U.S. Department of Energy
Washington, DC

ORDER

NE O 458.1A

Approved: November-2025

SUBJECT: RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT

1. PURPOSE.

   a. To establish requirements to protect the public and the environment against undue risk from radiation associated with nuclear facilities and radiological activities authorized by the Department of Energy's (DOE) Office of Nuclear Energy (NE), pursuant to the *Atomic Energy Act (AEA) of 1954*, as amended and other applicable law.

   b. The objectives of this Order are:

      (1) To operate NE-authorized nuclear and radiological facilities and conduct NE-authorized activities so that radiation exposure to members of the public does not exceed the dose limit established in this Order; and

      (2) To provide for radiological clearance of DOE real and personal property associated with NE-authorized nuclear facilities or activities.

      (3) To provide protection of the public and environment from the effects of radiation and radioactive material.

2. CANCELS/SUPERSEDES. This Order applies in lieu of DOE O 458.1 (current version) with respect to the facilities and activities covered by Section 3 below. Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless and until the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.

3. APPLICABILITY.

   a. Departmental Elements. This Order applies to all Departmental elements including NNSA, and their associated field element(s),[1] to the extent they are involved with facilities and activities described in paragraph 3.b.

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1 Operations offices, service centers, site offices, area offices, field offices, government-owned government-operated facilities, and regional offices of federally staffed laboratories that report directly to a DOE Headquarters office.

b. Nuclear Facilities and Activities. Except as stated in paragraph 3.d., this Order applies to all NE-authorized nuclear facilities and radiological activities. Such activities include the design, construction, management, operation, decontamination, remedial activities, decommissioning, or demolition of nuclear facilities and radiological activities that can result in exposures of the public to radiation or radioactive materials.

c. Contractors. Except as stated in paragraph 3.d., this Order sets forth conditions to be applied to contractors performing work that involves facilities and activities described in paragraph 3.b. The CRD must be included in contracts under which the contractor is involved with such facilities and activities.

d. Equivalencies and Exemptions.

(1) Exemption. In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 50 United States Code (USC) sections 2406 and 2511, and to ensure consistency through the joint Navy/DOE Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) will implement and oversee requirements and practices pertaining to this Directive for activities under the Director's cognizance, as deemed appropriate.

(2) Exemption. This Order does not apply to activities or facilities regulated by either the Nuclear Regulatory Commission (NRC) or the authorities of a State under an agreement with the NRC pursuant to the AEA.

(3) Other Equivalencies/Exemptions. Any other equivalencies or exemptions to this Order requires the approval of the Office of Nuclear Energy, Safety Basis Approval Authority (SBAA). Requests for equivalencies/exemptions will be adjudicated by NE's SBAA within 14 calendar days of receipt of a substantially complete request.

4. REQUIREMENTS.

a. The requirements of this Order mustbe implemented using a risk-informed, graded approach that is commensurate with the hazard or risk to the public or the environment and is tailored to the particular facility being operated or activity being conducted. The requirements of this Order shall be implemented consistent with applicable laws, regulations, permits, and agreements.

b. Radiological Protection Program.

(1) DOE must ensure that:

(a) DOE or DOE contractors establish and maintain a program that complies with applicable requirements of this Order.

(b) The program, which is the composite of plans, procedures, protocols, and other documents describing the methods used to achieve compliance, should be tailored to the hazard or risk and the particular facility or activity and relevant requirements of this Order.

(c) For any determination that a requirement of this Order is not relevant, the basis for that determination must be adequately documented and be based on the hazard of the applicable facility or activity.

(2) DOE must document directions to the contractor necessary to correct any reasonably potential inadequacies or inappropriate determinations of relevancy.

(3) DOE must ensure that long-term stewardship and institutional controls for protection of the public and environment determined necessary to meet the requirements of this Order are adequately documented and implemented as long as is necessary.

c. Public Dose Limit.

(1) NE-authorized nuclear facilities and radiological activities must be operated and conducted so that exposure of members of the public to ionizing radiation will:

(a) Not cause a total effective dose (TED) exceeding 100 mrem (1 mSv) in a year from all DOE-controlled sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose except:

i. Dose from radon and its decay products in air;

ii. Dose received by patients from medical sources of radiation, and by volunteers in medical research programs;

iii. Dose from background radiation; and

iv. Dose from occupational exposure under Nuclear Regulatory Commission or Agreement State license or to general employees regulated under 10 CFR Part 835.

(2) The public dose limit applies to members of the public located i) off NE-authorized facilities/sites, and ii) on NE-authorized facilities/sites outside of controlled areas.

d. Demonstrating Compliance with the Public Dose Limit.

(1) Dose evaluations to demonstrate compliance with paragraph 4.c of this Order must include the following:

(a) The TED to members of the public from exposure to radiation, airborne effluents, and liquid effluents from NE-authorized nuclear facilities and radiological activities, as applicable.

(b) Analytical models or equivalent information that consider likely exposure pathways, such as:

i. Direct external radiation from sources located on site;

ii. External radiation from airborne radioactive material;

iii. External radiation from radioactive material deposited on surfaces off site;

iv. Internal radiation from inhaled airborne radioactive material;

v. Internal radiation from radioactive material ingested with water, and with food from terrestrial crops or animal products (e.g., meat, eggs, milk);

vi. Internal radiation from radioactive material ingested with aquatic food products such as fish, shellfish, crustaceans (e.g., crayfish, shrimp, crab, lobsters), and aquatic plants and algae; and

vii. Any other pathway unique to the site or activity.

(2) The estimated individual dose to the representative person that is representative of the persons or group likely to receive the most dose and is based on pathway and exposure parameters that are not likely to underestimate or substantially overestimate the dose.

(3) Site -specific information on radiation source dispersion patterns, the location and demography of members of the public and exposure pathway information must be updated, as necessary, to document significant changes that could affect dose.

(4) Values of assumed default or site -specific parameters used in calculations must be identified and included with the documentation of the calculations, as applicable.

(5) Direct measurements should be made, to the extent practical, to obtain information characterizing source terms, exposures, exposure modes, and other information needed to determine potential dose.

(6) Models or other information for dose calculations must be appropriate for their purpose. Dose evaluation models that are codified or approved for use by regulators of DOE or by DOE may be used where applicable. Alternatives to such codified or approved dose evaluation models to be used for demonstrating compliance with this Order must be approved by the SBAA.

(7) DOE -approved dose coefficients must be used to evaluate doses resulting from NE-authorized nuclear facilities and activities.

(8) Monitoring must be conducted to characterize routine and non-routine releases of radioactive material. Monitoring should be tailored to the level of radiological activities and the magnitude of the potential source term, using a risk-informed, graded approach. Monitoring should include, as appropriate:

(a) Effluent monitoring.

(b) Environmental surveillance

(c) Meteorological monitoring, if needed, to characterize potential atmospheric dispersion.

(d) Preoperational information and monitoring, if needed, should obtained prior to startup to understand: radiological background; pertinent environmental and ecological parameters; and potential pathways for human exposures. To the extent practical, existing data or documents (for example, National Environmental Policy Act documents or existing monitoring and surveillance program documents) should be used.

(e) Site-specific or project-specific monitoring criteria should be established to ensure that representative measurements of quantities and concentrations of radiological contaminants are conducted and that the effects from NE-authorized nuclear and radiological facilities and activities on members of the public are monitored sufficiently to demonstrate compliance with this Order.

e. Airborne Radioactive Effluents. The release of radioactive material to the atmosphere must comply with applicable subparts of 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

f. Control and Management of Radionuclides in Liquid Discharges. Operators of NE-authorized nuclear and radiological facilities and activities discharging or releasing liquids containing radionuclides must:

(1) Characterize planned and unplanned releases of liquids containing radionuclides, consistent with the reasonable potential for on- and offsite impacts and provide an assessment of radiological

consequences, as necessary, to demonstrate compliance with the requirements of this Order.

(2) Control discharges into sanitary sewers in accordance with the following requirements:

(a) Except for excreta from patients and medical research volunteers treated with radioactive material, discharges of liquids containing radionuclides into non-Federally owned sanitary sewers should be avoided unless:

i. The material is readily soluble (or readily dispersed biological materials) in water;

ii. Operations are conducted to minimize long -term buildup of radionuclides in the sewage treatment plants that may create handling and disposal issues or interfere with plant operations; and

iii. Operators of sewage treatment plants are informed of unusual discharges to sanitary sewers.

(b) NE-authorized nuclear or radiological facilities or activities discharging liquids containing radionuclides into sanitary sewer systems owned by the Federal government are not subject to the requirements in paragraph 4.g.(3)(a) of this Order if:

i. The system provides treatment in accordance with the environmental radiological protection program; and

ii. Sludge from the system is disposed of in accordance with this Order and applicable Federal, State, and municipal regulations.

(3) Prohibit the use of soil columns for liquid discharges.

(4) Appropriately manage the disposition of non-process water potentially containing radionuclides.

(5) Ensure that storm water runoff containing radionuclides is considered using a graded approach, when warranted, based on site-specific risk.

g. Ground Water. Consideration must be given to avoiding or minimizing potential radiological contamination of groundwater from NE-authorized nuclear facilities and radiological activities, to ensure compliance with public dose limits in this Order. To this end: (i) baseline conditions of the ground water quantity and quality may be considered; (ii) potential sources of radiological contamination

may be identified; (iii) strategies to control radiological groundwater contamination may be developed, as appropriate;(iv) monitoring may be implemented, as appropriate, and integrated with other monitoring activities.

h. Drinking Water. Consideration must be given to avoiding or minimizing potential radiological contamination of public and private drinking water systems from NE-authorized nuclear facilities and radiological activities, to not exceed the public dose limit of this Order or the numerical maximum contaminant limit (MCL) radiological values specified in 40 CFR 141

i. Biota. Consideration may be given to avoiding or minimizing, if practical, potential adverse impacts to aquatic animals, terrestrial plants, and terrestrial animals in local ecosystems from radiation and releases of radioactive material, using a graded approach.

j. Release and Clearance of Property. Release or clearance of DOE property associated with NE-authorized nuclear facilities and activities, with the potential to contain residual radioactive material, must be conducted in accordance with the requirements in paragraph 4.j. of this Order.[2]

(1) Property control and clearance processes must be developed and implemented in accordance with the dose limit in paragraph 4.c under any plausible use of the property before the property is cleared.

(2) Residual Radioactive Material. Property potentially containing residual radioactive material may not be cleared from DOE control unless either:

(a) The property is demonstrated not to contain residual radioactive material based on process and historical knowledge, radiological monitoring or surveys, or a combination of these; or

(b) The property is evaluated and appropriately monitored or surveyed to determine:

i. The types and quantities of residual radioactive material within the property;

ii. The quantities of removable and total residual radioactive material on property surfaces (including residual radioactive material present on and under any coating);

2 In addition to paragraph 4.j of this Order, the following may have applicable requirements regarding clearance of property: 41 CFR Chapter 109, *Department of Energy Property Management Regulations*; 10 CFR Part 770, *Transfer of Real Property at Defense Nuclear Facilities for Economic Development*; and DOE O 430.1, *Real Property Asset Management,* current version.

iii. That, for property with potentially contaminated surfaces that are difficult to access for radiological monitoring or surveys, an evaluation of residual radioactive material on such surfaces is performed which is:

(1) based on operational process knowledge, historical knowledge, and monitoring and or surveys, to the extent feasible; and

(2) sufficient to demonstrate that applicable specific or pre-approved DOE Authorized Limits will not be exceeded from Attachment 3 Table 1; and

iv. That any residual radioactive material within or on the property is in compliance with applicable specific or pre-approved DOE Authorized Limits from Attachment 3 Table 1..

2) Evaluation of the Need for Maintaining Institutional Controls for Real Property. Real property under evaluation for clearance from DOE radiological controls must be evaluated against the need for maintaining institutional controls or impacting long-term stewardship of adjacent DOE real property. In situations where transfer of the real property to other use would impact long-term radiological protection of adjacent DOE properties, it must be demonstrated that the impact of the property clearance would not result in noncompliance for the adjacent property with the requirements of this Order or other applicable statutes or regulations.

3) Process and Historical Knowledge. Radiological clearance of property must, using a graded approach, consider the operational processes and historical knowledge to determine if property potentially contains residual radioactive material. The types and quantities of residual radioactive material must be considered.

(a) Information to support the release of real property must be documented, and must include operational records and operating history.

(b) For real property, the information must address each specific property individually. If several parcels of land are contiguous, or if several structures are located in the same area and have a common operational history, a single evaluation for all of the properties is acceptable.

(c) If available operational process knowledge and historical knowledge cannot demonstrate that the property would meet the dose limit in paragraph 4.c, radiological monitoring or surveys must be conducted.

(d) If not supplemented by radiological surveys, operational process knowledge and historical knowledge must be adequate to determine:

i. Whether the property has ever been used for radiological activities or in areas that could have resulted in the presence of residual radioactive material within or on the property or

ii. Whether property formerly containing residual radioactive material has been decontaminated and demonstrated to meet DOE Authorized Limits and has not been used in a manner or in areas that could have resulted in the recontamination of the property.

4) Authorized Limits.

(a) Authorized Limits must be established and approved for the clearance of any property with residual radioactive material to provide reasonable assurance that the limits in paragraph 4.j.(1) will be met.

(b) Authorized Limits must:

i. Be supported by a complete exposure pathway analysis using appropriate methodologies, techniques, parameters and models (such as the RESRAD family of codes) that meet DOE quality assurance requirements under NE O 414.1, Quality Assurance;

ii. Be expressed in terms of concentration of radioactivity per unit surface area (e.g., dpm per 100 cm2), radioactivity per unit mass (e.g., pCi per gram) or volume (e.g., pCi per ml), total radioactivity, or DOE controls and restrictions, if applicable;

iii. Explicitly state any restrictions or conditions on future use of the property;

iv. Be approved by the SBAA or cognizant FEM, as applicable.

(c) Applications for approval of Authorized Limits should contain the following:

i. A description of the property.

ii. Specific limits proposed for each radionuclide or group of radionuclides and/or external radiation exposure, surrogate metrics, or conditions used to limit radionuclides.

iii. Potential dose to a member of the public most likely to receive the highest dose for both: actual or likely future use, and plausible future use of the property.

iv. A description of the procedures and radiological monitoring or surveys to be used to demonstrate compliance with proposed limits.

v. Identification of any restrictions or conditions on the future use of the property upon which the proposed limits are based, and the means by which the restrictions or conditions will be implemented and maintained.

vi. An estimated date for when the property will be cleared and an estimate of when the property will be released from DOE control.

(d) Approval of Authorized Limits. All Authorized Limits must be submitted for review. The use of Authorized Limits must be approved by the SBAA or the cognizant FEM, as applicable.

(e) Pre-Approved Authorized Limits from Attachment 3 Table 1 may be used for any radiological activity instead of developing specific Authorized Limits if their use is documented in the radiological protection program and the specific application of the Authorized Limits is approved by the SBAA or the responsible FEM, as applicable.

5) Radiological Monitoring or Surveys.

(a) All radiological monitoring or surveys performed in support of clearance of property must use methodologies sufficient to meet measurement and quality objectives;

(b) Instrumentation used for radiological monitoring or surveys must be capable of detecting and quantifying residual radioactive material consistent with the applicable Authorized Limits.

6) Documentation and Verification.

(a) Radiological clearance of property must be documented and must ensure that the clearance meets applicable Authorized Limits, or other applicable requirements including associated restrictions or institutional controls (See DOE P 454.1, *Use of Institutional Controls*, current version).

(b) The clearance processes must verify that the applicable radiological clearance requirements have been met, using a graded approach. The graded approach should be commensurate

with the scope, complexity, and risk, and must ensure that the clearance complies with the requirements of this Order.

2. RESPONSIBILITIES.

a. Program Secretarial Officers (PSOs). PSOs involved with NE-authorized nuclear facilities and radiological activities are responsible, within their respective programs, for ensuring that FEMs meet the requirements of this Order.

b. Assistant Secretary for the Office of Nuclear Energy (NE Assistant Secretary). In addition to 5(a), the NE Assistant Secretary is responsible for designating and delegating authority to the SBAA.

c. SBAA. The SBAA, consistent with its delegated authority, is responsible for:

1) Implementing the requirements in this Order;

2) Ensuring that radiological protection programs are established and maintained;

3) Serving as the approving and authorizing official for the authorizations and approvals required by this Order;

4) Approving Authorized Limits for clearance of property in accordance with the requirements of this Order;

5) Ensuring that appropriate capabilities are maintained for monitoring and assessing routine and unplanned releases of radioactive materials, consistent with the types of radioactive materials released, release modes, and radiological activities conducted; and

6) Temporarily suspending any requirement of this Order when doing so is, in the SBAA's judgment, necessary to minimize damage to life or property, or to protect public health or safety, or during periods of emergency. Whenever this provision is invoked, such suspension and the reason for it must be reported to the Assistant Secretary for NE at the earliest practicable time.

7) Consulting and coordinating with DOE's Office of Environment, Health, Safety and Security, as appropriate.

8) Delegating authority, as appropriate, to the cognizant FEM.

d. FEMs. FEMs are responsible for implementing the requirements of this Order. FEMs, to the extent authority has been delegated by the SBAA, are also responsible for implementing the responsibilities in 5.c)1)-7) of this Order.

e. Contracting Officers or Representatives. Contracting Officers or Representatives are responsible for modifying contracts to incorporate the CRD in Attachment 1.

3. REFERENCES.

   a. 42 U.S.C. 2011, et seq., *Atomic Energy Act of 1954*, as amended, which authorizes the conduct of atomic energy activities and establishes authority for protecting the health and safety of the public.

   b. DOE-STD-1196-2022, *Derived Concentration Technical Standard*, which establishes the numerical values of Derived Concentration Standards in a manner reflecting the current state of knowledge and practice in radiation protection.

   c. American National Standards Institute (ANSI) and Health Physics Society (HPS), 2013. ANSI/HPS N.13-12-2013, *Surface and Volume Radioactivity Standards for Clearance*, which contains recommendations on clearance of solid materials.

   d. American National Standards Institute (ANSI) and Health Physics Society (HPS), 2009. ANSI/HPS N 13.53-2009, *Control and Release of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)*, which contains recommendations on control of TENORM.

   e. DOE-HDBK-1216-2015 Chg Notice 1 (Reaffirmed 2022), *Environmental Radiological Effluent Monitoring and Environmental Surveillance*, which describes elements that may be used to implement the radiological effluent monitoring and environmental surveillance requirements.

4. DEFINITIONS. See Attachment 2.

5. CONTACT. Questions concerning this Order should be referred to the Assistant Secretary of NE.

BY ORDER OF THE SECRETARY OF ENERGY:

JAMES P. DANLY
Deputy Secretary

ATTACHMENT 1
CONTRACTOR REQUIREMENTS DOCUMENT
NE O 458.1 *RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT*

The provisions of this Contractor Requirements Document (CRD) apply to contractors operating NE-authorized nuclear and radiological facilities or conducting NE-authorized nuclear activities. Such nuclear activities include the design, construction, management, operation, decontamination, decommissioning, or demolition of nuclear facilities.

Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this CRD and flowing down the CRD requirements to subcontractors at any tier to the extent necessary to ensure contractor compliance with the requirements.

REQUIREMENTS.

1. The requirements of this CRD shall be implemented using a risk-informed, graded approach that is commensurate with the hazard or risk to the public or the environment and is tailored to the particular facility being operated or activity being conducted. The requirements of this CRD shall be implemented consistent with applicable law, permits and agreements.

2. Radiological Protection Program.

    a. The contractor must establish and maintain a program that complies with applicable requirements of this Order for NE-authorized nuclear facilities and radiological activities.

    b. The contractor's program should be a composite of plans, procedures, protocols and other documents describing the methods used to achieve compliance.

    c. The contractor shall prepare documents to support any determination that any requirement of this Order is not relevant, based on the hazard.

3. Where long-term stewardship and institutional controls are necessary to meet the requirements in this Order and this CRD, the contractor must ensure that the need for the controls is documented and maintained and to the extent the contractor is responsible, implement the controls.

4. Public Dose Limit.

    a. The contractor must ensure that exposure of members of the public to ionizing radiation will not cause a total effective dose (TED) exceeding 100 mrem (1 mSv) in a year from contractor-controlled sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose, except:

        (1) Dose from radon and its decay products in air;

        (2) Dose received by patients from medical sources of radiation, and by volunteers in medical research programs;

(3) Dose from background radiation; and

(4) Dose from occupational exposure under Nuclear Regulatory Commission or Agreement State license or to general employees regulated under 10 CFR Part 835.

b. The public dose limit applies to members of the public located: i) off NE-authorized facilities/sites, and ii) on NE-authorized facilities/sites outside of controlled areas.

5. Demonstrating Compliance with the Public Dose Limit. The contractor must establish and implement procedures and practices to demonstrate compliance with the public dose limit and address the following elements:

a. Dose evaluations to demonstrate compliance with the public dose limit in this CRD must include the following—

(1) The TED to members of the public from exposure to radiation, airborne effluents, and liquid effluents from NE-authorized nuclear facilities and radiological activities .

(2) Analytical models that consider likely exposure pathways, such as:

(a) Direct external radiation from sources located on site;

(b) External radiation from airborne radioactive material;

(c) External radiation from radioactive material deposited on surfaces off site;

(d) Internal radiation from inhaled airborne radioactive material;

(e) Internal radiation from radioactive material ingested with water, and with food from terrestrial crops or animal products (e.g., meat, eggs, milk);

(f) Internal radiation from radioactive material ingested with aquatic food products such as fish, shellfish, crustaceans (e.g., crayfish, shrimp, crab, lobsters), and aquatic plants and algae.

(3) The estimated individual dose to the representative person that is representative of the persons or group likely to receive the most dose and is based on pathway and exposure parameters that are not likely to underestimate or substantially overestimate the dose.

(4) Site specific information on radiation source dispersion patterns, location and demography of members of the public, and exposure pathway

information must be updated, as necessary, to document significant changes that could affect dose.

(5) Values of assumed default or site -specific parameters used in the contractor's calculations must be identified and included with the documentation of the calculations, as applicable.

(6) Direct measurements should be made by the contractor, to the extent practical, to obtain information characterizing source terms, exposures, exposure modes, and other information needed to determine potential dose.

(7) Models or other information for dose calculations must be appropriate for their purpose. Dose evaluation models that are codified or approved for use by regulators of DOE or by DOE should be used where applicable. Alternatives to such codified or approved dose evaluation models to be used by the contractor for demonstrating compliance with this Order and this CRD must be approved by the SBAA.

(8) The contractor must use DOE-approved dose coefficients to evaluate doses resulting from NE-authorized nuclear facilities or radiological activities.

(9) Monitoring. Monitoring must be conducted by the contractor to characterize routine and non-routine releases of radioactive material. Monitoring should be tailored to the level of radiological activities and the magnitude of the potential source term, using a risk-informed, graded approach. Monitoring should include:

(a) Effluent monitoring

(b) Environmental Surveillance

(c) Meteorological monitoring if needed to characterize potential atmospheric dispersion.

(d) Preoperational information and monitoring, if needed, prior to the startup, to understand: radiological background; pertinent environmental and ecological parameters; and potential pathways for human exposures. To the extent practical, existing data or documents (for example, National Environmental Policy Act documents or existing monitoring and surveillance program documents) should be used.

(10) Site-specific or project-specific environmental monitoring criteria should be established by the contractor to ensure that representative measurements of quantities and concentrations of radiological contaminants are conducted and that the effects on members of the public

are monitored sufficiently to demonstrate compliance with this Order and this CRD.

6. Airborne Radioactive Effluents. The contractor must establish and implement procedures and practices to ensure that airborne release of radioactive material to the atmosphere will comply with applicable subparts of 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

7. Control and Management of Radionuclides in Liquid Discharges. The contractor must establish and implement procedures and practices related to control and management of radionuclides in liquid discharges. Contractors discharging or releasing liquids containing radionuclides must:

   a. Characterize planned and unplanned releases of liquids containing radionuclides, consistent with the reasonable potential for on- and offsite impacts, and provide an assessment of radiological consequences, as necessary, to demonstrate compliance with the requirements of this Order and this CRD.

      (1) Control discharges into sanitary sewers in accordance with the following requirements:

      (2) Except for excreta from patients and medical research volunteers treated with radioactive material, discharges of liquids containing radionuclides into non-Federally owned sanitary sewers should be avoided unless:

         (a) The material is readily soluble (or readily dispersed biological materials) in water;

         (b) Operations are conducted to minimize long-term buildup of radionuclides in the sewage treatment plants that may create handling and disposal issues or interfere with plant operations;

         (c) Operators of sewage treatment plants are informed by the contractor of unusual discharges to sanitary sewers;

      (3) The discharge of liquids containing radionuclides into sanitary sewer systems owned by the Federal government are not subject to the requirements in subparagraph 7.b.(1) above if:

         (a) The system provides treatment in accordance with the environmental radiological protection program; and

         (b) Sludge from the system is disposed of in accordance with the Specific Requirements in this CRD and applicable Federal, State, and municipal regulations.

      (4) Prohibit the use of soil columns.

      (5) Appropriately manage the disposition of non-process water potentially containing radionuclides.

(6) Ensure that storm water runoff containing radionuclides is considered, using a graded approach, when warranted based on site specific risk.

8. Ground Water. The contractor must consider avoiding or minimizing potential radiological contamination of groundwater from NE-authorized nuclear facility and radiological activities to ensure compliance with public dose simits in this Order. To this end: (i) baseline conditions of the ground water quantity and quality may be considered; (ii) potential sources of radiological contamination may be identified; (iii) strategies to control radiological groundwater contamination may be developed, as appropriate;(iv) monitoring may be implemented, as appropriate, and integrated with other monitoring activities.

9. Drinking Water. The contractor must consider avoiding or minimizing potential radiological contamination of public and private drinking water systems from its NE-authorized nuclear facilities and radiological activities to demonstrate compliance with public dose limit of this Order and the numerical maximum contaminant limit (MCL) radiological values specified in 40 CFR 141.

10. Biota. The contractor may consider avoiding or minimizing, if practical, potential adverse impacts to aquatic animals, terrestrial plants, and terrestrial animals in local ecosystems from radiation and releases of radioactive material, using a graded approach.

11. Release and Clearance of Property. The contractor must establish and implement procedures and practices to ensure that release or clearance of property, with the potential to contain residual radioactive material, is conducted in accordance with DOE direction and in accordance with the requirements in this Order and this CRD.[3]

a. The contractor must comply with property control and clearance processes in accordance with the dose limit in this Order and this CRD.

b. Residual Radioactive Material. The contractor must provide supporting documentation to support clearance from DOE control. Such clearance will not be provided unless either:

(1) The contractor demonstrates that the property does not contain residual radioactive material based on process and historical knowledge, radiological monitoring or surveys, or a combination of these; or

(2) The contractor evaluates and appropriately monitors or surveys the property to determine:

(a) The types and quantities of residual radioactive material within the property;

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[3] In addition to this CRD, the following may have applicable requirements regarding clearance of property: 41 CFR Chapter 109, *Department of Energy Property Management Regulations*; DOE O 430.1, *Real Property Asset Management*, current version.

(b) The quantities of removable and total residual radioactive material on property surfaces (including residual radioactive material present on and under any coating);

(c) For property with potentially contaminated surfaces that are difficult to access for radiological monitoring or surveys, an evaluation of residual radioactive material on such surfaces is performed which is:

1) Based on operational process knowledge, historical knowledge, and monitoring and/ or surveys, to the extent feasible; and

2) Sufficient to demonstrate that applicable specific or pre-approved DOE Authorized Limits from Attachment 3 Table 1 will not be exceeded.

3) Sufficient to demonstrate that any residual radioactive material within or on the property is in compliance with applicable specific or pre-approved DOE Authorized Limits from Attachment 3 Table 1.

c. Evaluation of the Need for Maintaining Institutional Controls for Real Property. The contractor must provide documentation to support clearance of real property from DOE radiological control and evaluate the need for maintaining institutional controls and the impacts on long-term stewardship of adjacent DOE real property. In situations where transfer of the real property to other use would impact long-term radiological protection of adjacent DOE properties, the contractor must demonstrate that the impact of the property clearance would not result in noncompliance for the adjacent property with the requirements of applicable statutes, regulations or DOE directives.

d. Process and Historical Knowledge. Contractors must prepare documents to support radiological clearance of property, using a graded approach, and consider operational process and historical knowledge to determine if property potentially contains residual radioactive material. The types and quantities of residual radioactive material must be considered.

(1) The contractor must document information to support the release of real property and must include operational records and operational history.

(2) For real property, the contractor must address each specific property individually. If several parcels of land are contiguous, or if several structures are located in the same area and have a common operational history, a single evaluation for all of the properties is acceptable.

(3) If available operational process knowledge and historical knowledge does not demonstrate that the property meets the public dose limit in this Order

and this CRD, the contractor must conduct radiological monitoring or surveys.

(4) If not supplemented by radiological surveys, operational process knowledge and historical knowledge, the contractor must determine:

(a) Whether the property has ever been used for radiological activities or in areas that could have resulted in the presence of residual radioactive material within or on the property, or

(b) Whether property formerly containing residual radioactive material has been decontaminated and demonstrated to meet DOE Authorized Limits and has not been used in a manner or in areas that could have resulted in the recontamination of the property.

e. Authorized Limits.

i. The contractor must provide information to support the establishment of Authorized Limits for the clearance of any property, to ensure that the public dose limit in this Order and this CRD are met.

ii. Authorized Limits must comply with the following:

(a) The contractor must support a complete exposure pathway analysis using appropriate methodologies, techniques, parameters and models (such as the RESRAD family of codes) that meet DOE quality assurance requirements under the CRD to NE O 414.1, *Quality Assurance*.

(b) The contractor's documentation must be expressed in terms of concentration of radioactivity per unit surface area (e.g., dpm per 100 cm^2), radioactivity per unit mass (e.g., pCi per gram) or volume (e.g., pCi per ml), total radioactivity, or DOE controls and restrictions, if applicable.

(c) The contractor must recommend any restrictions or conditions on future use of the property.

(d) The contractor must submit proposed Authorized limits to the SBAA or the cognizant FEM, as applicable, to obtain DOE approval.

iii. The contractor's application for approval of an Authorized Limit must contain the following:

(a) A description of the property.

(b) Specific limits proposed for each radionuclide or group of radionuclides and/or external radiation exposure, surrogate metrics, or conditions used to limit radionuclides.

(c) Potential dose to a member of the public most likely to receive the highest dose for both actual or likely future use, and plausible future use of the property.

(d) A description of the procedures and radiological monitoring or surveys to be used to demonstrate compliance with proposed limits.

(e) Identification of any restrictions or conditions on the future use of the property upon which the proposed limits are based, and the means by which the restrictions or conditions will be implemented and maintained.

(f) An estimated date for when the property is requested to be cleared and released from DOE control.

iv. Pre-Approved Authorized Limits from Attachment 3 Table 1 may be used for any radiological activity instead of developing specific Authorized Limits if their use is documented in the radiological protection program and the specific application of the Authorized Limits is approved by the SBAA or the cognizant FEM, as applicable.

f. Radiological Monitoring or Surveys.

(1) All radiological monitoring or surveys performed by the contractor in support of clearance of property must use methodologies sufficient to meet measurement and quality objectives.

(2) The contractor must use instrumentation or radiological monitoring capable of detecting and quantifying residual radioactive material consistent with the applicable Authorized Limits.

(3) Documentation and Verification. Any radiological monitoring or surveys must be documented and must demonstrate that the clearance meets applicable Authorized Limits, or other applicable requirements including associated restrictions or institutional controls (See DOE P 454.1, *Use of Institutional Controls,* current version).

12. DEFINITIONS. See Attachment 2.

ATTACHMENT 2
DEFINITIONS

1. ABSORBED DOSE (D). The average energy imparted by ionizing radiation to the matter in a volume element per unit mass of irradiated material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

2. ACTUAL OR LIKELY USE SCENARIOS. The current uses and reasonably anticipated uses in the foreseeable future of real and personal property considering the history of use; use restrictions, designations or controls; affected populations, ecosystems, or natural resources; and the property's historic or cultural significance. For real property considerations also include Federal and State use designations; local zoning and future land use plans; and proximity to residences, commercial or industrial areas, or areas of cultural or historic significance.

3. AIRBORNE DISCHARGES. Material released to the atmosphere in the form of dusts, fumes, particulates, mists, vapors, or gases.

4. AUTHORIZED LIMIT. A limit on the concentration or quantity of residual radioactive material on the surfaces or within property that has been derived consistent with DOE directives including the optimization process requirements. An authorized limit may also include conditions or measures that limit or control the disposition of property.

5. BACKGROUND RADIATION. Radiation from: (1) naturally occurring radioactive materials which have not been technologically enhanced (i.e., background radiation does not include TENORM); (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 decay products 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.

6. CLEARANCE OF PROPERTY. The removal of property that contains or may contain residual radioactive material from DOE radiological control.

7. COMMITTED EFFECTIVE DOSE (E_{50}). The sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate tissue weighting factor (w_T)--that is, $E_{50} = \Sigma w_T H_{T,50} + w_{Remainder} H_{Remainder,50}$, where $w_{Remainder}$ is the tissue weighting factor assigned to the remainder organs and tissues and $H_{Remainder,50}$ is the committed equivalent dose to the remainder organs and tissues. Committed effective dose is expressed in units of rems (or sieverts).

8. COMMITTED EQUIVALENT DOSE ($H_{T,50}$). 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 rems (or sieverts).

9. CONTROLLED AREA. Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material.

10. DOSE. A general term for absorbed dose, equivalent dose, effective dose, committed equivalent dose, committed effective dose, or TED as defined in this Order.

11. EFFECTIVE DOSE (E). 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 Order, equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of rems (or sieverts).

12. EFFLUENT MONITORING. The collection and analysis of samples of liquid and gaseous effluents or measurements of liquid and gaseous effluents performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards. (See DOE-HDBK-1216-2015 Chg Notice 1)

13. ENVIRONMENTAL SURVEILLANCE. The collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE site and surrounding environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment. (See DOE-HDBK-1216-2015 Chg Notice 1)

14. EXTERNAL DOSE OR EXPOSURE. That portion of the dose received from radiation sources outside the body (i.e., external sources).

15. FACILITY. Something that is built, installed, or established to serve a particular DOE radiological activity.

16. GENERAL EMPLOYEE. An individual who is either a DOE or DOE contractor employee; an employee of a subcontractor; or an individual who performs work for or in conjunction with DOE or utilizes DOE facilities.

17. INTERNAL DOSE OR EXPOSURE. That portion of the dose received from radioactive material taken into the body (i.e., internal sources).

18. LIQUID DISCHARGE. The release to the environment of radioactive material in a liquid medium. The discharge generally occurs at a point, such as the end of a pipe, where it is released to any of several receptors in the environment, such as a waterway, land, sewer system, etc.

19. MEMBER OF THE PUBLIC. 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.

20. MONITORING. The measurement of radiation levels, discharges or environmental releases, residual radioactive levels, quantities of radioactive material, or exposure to members of the public and the use of the results of these measurements to evaluate radiological discharges or releases or potential and actual dose resulting from exposures to radioactive material or radiation.

21. PERSONAL PROPERTY. Property of any kind, except for real property.

22. POTENTIAL DOSE. A calculated dose based on a postulated set of exposure conditions that have a reasonable probability of occurrence.

23. PUBLIC DOSE. The dose received by members of the public from exposure to radiation and to radioactive material released by a DOE radiological activity whether the exposure is within a DOE site boundary or offsite.

24. RADIATION. 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 Order, does not include non-ionizing radiation, such as radio waves or microwaves, or visible, infrared, or ultraviolet light.

25. RADIATION WEIGHTING FACTOR (w_R). 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.

26. RADIOACTIVITY. The property or characteristic of radioactive material to undergo spontaneous transformations (disintegrations or decay) with the emission of energy in the form of radiation. It is measured by the rate of spontaneous transformations of a radionuclide. The unit of radioactivity is the curie, Ci (or becquerel, Bq). ($1\ Ci = 3.7 \times 10^{10}\ Bq$).

27. RADIOLOGICAL ACTIVITY. Any activity taken for, or by, DOE that has the potential to result in releases of radioactive material to the environment or exposures of members of the public to include all doses both present and future, from clearance activities and radiation generating devices. The activity may involve a single DOE facility, or combination of facilities and operations, possibly including an entire site or no fixed site at all.

28. REAL PROPERTY. 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.

29. REFERENCE PERSON. A hypothetical aggregation of human (male and female) physical and physiological characteristics arrived at by international consensus for the purpose of standardizing radiation dose calculations.

30. REMEDIAL ACTIONS. Those actions, consistent with permanent remedy, taken to control or remove radiological contaminants to prevent or to minimize doses to members of the public.

31. REPRESENTATIVE PERSON. An individual receiving a dose that is representative of the more highly exposed individuals in the population. This term is the equivalent of, and replaces, "average member of the critical group." (Source: ICRP Publication 103*, The 2007 Recommendations of the International Commission on Radiological* Protection, page 32).

32. RESIDUAL RADIOACTIVE MATERIAL. Any radioactive material which is in or on soil, air, water, equipment, or structures as a consequence of past operations or activities of the Department or its predecessors.

33. SANITARY SEWAGE. A system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by, or for, the Department.

34. SEWER. An artificial conduit, usually underground, for carrying off waste water and refuse.

35. SITE. Land or property upon which DOE facilities or activities are located and access to which is subject to DOE or DOE contractor control.

36. SITE BOUNDARY. The perimeter of a DOE site, within which DOE or a DOE contractor normally can control access or restrict activities.

37. SOIL COLUMN. An in-situ volume of soil through which liquid waste streams percolate from ponds, cribs, trenches, drain fields, or other areas or facilities used for the primary purpose of removing or retaining the suspended or dissolved radionuclides contained within the liquid process waste stream.

38. TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVE MATERIAL (TENORM). Any naturally occurring radioactive materials, the radionuclide concentrations or potential for human exposure from which have been increased above levels encountered in the natural state by human activities.

39. TISSUE WEIGHTING FACTOR (w_T). The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The equivalent dose to tissue, (H_T), is multiplied by the appropriate tissue weighting factor to obtain the effective dose (E) contribution from that tissue.

40. TOTAL EFFECTIVE DOSE (TED). Sum of the effective dose (for external exposures) and the committed effective dose.

41. WHOLE BODY. For the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

Table 1: Pre-authorized Surface Contaminations Values in dpm/100cm^2

Radionuclide	Removable (dpm/100 cm^2) [b,c]	Total (Fixed + Removable) (dpm/100 cm^2) [b,d]
U-natural, U-235, U-238, and associated decay products	1,000 alpha	6,000 alpha
Transuranics[e], Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, and I-129[f], and associated decay products	20	600
Th-natural, Th-232, Sr-90/Y-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133[f]	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr90/Y-90 a-nd others noted above and mixed fission products containing Sr-90/Y-90[g], Pu-241, and others[i]	1,000 beta-gamma	6,000 beta-gamma
Low-energy beta-gamma emitters: S-35, Ca-45, Cr-51, Mn-53, Ni-59, Ni-63, Rb-86, Y-91, Tc-97m, Cd-115m, In-115m, I-125, Cs-135, Ce-141, Nd-147, Tm-170, Os-191, Pu-237, Bk-249, Cf-253, and others[i] Tritium and special tritium compounds[h]	60,000	600,000 See Footnote h,

a. Except as indicated in Footnote h below, the values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

b. As used in this table, dpm 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.

c. 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 while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (However, the use of dry material may not be appropriate for tritium.) For objects with a surface area less than 100 cm^2, the entire surface shall be swiped, and the activity per unit area shall be based on the actual surface area. The use of swiping techniques is not necessary to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

d. The levels may be averaged over 1 m^2 provided the maximum activity in any area of 100 cm^2 is less than three times the values above. For the 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, the average contamination level is determined to exceed the applicable value or (2) the sum of the activity of all isolated spots or particles in any 100-cm^2 area is determined to exceed three times the applicable value above.

e. Transuranics are elements with atomic number greater than 92. Pu-241 is not included as a transuranic.

f. Depending on the radionuclide of concern, the surface contamination values are for alpha only or beta-gamma only. Due to its mobility, if I-129 is released to soil or water, the Total value shall be reduced by one order of magnitude.

g. This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90, which has been separated from the other fission products or mixtures where the Sr-90 has been enriched. These values will be applied to mixed fission products containing Sr-90/Y-90:

- If the Sr-90/Y-90 fraction is 50% or less of the total activity, the mixed fission product surface activity values apply.
- If the Sr-90/Y-90 fraction is between 50% and 90% of the total activity, the surface radioactivity values should be 600 dpm/100 cm^2 removable and 3000 dpm/100 cm^2 total (the 600 dpm/100cm^2 removable is administratively set).
- If the Sr-90/Y-90 fraction exceeds 90% of the total activity, the Sr-90/Y-90 surface activity values apply (RCTP 96-02).

h. 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 to ensure that the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply. In certain cases, a "Total" value of 600,000 dpm/100 cm^2 may be applicable either to metals of the types from which insoluble special tritium compounds are formed, that have been exposed to tritium, or to bulk materials to which insoluble special tritium compound particles are fixed to a surface.

i. To determine the specific group for radionuclides not shown, a comparison of the screening factors, by exposure scenario, listed in Tables B.1, C.1, and D.1 of NCRP Report No. 123I (NCRP 1996) for the radionuclides in question and the radionuclides in the general groups above should be performed and a determination of the proper group made, as described in ANSI/HPS N13.12-2013, Annex A.