+03	–	/T/
I-130	3.E−07	–	–	1.E+04	–	–	T/ /
I-131 (Methyl)	1.E−08	–	–	6.E+02	–	–	T/ /
I-131 (Vapor)	–	1.E−08	–	–	5.E+02	–	/T/
I-131	2.E−08	–	–	9.E+02	–	–	T/ /
I-132m (Methyl)	1.E−06	–	–	7.E+04	–	–	T/ /
I-132m (Vapor)	–	1.E−06	–	–	6.E+04	–	/T/
I-132m	3.E−06	–	–	1.E+05	–	–	T/ /
I-132 (Methyl)	1.E−06	–	–	6.E+04	–	–	T/ /
I-132 (Vapor)	–	1.E−06	–	–	5.E+04	–	/T/
I-132	2.E−06	–	–	7.E+04	–	–	T/ /
I-133 (Methyl)	9.E−08	–	–	3.E+03	–	–	T/ /
I-133 (Vapor)	–	7.E−08	–	–	2.E+03	–	/T/
I-133	1.E−07	–	–	5.E+03	–	–	T/ /
I-134 (Methyl)	8.E−06	–	–	2.E+05	–	–	T/ /
I-134 (Vapor)	–	3.E−06	–	–	1.E+05	–	/St/
I-134	3.E−06	–	–	1.E+05	–	–	ET/ /
I-135 (Methyl)	4.E−07	–	–	1.E+04	–	–	T/ /
I-135 (Vapor)	–	3.E−07	–	–	1.E+04	–	/T/
I-135	6.E−07	–	–	2.E+04	–	–	T/ /
Cs-125	1.E−05	–	–	4.E+05	–	–	ET/ /
Cs-127	4.E−06	–	–	1.E+05	–	–	ET/ /
Cs-129	2.E−06	–	–	9.E+04	–	–	ET/ /
Cs-130	1.E−05	–	–	6.E+05	–	–	ET/ /
Cs-131	7.E−06	–	–	2.E+05	–	–	ET/ /
Cs-132	9.E−07	–	–	3.E+04	–	–	ET/ /
Cs-134m	8.E−06	–	–	2.E+05	–	–	ET/ /
Cs-134	5.E−08	–	–	2.E+03	–	–	St/ /
Cs-135m	8.E−06	–	–	2.E+05	–	–	ET/ /
Cs-135	5.E−07	–	–	2.E+04	–	–	St/ /
Cs-136	2.E−07	–	–	1.E+04	–	–	E/ /
Cs-137	8.E−08	–	–	3.E+03	–	–	St/ /
Cs-138	5.E−06	–	–	2.E+05	–	–	ET/ /
Ba-126	4.E−06	–	–	1.E+05	–	–	ET/ /
Ba-128	4.E−07	–	–	1.E+04	–	–	St/ /
Ba-131m	4.E−05	–	–	1.E+06	–	–	ET/ /
Ba-131	1.E−06	–	–	4.E+04	–	–	ET/ /
Ba-133m	2.E−06	–	–	7.E+04	–	–	St/ /
Ba-133	3.E−07	–	–	1.E+04	–	–	St/ /
Ba-135m	2.E−06	–	–	9.E+04	–	–	St/ /
Ba-139	1.E−05	–	–	3.E+05	–	–	St/ /
Ba-140	3.E−07	–	–	1.E+04	–	–	St/ /
Ba-141	1.E−05	–	–	4.E+05	–	–	ET/ /
Ba-142	9.E−06	–	–	3.E+05	–	–	ET/ /
La-131	1.E−05	8.E−06	–	4.E+05	3.E+05	–	ET/ET/
La-132	1.E−06	1.E−06	–	5.E+04	5.E+04	–	ET/ET/
La-135	1.E−05	1.E−05	–	4.E+05	4.E+05	–	ET/ET/
La-137	4.E−08	2.E−07	–	1.E+03	8.E+03	–	L/L/
La-138	3.E−09	1.E−08	–	1.E+02	4.E+02	–	St/St/
La-140	4.E−07	3.E−07	–	1.E+04	1.E+04	–	ET/St/
La-141	5.E−06	2.E−06	–	1.E+05	9.E+04	–	St/St/
La-142	2.E−06	2.E−06	–	9.E+04	8.E+04	–	ET/ET/
La-143	1.E−05	1.E−05	–	6.E+05	4.E+05	–	ET/ET/
Ce-134	–	3.E−07	3.E−07	–	1.E+04	1.E+04	/St/St
Ce-135	–	5.E−07	5.E−07	–	2.E+04	2.E+04	/ET/ET
Ce-137m	–	1.E−06	9.E−07	–	3.E+04	3.E+04	/St/St
Ce-137	–	1.E−05	1.E−05	–	7.E+05	7.E+05	/ET/ET
Ce-139	–	4.E−07	4.E−07	–	1.E+04	1.E+04	/St/St
Ce-141	–	2.E−07	1.E−07	–	7.E+03	6.E+03	/St/St
Ce-143	–	5.E−07	5.E−07	–	2.E+04	2.E+04	/St/St
Ce-144	–	2.E−08	1.E−08	–	9.E+02	7.E+02	/St/St
Pr-136	–	1.E−05	1.E−05	–	3.E+05	3.E+05	/ET/ET
Pr-137	–	9.E−06	9.E−06	–	3.E+05	3.E+05	/ET/ET
Pr-138m	–	2.E−06	2.E−06	–	7.E+04	7.E+04	/ET/ET
Pr-139	–	1.E−05	1.E−05	–	5.E+05	5.E+05	/ET/ET
Pr-142m	–	6.E−05	5.E−05	–	2.E+06	2.E+06	/St/St
Pr-142	–	8.E−07	7.E−07	–	2.E+04	2.E+04	/St/St

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Pr-143	–	2.E−07	2.E−07	–	1.E+04	9.E+03	/St/St
Pr-144	–	1.E−05	1.E−05	–	4.E+05	4.E+05	/ET/ET
Pr-145	–	2.E−06	2.E−06	–	8.E+04	8.E+04	/St/St
Pr-147	–	9.E−06	9.E−06	–	3.E+05	3.E+05	/ET/ET
Nd-136	–	4.E−06	4.E−06	–	1.E+05	1.E+05	/ET/ET
Nd-138	–	1.E−06	1.E−06	–	5.E+04	5.E+04	/St/St
Nd-139m	–	1.E−06	1.E−06	–	5.E+04	5.E+04	/ET/ET
Nd-139	–	1.E−05	1.E−05	–	6.E+05	6.E+05	/ET/ET
Nd-141	–	3.E−05	3.E−05	–	1.E+06	1.E+06	/ET/ET
Nd-147	–	2.E−07	2.E−07	–	1.E+04	9.E+03	/St/St
Nd-149	–	4.E−06	4.E−06	–	1.E+05	1.E+05	/ET/ET
Nd-151	–	9.E−06	9.E−06	–	3.E+05	3.E+05	/ET/ET
Pm-141	–	1.E−05	1.E−05	–	4.E+05	4.E+05	/ET/ET
Pm-143	–	5.E−07	6.E−07	–	2.E+04	2.E+04	/St/St
Pm-144	–	1.E−07	1.E−07	–	3.E+03	5.E+03	/St/St
Pm-145	–	1.E−07	4.E−07	–	5.E+03	1.E+04	/BS/St
Pm-146	–	4.E−08	6.E−08	–	1.E+03	2.E+03	/St/St
Pm-147	–	1.E−07	1.E−07	–	4.E+03	6.E+03	/BS/St
Pm-148m	–	1.E−07	1.E−07	–	5.E+03	4.E+03	/St/St
Pm-148	–	2.E−07	2.E−07	–	9.E+03	9.E+03	/St/St
Pm-149	–	7.E−07	6.E−07	–	2.E+04	2.E+04	/St/St
Pm-150	–	2.E−06	2.E−06	–	8.E+04	8.E+04	/ET/ET
Pm-151	–	9.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Sm-141m	–	5.E−06	–	–	2.E+05	–	/ET/
Sm-141	–	1.E−05	–	–	4.E+05	–	/ET/
Sm-142	–	4.E−06	–	–	1.E+05	–	/ET/
Sm-145	–	4.E−07	–	–	1.E+04	–	/BS/
Sm-146	–	2.E−11	–	–	1.E+00	–	/BS/
Sm-147	–	2.E−11	–	–	1.E+00	–	/BS/
Sm-151	–	7.E−08	–	–	2.E+03	–	/BS/
Sm-153	–	8.E−07	–	–	3.E+04	–	St/
Sm-155	–	1.E−05	–	–	3.E+05	–	/ET/
Sm-156	–	2.E−06	–	–	7.E+04	–	/St/
Eu-145	–	5.E−07	–	–	2.E+04	–	/ET/
Eu-146	–	3.E−07	–	–	1.E+04	–	/ET/
Eu-147	–	5.E−07	–	–	2.E+04	–	/St/
Eu-148	–	2.E−07	–	–	9.E+03	–	/St/
Eu-149	–	2.E−06	–	–	9.E+04	–	/St/
Eu-150 (12 h)	–	2.E−06	–	–	7.E+04	–	/St/
Eu-150 (34 yr)	–	1.E−08	–	–	6.E+02	–	/St/
Eu-152m	–	1.E−06	–	–	6.E+04	–	/St/
Eu-152	–	2.E−08	–	–	7.E+02	–	/St/
Eu-154	–	1.E−08	–	–	5.E+02	–	/St/
Eu-155	–	7.E−08	–	–	2.E+03	–	/BS/
Eu-156	–	1.E−07	–	–	6.E+03	–	/St/
Eu-157	–	1.E−06	–	–	4.E+04	–	/St/
Eu-158	–	5.E−06	–	–	1.E+05	–	/ET/
Gd-145	9.E−06	7.E−06	–	3.E+05	2.E+05	–	ET/ET/
Gd-146	1.E−07	1.E−07	–	4.E+03	4.E+03	–	St/St/
Gd-147	7.E−07	6.E−07	–	2.E+04	2.E+04	–	ET/ET/
Gd-148	5.E−12	2.E−11	–	2.E−01	9.E−01	–	BS/BS/
Gd-149	1.E−06	7.E−07	–	4.E+04	2.E+04	–	St/St/
Gd-151	2.E−07	8.E−07	–	9.E+03	3.E+04	–	BS/St/
Gd-152	7.E−12	3.E−11	–	2.E−01	1.E+00	–	BS/BS/
Gd-153	9.E−08	4.E−07	–	3.E+03	1.E+04	–	BS/St/
Gd-159	3.E−06	1.E−06	–	1.E+05	5.E+04	–	St/St/
Tb-147	–	2.E−06	–	–	1.E+05	–	/ET/
Tb-149	–	1.E−07	–	–	6.E+03	–	/St/
Tb-150	–	2.E−06	–	–	8.E+04	–	/ET/
Tb-151	–	1.E−06	–	–	4.E+04	–	/ET/
Tb-153	–	2.E−06	–	–	8.E+04	–	/St/
Tb-154	–	5.E−07	–	–	2.E+04	–	/ET/
Tb-155	–	2.E−06	–	–	8.E+04	–	/St/
Tb-156m (24 h)	–	2.E−06	–	–	9.E+04	–	/St/
Tb-156m (5 h)	–	4.E−06	–	–	1.E+05	–	/St/
Tb-156	–	4.E−07	–	–	1.E+04	–	/E/
Tb-157	–	2.E−07	–	–	8.E+03	–	/BS/
Tb-158	–	1.E−08	–	–	6.E+02	–	/BS/
Tb-160	–	1.E−07	–	–	3.E+03	–	/St/
Tb-161	–	4.E−07	–	–	1.E+04	–	/St/

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Dy-155	–	2.E−06	–	–	1.E+05	–	/ET/
Dy-157	–	5.E−06	–	–	1.E+05	–	/ET/
Dy-159	–	2.E−06	–	–	8.E+04	–	/BS/
Dy-165	–	6.E−06	–	–	2.E+05	–	/ET/
Dy-166	–	3.E−07	–	–	1.E+04	–	/St/
Ho-155	–	1.E−05	–	–	4.E+05	–	/ET/
Ho-157	–	2.E−05	–	–	1.E+06	–	/ET/
Ho-159	–	2.E−05	–	–	9.E+05	–	/ET/
Ho-161	–	3.E−05	–	–	1.E+06	–	/ET/
Ho-162m	–	9.E−06	–	–	3.E+05	–	/ET/
Ho-162	–	5.E−05	–	–	2.E+06	–	/ET/
Ho-164m	–	3.E−05	–	–	1.E+06	–	/St/
Ho-164	–	2.E−05	–	–	8.E+05	–	/ET/
Ho-166m	–	7.E−09	–	–	2.E+02	–	/St/
Ho-166	–	6.E−07	–	–	2.E+04	–	/St/
Ho-167	–	4.E−06	–	–	1.E+05	–	/ET/
Er-161	–	3.E−06	–	–	1.E+05	–	/ET/
Er-165	–	2.E−05	–	–	1.E+06	–	/ET/
Er-169	–	6.E−07	–	–	2.E+04	–	/St/
Er-171	–	1.E−06	–	–	6.E+04	–	/St/
Er-172	–	4.E−07	–	–	1.E+04	–	/St/
Tm-162	–	9.E−06	–	–	3E+05	–	/ET/
Tm-166	–	1.E−06	–	–	4.E+04	–	/ET/
Tm-167	–	5.E−07	–	–	2.E+04	–	/St/
Tm-170	–	1.E−07	–	–	4.E+03	–	/St/
Tm-171	–	2.E−07	–	–	9.E+03	–	/BS/
Tm-172	–	4.E−07	–	–	1.E+04	–	/St/
Tm-173	–	2.E−06	–	–	8.E+04	–	/St/
Tm-175	–	8.E−06	–	–	2.E+05	–	/ET/
Yb-162	–	1.E−05	1.E−05	–	5.E+05	5.E+05	/ET/ET
Yb-166	–	6.E−07	5.E−07	–	2.E+04	2.E+04	/St/St
Yb-167	–	3.E−05	3.E−05	–	1.E+06	1.E+06	/ET/ET
Yb-169	–	2.E−07	2.E−07	–	9.E+03	8.E+03	/St/St
Yb-175	–	8.E−07	8.E−07	–	3.E+04	2.E+04	/St/St
Yb-177	–	6.E−06	5.E−06	–	2.E+05	2.E+05	/ET/ET
Yb-178	–	5.E−06	5.E−06	–	1.E+05	1.E+05	/ET/E
Lu-169	–	9.E−07	9.E−07	–	3.E+04	3.E+04	/ET/ET
Lu-170	–	4.E−07	4.E−07	–	1.E+04	1.E+04	/ET/ET
Lu-171	–	6.E−07	6.E−07	–	2.E+04	2.E+04	/St/St
Lu-172	–	3.E−07	3.E−07	–	1.E+04	1.E+04	/St/St
Lu-173	–	2.E−07	4.E−07	–	8.E+03	1.E+04	/BS/St
Lu-174m	–	2.E−07	2.E−07	–	7.E+03	8.E+03	/BS/St
Lu-174	–	9.E−08	2.E−07	–	3.E+03	8.E+03	/BS/St
Lu-176m	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/St/St
Lu-176	–	3.E−09	1.E−08	–	1.E+02	6.E+02	/BS/St
Lu-177m	–	5.E−08	4.E−08	–	2.E+03	1.E+03	/St/St
Lu-177	–	5.E−07	5.E−07	–	2.E+04	1.E+04	/St/St
Lu-178m	–	4.E−06	4.E−06	–	1.E+05	1.E+05	/ET/ET
Lu-178	–	8.E−06	8.E−06	–	3.E+05	3.E+05	/ET/ET
Lu-179	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/St/St
Hf-170	1.E−06	1.E−06	–	4.E+04	4.E+04	–	ET/ET/
Hf-172	6.E−09	3.E−08	–	2.E+02	1.E+03	–	BS/BS/
Hf-173	2.E−06	2.E−06	–	9.E+04	8.E+04	–	ET/ET/
Hf-175	5.E−07	6.E−07	–	2.E+04	2.E+04	–	BS/St/
Hf-177m	2.E−06	1.E−06	–	9.E+04	6.E+04	–	ET/ET/
Hf-178m	8.E−10	4.E−09	–	3.E+01	1.E+02	–	BS/BS/
Hf-179m	2.E−07	1.E−07	–	8.E+03	6.E+03	–	BS/St/
Hf-180m	2.E−06	1.E−06	–	7.E+04	6.E+04	–	ET/ET/
Hf-181	1.E−07	1.E−07	–	4.E+03	5.E+03	–	BS/St/
Hf-182m	5.E−06	4.E−06	–	2.E+05	1.E+05	–	ET/ET/
Hf-182	5.E−10	2.E−09	–	2.E+01	9.E+01	–	BS/BS/
Hf-183	6.E−06	4.E−06	–	2.E+05	1.E+05	–	ET/ET/
Hf-184	1.E−06	1.E−06	–	5.E+04	4.E+04	–	ET/St/
Ta-172	–	5.E−06	5.E−06	–	1.E+05	1.E+05	/ET/ET
Ta-173	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/E/E
Ta-174	–	5.E−06	5.E−06	–	2.E+05	2.E+05	/ET/ET
Ta-175	–	1.E−06	1.E−06	–	6.E+04	6.E+04	/ET/ET
Ta-176	–	1.E−06	1.E−06	–	3.E+04	3.E+04	/ET/ET
Ta-177	–	4.E−06	4.E−06	–	1.E+05	1.E+05	/St/St
Ta-178	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/ET/ET

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Ta-179	–	4.E−06	1.E−06	–	1.E+05	7.E+04	/St/St
Ta-180m	–	9.E−06	9.E−06	–	3.E+05	3.E+05	/St/St
Ta-180	–	1.E−07	4.E−08	–	4.E+03	1.E+03	/St/St
Ta-182m	–	6.E−06	6.E−06	–	2.E+05	2.E+05	/ET/ET
Ta-182	–	9.E−08	7.E−08	–	3.E+03	2.E+03	/St/St
Ta-183	–	3.E−07	2.E−07	–	1.E+04	1.E+04	/St/St
Ta-184	–	8.E−07	8.E−07	–	3.E+04	3.E+04	/ET/ET
Ta-185	–	5.E−06	5.E−06	–	2.E+05	1.E+05	/ET/ET
Ta-186	–	7.E−06	7.E−06	–	2.E+05	2.E+05	/ET/ET
W-176	3.E−06	–	–	1.E+05	–	–	ET/ /
W-177	5.E−06	–	–	2.E+05	–	–	ET/ /
W-178	3.E−06	–	–	1.E+05	–	–	ET/ /
W-179	1.E−04	–	–	5.E+06	–	–	ET/ /
W-181	1.E−05	–	–	4.E+05	–	–	ET/ /
W-185	2.E−06	–	–	9.E+04	–	–	St/ /
W-187	1.E−06	–	–	5.E+04	–	–	ET/ /
W-188	6.E−07	–	–	2.E+04	–	–	St/ /
Re-177	1.E−05	1.E−05	–	6.E+05	4.E+05	–	ET/ET/
Re-178	1.E−05	1.E−05	–	5.E+05	3.E+05	–	ET/ET/
Re-181	1.E−06	1.E−06	–	5.E+04	4.E+04	–	;ET/ET/
Re-182 (64 h)	4.E−07	3.E−07	–	1.E+04	1.E+04	–	ET/St/
Re-182 (12 h)	1.E−06	1.E−06	–	4.E+04	4.E+04	–	ET/ET/
Re-184m	6.E−07	1.E−07	–	2.E+04	4.E+03	–	St/St/
Re-184	7.E−07	3.E−07	–	2.E+04	1.E+04	–	ET/St/
Re-186m	4.E−07	7.E−08	–	1.E+04	2.E+03	–	St/St/
Re-186	7.E−07	4.E−07	–	2.E+04	1.E+04	–	St/St/
Re-187	2.E−04	1.E−04	–	8.E+06	4.E+06	–	St/St/
Re-188m	3.E−05	2.E−05	–	1.E+06	1.E+06	–	St/St/
Re-188	8.E−07	7.E−07	–	3.E+04	2.E+04	–	St/St/
Re-189	1.E−06	9.E−07	–	4.E+04	3.E+04	–	St/St/
Os-180	1.E−05	1.E−05	1.E−05	5.E+05	3.E+05	3.E+05	ET/ET/ET
Os-181	3.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Os-182	1.E−06	9.E−07	9.E−07	3.E+04	3.E+04	3.E+04	ET/ET/ET
Os-185	4.E−07	5.E−07	5.E−07	1.E+04	2.E+04	1.E+04	St/St/St
Os-189m	1.E−04	7.E−05	7.E−05	4.E+06	2.E+06	2.E+06	St/St/St
Os-191m	1.E−05	4.E−06	4.E−06	5.E+05	1.E+05	1.E+05	St/St/St
Os-191	1.E−06	4.E−07	3.E−07	5.E+04	1.E+04	1.E+04	St/St/St
Os-193	2.E−06	8.E−07	8.E−07	7.E+04	3.E+04	3.E+04	St/St/St
Os-194	4.E−08	4.E−08	1.E−08	1.E+03	1.E+03	4.E+02	St/St/St
Ir-182	9.E−06	7.E−06	7.E−06	3.E+05	2.E+05	2.E+05	ET/ET/ET
Ir-184	1.E−06	1.E−06	1.E−06	7.E+04	6.E+04	7.E+04	ET/ET/ET
Ir-185	2.E−06	1.E−06	1.E−06	7.E+04	7.E+04	7.E+04	ET/ET/ET
Ir-186 (16 h)	8.E−07	7.E−07	7.E−07	2.E+04	2.E+04	2.E+04	ET/ET/ET
Ir-186 (2 h)	5.E−06	4.E−06	4.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Ir-187	4.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/ET/ET
Ir-188	6.E−07	6.E−07	6.E−07	2.E+04	2.E+04	2.E+04	ET/ET/ET
Ir-189	3.E−06	1.E−06	1.E−06	1.E+05	5.E+04	4.E+04	St/St/St
Ir-190m (3 h)	2.E−06	2.E−06	2.E−06	8.E+04	8.E+04	7.E+04	ET/ET/ET
Ir-190m (1 h)	9.E−05	5.E−05	5.E−05	3.E+06	2.E+06	1.E+06	ET/St/St
Ir-190	4.E−07	2.E−07	2.E−07	1.E+04	9.E+03	8.E+03	ET/St/St
Ir-192m	1.E−07	1.E−07	2.E−08	3.E+03	6.E+03	1.E+03	St/St/St
Ir-192	2.E−07	1.E−07	1.E−07	9.E+03	5.E+03	4.E+03	St/St/St
Ir-194m	8.E−08	8.E−08	6.E−08	3.E+03	3.E+03	2.E+03	St/St/St
Ir-194	1.E−06	7.E−07	7.E−07	5.E+04	2.E+04	2.E+04	St/St/St
Ir-195m	2.E−06	2.E−06	2.E−06	9.E+04	7.E+04	7.E+04	ET/ET/ET
Ir-195	7.E−06	5.E−06	4.E−06	2.E+05	1.E+05	1.E+05	ET/ET/ET
Pt-186	3.E−06	–	–	1.E+05	–	–	ET/ /
Pt-188	8.E−07	–	–	3.E+04	–	–	E/ /
Pt-189	3.E−06	–	–	1.E+05	–	–	ET/ /
Pt-191	1.E−06	–	–	7.E+04	–	–	ET/ /
Pt-193m	2.E−06	–	–	8.E+04	–	–	ET/ /
Pt-193	2.E−05	–	–	7.E+05	–	–	ET/ /
Pt-195m	1.E−06	–	–	5.E+04	–	–	ET/ /
Pt-197m	7.E−06	–	–	2.E+05	–	–	ET/ /
Pt-197	3.E−06	–	–	1.E+05	–	–	ET/ /
Pt-199	1.E−05	–	–	4.E+05	–	–	ET/ /
Pt-200	1.E−06	–	–	5.E+04	–	–	St/ /
Au-193	4.E−06	3.E−06	3.E−06	1.E+05	1.E+05	1.E+05	ET/E/St
Au-194	9.E−07	9.E−07	9.E−07	3.E+04	3.E+04	3.E+04	ET/ET/ET
Au-195	3.E−06	7.E−07	4.E−07	1.E+05	2.E+04	1.E+04	ET/St/St

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Au-198m	6.E−07	2.E−07	2.E−07	2.E+04	1.E+04	1.E+04	ET/St/St
Au-198	1.E−06	5.E−07	5.E−07	4.E+04	2.E+04	1.E+04	ET/St/St
Au-199	2.E−06	8.E−07	7.E−07	7.E+04	3.E+04	2.E+04	ET/St/St
Au-200m	5.E−07	4.E−07	4.E−07	1.E+04	1.E+04	1.E+04	ET/ET/ET
Au-200	1.E−05	7.E−06	7.E−06	4.E+05	2.E+05	2.E+05	ET/ET/ET
Au-201	1.E−05	1.E−05	9.E−06	5.E+05	3.E+05	3.E+05	ET/ET/ET
Hg-193m (Org)	1.E−06	–	–	4.E+04	–	–	ET/ /
Hg-193m	1.E−06	1.E−06	–	4.E+04	4.E+04	–	ET/ET/
Hg-193m (Vapor)	–	1.E−07	–	–	6.E+03	–	/St/
Hg-193 (Org)	5.E−06	–	–	1.E+05	–	–	ET/ /
Hg-193	5.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
Hg-193 (Vapor)	–	5.E−07	–	–	1.E+04	–	/St/
Hg-194 (Org)	2.E−08	–	–	1.E+03	–	–	St/ /
Hg-194	3.E−08	1.E−07	–	1.E+03	3.E+03	–	St/St/
Hg-194 (Vapor)	–	1.E−08	–	–	5.E+02	–	/St/
Hg-195m (Org)	1.E−06	–	–	5.E+04	–	–	ET/ /
Hg-195m	1.E−06	8.E−07	–	5.E+04	3.E+04	–	ET/St/
Hg-195m (Vapor)	–	6.E−08	–	–	2.E+03	–	/St/
Hg-195 (Org)	6.E−06	–	–	2.E+05	–	–	ET/ /
Hg-195	6.E−06	6.E−06	–	2.E+05	2.E+05	–	ET/ET/
Hg-195 (Vapor)	–	4.E−07	–	–	1.E+04	–	/St/
Hg-197m (Org)	1.E−06	–	–	5.E+04	–	–	ET/ /
Hg-197m	1.E−06	8.E−07	–	5.E+04	3.E+04	–	ET/St/
Hg-197m (Vapor)	–	9.E−08	–	–	3.E+03	–	/St/
Hg-197 (Org)	4.E−06	–	–	1.E+05	–	–	ET/ /
Hg-197	4.E−06	2.E−06	–	1.E+05	7.E+04	–	ET/St/
Hg-197 (Vapor)	–	1.E−07	–	–	4.E+03	–	/St/
Hg-199m (Org)	8.E−06	–	–	3.E+05	–	–	ET/ /
Hg-199m	8.E−06	5.E−06	–	3.E+05	1.E+05	–	ET/ET/
Hg-199m (Vapor)	–	3.E−06	–	–	1.E+05	–	/St/
Hg-203 (Org)	7.E−07	–	–	2.E+04	–	–	St/ /
Hg-203	9.E−07	2.E−07	–	3.E+04	1.E+04	–	St/St/
Hg-203 (Vapor)	–	8.E−08	–	–	2.E+03	–	/St/
Tl-194m	5.E−06	–	–	2.E+05	–	–	ET/ /
Tl-194	2.E−05	–	–	8.E+05	–	–	ET/ /
Tl-195	6.E−06	–	–	2.E+05	–	–	ET/ /
Tl-197	8.E−06	–	–	2.E+05	–	–	ET/ /
Tl-198m	2.E−06	–	–	9.E+04	–	–	ET/ /
Tl-198	1.E−06	–	–	5.E+04	–	–	ET/ /
Tl-199	5.E−06	–	–	2.E+05	–	–	ET/ /
Tl-200	8.E−07	–	–	3.E+04	–	–	ET/ /
Tl-201	4.E−06	–	–	1.E+05	–	–	ET/ /
Tl-202	1.E−06	–	–	5.E+04	–	–	ET/ /
Tl-204	9.E−07	–	–	3.E+04	–	–	St/ /
Pb-195m	7.E−06	–	–	2.E+05	–	–	ET/ /
Pb-198	2.E−06	–	–	9.E+04	–	–	ET/ /
Pb-199	4.E−06	–	–	1.E+05	–	–	ET/ /
Pb-200	1.E−06	–	–	4.E+04	–	–	ET/ /
Pb-201	2.E−06	–	–	7.E+04	–	–	ET/ /
Pb-202m	1.E−06	–	–	6.E+04	–	–	ET/ /
Pb-202	4.E−08	–	–	1.E+03	–	–	St/ /
Pb-203	2.E−06	–	–	7.E+04	–	–	ET/ /
Pb-205	9.E−07	–	–	3.E+04	–	–	BS/ /
Pb-209	9.E−06	–	–	3.E+05	–	–	ET/ /
Pb-210	1.E−10	–	–	5.E+00	–	–	BS/ /
Pb-211	4.E−08	–	–	1.E+03	–	–	ET/ /
Pb-212	5.E−09	–	–	2.E+02	–	–	ET/ /
Pb-214	4.E−08	–	–	1.E+03	–	–	ET/ /
Bi-200	5.E−06	4.E−06	–	2.E+05	1.E+05	–	ET/ET/
Bi-201	3.E−06	2.E−06	–	1.E+05	1.E+05	–	ET/ET/
Bi-202	2.E−06	2.E−06	–	9.E+04	9.E+04	–	ET/ET/
Bi-203	7.E−07	7.E−07	–	2.E+04	2.E+04	–	ET/ET/
Bi-205	4.E−07	4.E−07	–	1.E+04	1.E+04	–	ET/ET/
Bi-206	2.E−07	2.E−07	–	9.E+03	8.E+03	–	ET/ET/
Bi-207	4.E−07	1.E−07	–	1.E+04	6.E+03	–	ET/St/
Bi-210m	3.E−09	2.E−10	–	1.E+02	9.E+00	–	K/St/
Bi-210	1.E−07	9.E−09	–	6.E+03	3.E+02	–	K/St/
Bi-212	1.E−08	8.E−09	–	4.E+02	3.E+02	–	ET/ET/
Bi-213	1.E−08	7.E−09	–	4.E+02	2.E+02	–	ET/ET/
Bi-214	1.E−08	1.E−08	–	6.E+02	4.E+02	–	ET/ET/

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Po-203	5.E−06	4.E−06	–	1.E+05	1.E+05	–	ET/ET/
Po-205	4.E−06	3.E−06	–	1.E+05	1.E+05	–	ET/ET/
Po-207	1.E−06	1.E−06	–	7.E+04	6.E+04	–	ET/ET/
Po-210	7.E−10	2.E−10	–	2.E+01	9.E+00	–	K/St/
At-207	1.E−06	2.E−07	–	4.E+04	1.E+04	–	St/St/
At-211	7.E−09	5.E−09	–	2.E+02	1.E+02	–	ET/St/
Rn-220 [5]	1.E−08	–	–	6.E+02	–	–	–
Rn-222 [5]	8.E−08	–	–	3.E+03	–	–	–
Fr-222	1.E−08	–	–	3.E+02	–	–	ET/ /
Fr-223	4.E−07	–	–	1.E+04	–	–	St/ /
Ra-223	–	9.E−11	–	–	3.E+00	–	/St/
Ra-224	–	2.E−10	–	–	8.E+00	–	/St/
Ra-225	–	1.E−10	–	–	4.E+00	–	/St/
Ra-226	–	2.E−10	–	–	9.E+00	–	/St/
Ra-227	–	8.E−07	–	–	3.E+04	–	/BS/
Ra-228	–	1.E−10	–	–	5.E+00	–	/BS/
Ac-224	1.E−08	6.E−09	5.E−09	6.E+02	2.E+02	2.E+02	BS/St/St
Ac-225	2.E−10	9.E−11	8.E−11	7.E+00	3.E+00	3.E+00	BS/St/St
Ac-226	1.E−09	6.E−10	5.E−10	4.E+01	2.E+01	2.E+01	ET/St/St
Ac-227	2.E−13	1.E−12	1.E−11	1.E−02	5.E−02	4.E−01	BS/BS/St
Ac-228	6.E−09	3.E−08	4.E−08	2.E+02	1.E+03	1.E+03	BS/BS/St
Th-226	–	4.E−09	4.E−09	–	1.E+02	1.E+02	/ET/ET
Th-227	–	9.E−11	7.E−11	–	3.E+00	2.E+00	/St/St
Th-228	–	2.E−11	2.E−11	–	7.E−01	8.E−01	/BS/St
Th-229	–	2.E−12	1.E−11	–	7.E−02	4.E−01	/BS/St
Th-230	–	3.E−12	4.E−11	–	1.E−01	1.E+00	/BS/BS
Th-231	–	1.E−06	1.E−06	–	5.E+04	5.E+04	/St/St
Th-232	–	3.E−12	4.E−11	–	1.E−01	1.E+00	/BS/BS
Th-234	–	1.E−07	9.E−08	–	3.E+03	3.E+03	/St/St
Pa-227	–	4.E−09	4.E−09	–	1.E+02	1.E+02	/ET/ET
Pa-228	–	1.E−08	1.E−08	–	3.E+02	4.E+02	/BS/St
Pa-230	–	1.E−09	9.E−10	–	4.E+01	3.E+01	/St/St
Pa-231	–	1.E−12	1.E−11	–	4.E−02	4.E−01	/BS/BS
Pa-232	–	1.E−08	1.E−07	–	6.E+02	7.E+03	/BS/BS
Pa-233	–	2.E−07	1.E−07	–	7.E+03	6.E+03	/St/St
Pa-234	–	7.E−07	7.E−07	–	2.E+04	2.E+04	/ET/ET
U-230	6.E−10	5.E−11	4.E−11	2.E+01	2.E+00	1.E+00	K/St/St
U-231	2.E−06	1.E−06	1.E−06	8.E+04	4.E+04	4.E+04	ET/St/St
U-232	5.E−11	1.E−10	2.E−11	2.E+00	4.E+00	7.E−01	BS/St/ET
U-233	4.E−10	2.E−10	7.E−11	1.E+01	9.E+00	2.E+00	BS/St/ET
U-234	5.E−10	2.E−10	7.E−11	1.E+01	9.E+00	2.E+00	BS/St/ET
U-235	5.E−10	3.E−10	8.E−11	1.E+01	1.E+01	3.E+00	BS/St/ET
U-236	5.E−10	2.E−10	7.E−11	1.E+01	1.E+01	2.E+00	BS/St/ET
U-237	1.E−06	3.E−07	3.E−07	4.E+04	1.E+04	1.E+04	ET/St/St
U-238	5.E−10	3.E−10	8.E−11	2.E+01	1.E+01	3.E+00	BS/St/ET
U-239	1.E−05	9.E−06	9.E−06	5.E+05	3.E+05	3.E+05	ET/ET/ET
U-240	1.E−06	7.E−07	6.E−07	5.E+04	2.E+04	2.E+04	ET/St/St
Np-232	–	3.E−06	–	–	1.E+05	–	/BS/
Np-233	–	7.E−05	–	–	2.E+06	–	/ET/
Np-234	–	5.E−07	–	–	2.E+04	–	/ET/
Np-235	–	1.E−06	–	–	4.E+04	–	/BS/
Np-236 (1.E+05 yr)	–	4.E−11	–	–	1.E+00	–	/BS/
Np-236 (22 h)	–	5.E−08	–	–	1.E+03	–	/BS/
Np-237	–	8.E−12	–	–	3.E−01	–	/BS/
Np-238	–	1.E−07	–	–	4.E+03	–	/BS/
Np-239	–	5.E−07	–	–	1.E+04	–	/St/
Np-240	–	2.E−06	–	–	8.E+04	–	/ET/
Pu-234	–	3.E−08	3.E−08	–	1.E+03	1.E+03	/St/St
Pu-235	–	9.E−05	8.E−05	–	3.E+06	3.E+06	/ET/ET
Pu-236	–	1.E−11	7.E−11	–	6.E−01	2.E+00	/BS/St
Pu-237	–	1.E−06	1.E−06	–	7.E+04	6.E+04	/St/St
Pu-238	–	6.E−12	5.E−11	–	2.E−01	1.E+00	/BS/St
Pu-239	–	5.E−12	6.E−11	–	2.E−01	2.E+00	/BS/BS
Pu-240	–	5.E−12	6.E−11	–	2.E−01	2.E+00	/BS/BS
Pu-241	–	2.E−10	2.E−09	–	1.E+01	1.E+02	/BS/BS
Pu-242	–	5.E−12	6.E−11	–	2.E−01	2.E+00	/BS/BS
Pu-243	–	5.E−06	5.E−06	–	1.E+05	1.E+05	/E/E
Pu-244	–	5.E−12	6.E−11	–	2.E−01	2.E+00	/BS/BS
Pu-245	–	9.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Pu-246	–	8.E−08	8.E−08	–	3.E+03	2.E+03	/St/St

Radionuclide	Material type [3]			Material type [3]			Stochastic or organ [1]
	μCi/ml			Bq/m [3]			(F/M/S)
	F	M	S	F	M	S	
Am-237	–	8.E−06	–	–	3.E+05	–	/ET/
Am-238	–	2.E−06	–	–	9.E+04	–	/BS/
Am-239	–	1.E−06	–	–	6.E+04	–	/ET/
Am-240	–	7.E−07	–	–	2.E+04	–	/ET/
Am-241	–	5.E−12	–	–	1.E−01	–	/BS/
Am-242m	–	5.E−12	–	–	1.E−01	–	/BS/
Am-242	–	4.E−08	–	–	1.E+03	–	/St/
Am-243	–	5.E−12	–	–	1.E−01	–	/BS/
Am-244m	–	3.E−06	–	–	1.E+05	–	/BS/
Am-244	–	1.E−07	–	–	5.E+03	–	/BS/
Am-245	–	5.E−06	–	–	2.E+05	–	/ET/
Am-246m	–	6.E−06	–	–	2.E+05	–	/ET/
Am-246	–	2.E−06	–	–	9.E+04	–	/ET/
Cm-238	–	1.E−07	–	–	4.E+03	–	/St/
Cm-240	–	3.E−10	–	–	7.E+01	–	/St/
Cm-241	–	2.E−08	–	–	8.E+02	–	/St/
Cm-242	–	1.E−10	–	–	5.E+00	–	/St/
Cm-243	–	7.E−12	–	–	2.E−01	–	/BS/
Cm-244	–	9.E−12	–	–	3.E−01	–	/BS/
Cm-245	–	5.E−12	–	–	1.E−01	–	/BS/
Cm-246	–	5.E−12	–	–	1.E−01	–	/BS/
Cm-247	–	5.E−12	–	–	2.E−01	–	/BS/
Cm-248	–	1.E−12	–	–	5.E−02	–	/BS/
Cm-249	–	8.E−06	–	–	3.E+05	–	/ET/
Cm-250	–	2.E−13	–	–	8.E−03	–	/BS/
Bk-245	–	3.E−07	–	–	1.E+04	–	/St/
Bk-246	–	8.E−07	–	–	3.E+04	–	/ET/
Bk-247	–	3.E−12	–	–	1.E−01	–	/BS/
Bk-249	–	1.E−09	–	–	5.E+01	–	/BS/
Bk-250	–	2.E−07	–	–	9.E+03	–	/BS/
Cf-244	–	1.E−08	–	–	5.E+02	–	/ET/
Cf-246	–	1.E−09	–	–	5.E+01	–	/St/
Cf-248	–	5.E−11	–	–	2.E+00	–	/BS/
Cf-249	–	3.E−12	–	–	1.E−01	–	/BS/
Cf-250	–	7.E−12	–	–	2.E−01	–	/BS/
Cf-251	–	3.E−12	–	–	1.E−01	–	/BS/
Cf-252	–	1.E−11	–	–	6.E−01	–	/BS/
Cf-253	–	5.E−10	–	–	2.E+01	–	/St/
Cf-254	–	2.E−11	–	–	8.E−01	–	/BS/
Es-250	–	4.E−07	–	–	1.E+04	–	/BS/
Es-251	–	3.E−07	–	–	1.E+04	–	/St/
Es-253	–	2.E−10	–	–	9.E+00	–	/St/
Es-254m	–	1.E−09	–	–	5.E+01	–	/St/
Es-254	–	6.E−11	–	–	2.E+00	–	/BS/
Fm-252	–	2.E−09	–	–	8.E+01	–	/St/
Fm-253	–	1.E−09	–	–	6.E+01	–	/St/
Fm-254	–	6.E−09	–	–	2.E+02	–	/ET/
Fm-255	–	2.E−09	–	–	8.E+01	–	/St/
Fm-257	–	1.E−10	–	–	4.E+00	–	/St/
Md-257	–	2.E−08	–	–	1.E+03	–	/St/
Md-258	–	1.E−10	–	–	4.E+00	–	/St/

For any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than two hours, the DAC value shall be 4.E−11 μCi/ml (1 Bq/m^3).

For any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which the identity or the concentration of any radionuclide in the mixture is not known, the DAC value shall be 2.E−13 μCi/ml (8.E−03 Bq/m^3).

Footnotes for Appendix A

[1] A determination of whether the DACs are controlled by stochastic (St) or nonstochastic (organ) dose, or if they both give the same result (E), for each lung retention class, is given in this column. The key to the organ notation for nonstochastic dose is: BS = Bone surface, ET = Extrathoracic, K = Kidney, L = Liver, and T = Thyroid. A blank indicates that no calculations were performed for the material type shown.

[2] The ICRP identifies these materials as soluble or reactive gases and vapors or highly soluble or reactive gases and vapors. For tritiated water, the inhalation DAC values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 68, Dose Coefficients for Intakes of Radionuclides by Workers. For elemental tritium, the DAC values include a factor that irradiation from gas within the lungs might increase the dose by 20%.

[3] A dash indicates no values given for this data category.

[4] DAC values derived using hafnium tritide particle and are based on observed activity (*i.e,* only radiation emitted from the particle is considered). DAC values derived using methodology found in Radiological Control Programs for Special Tritium Compounds, DOE–HDBK–1184–2004.

[5] These values are appropriate for protection from radon combined with its short-lived daughters and are based on information given in ICRP Publication 65: Protection Against Radon-222 at Home and at Work and in DOE–STD–1121–98: Internal Dosimetry. The values given are for 100% equilibrium concentration conditions of the radon daughters with the parent. To allow for an actual measured equilibrium concentration or a demonstrated equilibrium concentration, the values given in this table should be multiplied by the ratio (100%/actual %) or (100%/demonstrated %), respectively. Alternatively, the DAC values for Rn-220 and Rn-222 may be replaced by 2.5 WL* and 0.83 WL*, respectively, for appropriate limiting of daughter concentrations.

* A ''Working Level'' (WL) is any combination of short-lived radon daughters, in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy.

30. Appendix C to part 835 is revised to read as follows:

Appendix C to Part 835—Derived Air Concentration (DAC) for Workers From External Exposure During Immersion in a Cloud of Airborne Radioactive Material

a. The data presented in appendix C are to be used for controlling occupational exposures in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403 and identifying the need for posting of airborne radioactivity areas in accordance with § 835.603(d).

b. The air immersion DAC values shown in this appendix are based on a stochastic dose limit of 5 rems (0.05 Sv) per year. Four columns of information are presented: (1) radionuclide; (2) half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (yr); (3) air immersion DAC in units of μCi/ml; and (4) air immersion DAC in units of Bq/m^3. The data are listed by radionuclide in order of increasing atomic mass. The air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite cloud of airborne radioactive material. The DACs listed in this appendix may be modified to allow for submersion in a cloud of finite dimensions.

c. The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

Air Immersion DASC			
Radionuclide	Half-Life	(μCi/ml)	(Bq/m^3
Ar-37	35.02 d	1.E+00	4.E+10
Ar-39	269 yr	4.E − 04	1.E+07
Ar-41	1.827 h	1.E − 06	3.E+04
Kr-74	11.5 min	1.E − 06	4.E+04
Kr-76	14.8 h	3.E − 06	1.E+05
Kr-77	74.7 h	1.E − 06	5.E+04
Kr-79	35.04 h	5.E − 06	2.E+05
Kr-81	2.1E+05 yr	2.E − 04	9.E+06
Kr-83m	1.83 h	2.E − 02	9.E+08
Kr-85	10.72 yr	2.E − 04	9.E+06
Kr-85m	4.48 h	9.E − 06	3.E+05
Kr-87	76.3 min	1.E − 06	5.E+04
Kr-88	2.84 h	6.E − 07	2.E+04
Xe-120	40.0 min	3.E − 06	1.E+05
Xe-121	40.1 min	7.E − 07	2.E+04
Xe-122	20.1 h	2.E − 05	1.E+06
Xe-123	2.14 h	2.E − 06	8.E+04
Xe-125	16.8 h	5.E − 06	2.E+05
Xe-127	36.406 d	5.E − 06	2.E+05
Xe-129m	8.89 d	6.E − 05	2.E+06
Xe-131m	11.84 d	1.E − 04	6.E+06
Xe-133	5.245 d	4.E − 05	1.E+06
Xe-133m	2.19 d	4.E − 05	1.E+06
Xe-135	9.11 h	5.E − 06	2.E+05
Xe-135m	15.36 min	3.E − 06	1.E+05
Xe-138	14.13 min	1.E − 06	4.E+04

For any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than two hours, the DAC value shall be 6.E − 06 μCi/ml (2.E+04 Bq/m^3).

31. Appendix D to part 835 is revised to read as follows:

Appendix D to Part 835—Surface Contamination Values

The data presented in appendix D are to be used in identifying and posting contamination and high contamination areas in accordance with § 835.603(e) and (f) and identifying the need for surface contamination monitoring and control in accordance with § 835.1101 and 1102.

SURFACE CONTAMINATION VALUES[1] IN DPM/100 CM^2

Radionuclide	Removable [2 4]	Total (fixed + removable) [2 3]
U-nat, U–235, U–238, and associated decay products	[7] 1,000	[7] 5,000 products
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I–125, I–129	20	500

SURFACE CONTAMINATION VALUES[1] IN DPM/100 CM[2]—Continued

Radionuclide	Removable[2 4]	Total (fixed + removable)[2 3]
Th-nat, Th-232, Sr-90 (including mixed fission products where the Sr-90 fraction is 90 percent or more of the total activity), Ra-223, Ra-224, U–232, I–126, I-131, I–133	200	1,000
Mixed fission products where the Sr-90 fraction is more than 50 percent but less than 90 percent of the total activity	600	3,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[5]	1,000	5,000
Tritium and tritiated compounds[6]	10,000	N/A

[1] The values in this appendix, with the exception noted in footnote 6 below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.

[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[3] The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if: (1) From measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note—The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[5] This category of radionuclides includes mixed fission products where the Sr-90 fraction is 50 percent or less of the total activity.

[6] Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a ''Total'' value does not apply.

[7] These limits only apply to the alpha emitters within the respective decay series.

32. Appendix E to part 835 is revised to read as follows:

Appendix E to Part 835—Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements

The data presented in appendix E are to be used for identifying accountable sealed radioactive sources and radioactive material areas as those terms are defined at § 835.2(a), establishing the need for radioactive material area posting in accordance with § 835.603(g), and establishing the need for radioactive material labeling in accordance with § 835.605.

Nuclide	Activity (μCi)
H-3	1.5E+08
Be-7	3.1E+03
Be-10	1.4E+05
C-14	4.6E+06
Na-22	1.9E+01
Al-26	1.5E+01
Si-32	4.9E+04
S-35	2.4E+06
Cl-36	5.2E+05
K-40	2.7E+02
Ca-41	9.3E+06
Ti-44	1.5E+02
Ca-45	1.1E+06
Sc-46	6.2E+01
V-49	1.0E+08
Mn-53	7.5E+07
Mn-54	6.5E+01
Fe-55	2.9E+06
Fe-59	1.9E+02
Fe-60	8.1E+03
Co-56	3.9E+01
Co-57	2.3E+02
Co-58	1.3E+02
Co-60	1.7E+01
Ni-59	3.2E+06
Ni-63	1.3E+06
Zn-65	1.1E+02
Ge-68	5.6E+02
As-73	5.3E+02
Se-75	6.3E+01
Se-79	8.7E+05
Rb-83	9.1E+01
Rb-84	2.0E+02
Sr-85	1.2E+02
Sr-89	4.8E+05
Sr-90	3.5E+04
Y-88	3.3E+01
Y-91	5.0E+04
Zr-88	1.1E+02
Zr-93	9.3E+04
Zr-95	1.9E+02
Nb-91	6.9E+01
Nb-91m	3.6E+02
Nb-92	1.8E+01
Nb-93m	4.4E+02
Nb-94	2.3E+01
Nb-95	3.4E+02
Mo-93	7.7E+01
Tc-95m	1.3E+02
Tc-97	8.1E+01
Tc-97m	3.5E+02
Tc-98	2.5E+01
Tc-99	8.4E+05
Rh-101	8.7E+05
Rh-102	3.0E+05
Rh-102m	6.4E+05
Ru-103	4.4E+02
Ru-106	2.5E+02
Ag-105	3.3E+06
Ag-108m	1.8E+01
Ag-110m	2.2E+01
Pd-107	9.3E+06
Cd-109	1.6E+02
Cd-113m	2.0E+04
Cd-115m	1.0E+04
Sn-113	3.1E+02
Sn-119m	3.3E+02
Sn-121m	8.1E+05
Sn-123	1.3E+04
Sn-126	1.8E+02
In-114m	7.7E+02
Te-121m	1.8E+02
Te-123m	2.8E+02
Te-125m	4.4E+02
Te-127m	8.0E+02
Te-129m	2.3E+03
Sb-124	9.1E+01
Sb-125	6.7E+01
I-125	3.5E+02
I-129	1.8E+02
Ba-133	5.1E+01
Cs-134	2.6E+01
Cs-135	1.3E+06
Cs-137	6.0E+01
La-137	2.7E+05
Ce-139	2.4E+02
Ce-141	2.4E+03
Ce-144	1.4E+03
Pm-143	1.3E+02
Pm-144	2.9E+01
Pm-145	2.6E+02
Pm-146	4.4E+01
Pm-147	7.7E+05
Pm-148m	1.0E+02
Sm-145	2.4E+06
Sm-146	4.0E+02
Sm-151	2.5E+05
Gd-146	5.1E+05

Nuclide	Activity (μCi)
Gd-148	9.0E+01
Gd-151	2.9E+06
Gd-153	2.1E+02
Eu-148	1.1E+06
Eu-149	1.1E+07
Eu-152	3.1E+01
Eu-154	3.1E+01
Eu-155	3.6E+02
Tb-157	2.5E+03
Tb-158	9.0E+04
Tb-160	1.2E+02
Dy-159	1.0E+07
Ho-166m	2.1E+01
Yb-169	5.5E+02
Tm-170	8.4E+03
Tm-171	2.8E+04
Hf-172	7.3E+04
Hf-175	3.0E+06
Hf-178m	8.7E+03
Hf-181	3.4E+02
Hf-182	7.5E+03
Lu-173	1.8E+06
Lu-174	9.3E+05
Lu-174m	1.0E+06
Lu-177m	5.8E+01
Ta-179	9.3E+06
Ta-182	7.3E+01
W-181	1.0E+03
W-185	3.9E+06
W-188	6.3E+04
Re-183	5.3E+02
Re-184	2.6E+02
Re-184m	1.5E+02
Re-186m	3.4E+05
Os-185	1.3E+02
Os-194	6.4E+04
Ir-192	1.3E+02
Ir-192m	1.4E+05
Ir-194m	2.7E+01
Pt-193	8.7E+07
Hg-194	5.2E+04
Hg-203	4.9E+02
Au-195	4.8E+02
Pb-202	1.9E+05
Pb-205	9.0E+01
Pb-210	9.2E+01
Tl-204	2.2E+04
Bi-207	1.7E+01
Bi-208	1.5E+01
Bi-210m	1.2E+03
Po-209	6.3E+03
Po-210	1.2E+03
Ra-226	2.2E+02
Ra-228	1.5E+03
Ac-227	4.2E+00
Th-228	8.4E+01
Th-229	3.1E+01
Th-230	5.4E+00
Th-232	9.3E+01
Pa-231	3.0E+01
U-232	1.0E+02
U-233	3.9E+02
U-234	2.9E+02
U-235	6.7E+01
U-236	3.1E+02
U-238	3.5E+02
Np-235	1.1E+02
Np-236	2.1E+01
Np-237	4.9E+01
Pu-236	2.0E+02
Pu-237	3.3E+02
Pu-238	9.0E+01
Pu-239	8.4E+01
Pu-240	8.4E+01
Pu-241	4.6E+03
Pu-242	8.7E+01
Pu-244	9.0E+01
Am-241	7.2E+01
Am-242m	1.1E+02
Am-243	7.3E+01
Cm-241	1.0E+05
Cm-242	6.2E+02
Cm-243	4.8E+01
Cm-244	1.5E+02
Cm-245	5.0E+01
Cm-246	1.0E+02
Cm-247	8.5E+01
Cm-248	2.8E+01
Cm-250	5.4E+00
Bk-247	6.0E+01
Bk-249	2.7E+04
Cf-248	4.4E+02
Cf-249	5.5E+01
Cf-250	1.2E+02
Cf-251	5.3E+01
Cf-252	5.2E+00
Cf-254	1.2E+02
Es-254	6.3E+01
Es-255	8.8E+03
Fm-257	5.1E+02
Md-258	6.1E+02

Any alpha emitting radionuclide not listed above and mixtures of alpha emitters of unknown composition have a value of 10 μCi.

Except as discussed below, any radionuclide other than alpha emitting radionuclides not listed above and mixtures of beta emitters of unknown composition have a value of 100 μCi.

Any type of tritiated particulate or organically–bound tritiated compound has a value of 10 Ci.

Note: Where there is involved a combination of radionuclides in known amounts, derive the value for the combination as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the value otherwise established for the specific radionuclide when not in combination. If the sum of such ratios for all radionuclides in the combination exceeds unity (1), then the accountability criterion has been exceeded.

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