# U.S. Department of Energy
**Washington, DC**

**ORDER**

**NE O 435.1**

Approved: August-2025

**SUBJECT:** RADIOACTIVE WASTE MANAGEMENT

1. PURPOSE. This Order establishes requirements to ensure that radioactive waste from facilities and activities under the responsibility of the Department of Energy's (DOE) Office of Nuclear Energy (NE) is managed efficiently and in a manner that is protective of workers, the public, and the environment.

2. CANCELS/SUPERSEDES. This Order applies in lieu of DOE Order 435.1 (current version), with respect to the material covered by Section 3 below. Cancellation or superseding 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contract unless and until the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.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. Material. This Order applies to the following material at, from or associated with facilities under the responsibility of NE: high-level radioactive waste (HLW), transuranic (TRU) waste, low-level radioactive waste (LLW), and the radioactive component of waste that also contains constituents regulated under the *Resource Conservation And Recovery Act, as amended* (RCRA) (also known as mixed radioactive waste [MW]), *Toxic Substances Control Act, as amended* (TSCA), *Comprehensive Environmental Response, Compensation, and Liability Act, as amended* (CERCLA), and/or other federal or state laws.

   b. 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 waste described in section 3.a of this Order.

   c. Contractors. This Order sets forth conditions to be applied to contractors performing work that involves waste described in section 3.a of this Order.

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.

d. Equivalencies and Exemptions.

(1) Exemption. In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 50 United States Code (U.S.C.) sections 2406 and 2511, and to ensure consistency throughout the joint Navy/DOE Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) implements and oversees 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 regulated by either the Nuclear Regulatory Commission (NRC) or the authorities of a State under an agreement with the NRC per *Atomic Energy Act of 1954*, as amended (AEA).

(3) Exemption. Requirements in this Order that duplicate or conflict with the Waste Isolation Pilot Plant Land Withdrawal Act of 1992 (P.L. 102-579 and as amended by P.L. 104-201), the Environmental Protection Agency's (EPA's) recertification decisions for the Waste Isolation Pilot Plant (WIPP), or the DOE's compliance with 40 Code of Federal Regulation (CFR) Parts 191 and 194 pursuant to that Act, do not apply to the operation of the WIPP facility or the disposal of waste therein.

(4) Exemption. This Order does not apply to either spent nuclear fuel (SNF) or materials that have not been generated, managed, or declared as radioactive waste (e.g., certain depleted uranium or sealed sources).

(5) Exemption. This Order does not apply to disposal of commercial Greater-Than-Class C LLW for which the Federal government is responsible under the *Low-Level Radioactive Waste Policy Amendment Act of 1985*, as amended.

(6) Exemption. Soil contaminated with waste from SNF reprocessing which will not be removed (in-situ soil) is not subject to this Order.

(7) Other Equivalencies/Exemptions. Any other equivalency or exemption to this Order requires the approval of NE's 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. RESPONSIBILITIES.

a. Secretary of Energy. The Secretary of Energy is responsible for any determination under Section 3116 of the *National Defense Authorization Act for Fiscal Year 2005*, P.L. 108-375.

b. Program Secretarial Offices (PSOs) and NNSA Cognizant Secretarial Officers (CSOs). Except as provided in Section 4(a) of this Order, PSOs and NNSA CSOs with facilities, operations, or activities that involve waste described in section 3.a of this Order are responsible, within their respective programs, for ensuring that Field Element Managers (FEMs) meet the requirements of this Order.

c. Assistant Secretary for the Office of Nuclear Energy (NE Assistant Secretary). Except as provided in section 4(a) of this Order, the NE Assistant Secretary is responsible for designating the Safety Basis Approval Authority (SBAA) and delegating authority to the SBAA.

d. Safety Basis Approval Authority (SBAA). Except as provided in Section 4(a) of this Order, the SBAA, to which authority has been delegated, is the approving and authorizing official for authorizations and approvals required by this Order, including approving exemptions/equivalencies for any requirement in this Order.

e. Field Element Managers (FEMs). Except as provided in Section 4(a) of this Order, FEMs, to the extent authority has been delegated by the SBAA, are responsible for authorizations and approvals required by this Order.

f. Delegations of Authority. Except as provided in Section 4(a), all delegations of authority must be documented.

g. Coordination and Consultation with the Office of Environmental Management. In implementing this Order, the SBAA and FEMs should consult and coordinate with DOE's Office of Environmental Management to ensure efficient management of the applicable waste.

5. GENERAL REQUIREMENTS.

a. Radioactive waste management activities shall be systematically planned, documented, executed, and evaluated.

b. Radioactive waste must be managed to comply with applicable laws and regulations.

c. Radioactive waste must be managed as HLW, TRU waste, LLW, or MW.

d. Waste Generated from Destructive Examination of Spent Nuclear Fuel. Debris, regardless of physical state, resulting from the destructive examination of SNF may be determined to be radioactive waste and managed in accordance with this Order when separating the debris from other contaminated material or retrieving and packaging the debris with intact fuel is technically infeasible, cost prohibitive, or would increase worker exposure.

e. Irradiated Fissionable Material. Irradiated fissionable material that is not fuel (as defined in this Order) is not spent nuclear fuel following withdrawal from a reactor. This material must be managed based on its nuclear characteristics. Sites

may choose to manage such material with SNF.

f. Irradiated Fuel Intended for Re-Use. Irradiated (including partly irradiated) fuel that is intended for re-use in a reactor is not spent nuclear fuel following withdrawal from a reactor.

g. Waste Generation Planning.

(1) Life-Cycle Planning. Prior to waste generation, planning must be performed to address the entire life cycle for all waste streams.

(2) Waste With No Identified Path to Disposal. Waste with no identified path for disposal must be justified by the generator and approved by the SBAA, prior to generation or as soon as practicable upon discovery.

h. Site Evaluation and Facility Design.

(1) Site Evaluation. New radioactive waste management facilities, operations, and activities must be sited and designed in accordance with this Order. Proposed locations and major modifications to existing waste facilities must be evaluated to identify relevant features that should be considered in facility design and analyses.

(2) Facility Design. The design of new, and major modifications to existing, radioactive waste management facilities must have waste confinement consistent with their design basis. Facilities must be designed and operated to:

(a) prevent flammable and explosive conditions;

(b) facilitate decontamination and decommissioning, as applicable;

(c) incorporate engineered instrumentation and controls to keep worker and public exposure, and releases to the environment, within applicable limits;

(d) contain leaks; and

(e) provide monitoring systems for early leak detection or other releases from tanks or confinement systems.

i. Waste Characterization. Waste shall be characterized, and documented in sufficient detail, to develop adequate controls to ensure safe management during generation, consolidation, staging, storage, treatment, transport, and disposal.

j. Waste Acceptance Criteria (WAC).

(1) The WAC of the treatment, storage, or disposal facility must be met unless a variance is obtained.

(2) If the WAC will not be met, a variance must be obtained prior to transfer of waste. For transfers to a DOE treatment, storage or disposal facility, the variance must be approved by the receiving facility, or the SBAA or cognizant Field Element Manager (FEM), as applicable, and as set forth in this Order.

k. Segregation. Radioactive waste that contains RCRA, TSCA, and/or other Federal- or State-regulated constituents must be segregated from other radioactive waste, if practical.

l. Containment. Waste must be packaged to provide containment and protection until the waste is either overpacked, removed from the container, or disposed.

m. Detonation, Explosive Decomposition, or Reaction.

(1) Waste in storage must not be readily capable of detonation, explosive decomposition, or reaction that could result in pressures and/or temperatures that exceed container design limits.

(2) Pyrophoric materials must be treated, prepared, and/or packaged to remove the pyrophoricity hazard.

n. Inspection. A process must be developed and implemented for inspecting and maintaining waste containers to ensure container integrity is not compromised. Containers must be accessible to perform visual and/or remote inspections.

o. Waste Compatibility. The chemical compatibility of waste, stabilizing materials, and containers must be ensured.

p. Storage and Staging.

(1) Staging. The staging of waste must be for the purpose of accumulating such quantities of waste as necessary to facilitate characterization, transportation, storage, treatment, or disposal. Staging durations must be limited to those necessary to efficiently manage the waste.

(2) Storage.

(a) Container Integrity. The storage container must be selected and maintained to ensure that the waste container remains in a sound and unimpaired condition for the expected storage duration.

(b) Contingency Storage Capacity. For liquid radioactive waste facilities, contingency storage capacity must be maintained to receive the largest volume of radioactive waste that could be released from a single storage vessel, pipe, valve, or component

failure.

q. Waste Classification. Radioactive waste must be classified prior to disposal to ensure that it is disposed of in the appropriate facility. Waste must be classified in accordance with the HLW, TRU waste, or LLW definitions in this Order. Classification must be based on documented characterization results. Classification activities must include an evaluation of the properties of the waste matrix/form and must consider the facility, activity, and process that generated the waste. The classification must reflect properties resulting from any treatment and/or waste consolidation.

r. Classified Waste and Classified Matter. Any handling of classified waste must be coordinated with the Officially Designated Federal Security Authority (ODFSA) to ensure compliance with applicable DOE Safeguards and Security requirements, prior to any storage, transportation, and classification associated with it. Matter that is classified in accordance with the current versions of DOE O 471.6, *Information Security*, and/or DOE O 475.2, *Identifying Classified Information*, must be minimized prior to disposal by sanitization, as practicable and appropriate, in accordance with applicable laws, policies, and DOE directives. Sanitization technologies must be evaluated by the generator, if available and feasible (i.e., safe and cost effective), prior to determining whether permanent burial is the proper disposition path for classified matter.

s. Disposal Waste Form Criteria for New Disposal Facilities. Radioactive waste, in its final disposal configuration, must meet the following waste form criteria and the disposal facility's WAC:

(1) Free Liquids. Liquid waste or waste containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable while ensuring that the liquid, in no case, exceeds 1% by volume of the disposal container or 0.5% of the waste volume after it is processed to a stable form.

(2) Toxic Gases, Vapors, or Fumes. Waste must not contain or be capable of generating, (e.g., by radiolysis or biodegradation) quantities of toxic gases, vapors, or fumes harmful to workers, the public, or the long-term structural stability of the disposal facility.

(3) Long-Term Stability. Void spaces within the waste or, if containers are used, between the waste and its container, must be reduced to the extent practical.

t. Facility Siting and Design. Disposal facilities must be designed and constructed using a risk-informed, total systems evaluation approach that considers natural and engineered barriers to ensure performance objectives will not be exceeded.

(1) Facility Site. The facility must not be within a floodplain, a

tectonically active area, or within a water-table fluctuation zone, or subject to other natural phenomena hazards (e.g., high seismic ground motions, volcanic activity) without mitigation through facility design.

(2) Facility Design. Facility designs must consider the effect of natural and engineered barriers on the disposal system performance. Systems and components must be designed to maintain waste confinement.

(3) The facility design must demonstrate that the facility is able to:

(a) accommodate the projected volume of waste to be received;

(b) control radionuclides to meet applicable requirements;

(c) control radionuclides to meet applicable requirements;

(d) control water contact with the waste during operations;

(e) mitigate, to the extent practical, the potential for erosion or subsidence; and

(f) achieve long-term stability and minimize, to the extent practical, the need for active maintenance following final closure.

u. Monitoring. Monitoring should be conducted for chemical, physical, radiological, structural, and other changes that could indicate failure of system confinement, integrity, safety, or performance.

v. Non-DOE Facilities. Non-DOE facilities may be used for the storage, treatment, or disposal of radioactive waste, subject to approval by the SBAA. Such non-DOE facilities shall: (i) comply with applicable Federal, State, and local requirements, and (ii) have all necessary permits, licenses, and approvals.

w. Radioactive Waste Generator Requirements.

(1) Radioactive waste generators must develop and implement a program for waste generation planning, characterization, classification, certification, storage, disposal, transfer, and transportation in compliance with this Order.

(2) The program must be approved by the SBAA.

(3) A revised program must be developed and approved prior to implementation for:

(a) proposed changes to design, construction, or operations;

(b) proposed new processes and/or waste streams;

(c) monitoring, testing, maintenance, and/or research results that represent potential deviations from expected conditions;

(d) previously unrecognized conditions; and

(e) new regulations or significant changes to regulations.

6. HIGH-LEVEL WASTE REQUIREMENTS. The following requirements apply in addition to those in section 5 of this Order.

a. Waste Incidental to Reprocessing. Waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not HLW and shall be managed under DOE's regulatory authority in accordance with the requirements for TRU waste or LLW, as appropriate. When determining whether spent nuclear fuel reprocessing-plant wastes are incidental to reprocessing, either the citation or evaluation process described below shall be used.

(1) Citation. Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes that meet the description included in the Notice of Proposed Rulemaking (34 FR 8712) for proposed Appendix D, 10 CFR Part 50, Paragraphs 6 and 7. These radioactive wastes are the result of reprocessing-plant operations, such as, but not limited to: contaminated job wastes including laboratory items such as clothing, tools, and equipment. Ex situ soil must be addressed pursuant to section 6.d below.

(2) Evaluation. Determinations that any waste is incidental to reprocessing by the evaluation process shall be developed under good record-keeping practices, with an adequate quality assurance process, and shall be documented to support the determinations. Such wastes may include, but are not limited to, spent nuclear fuel reprocessing plant wastes that:

(f) Will be managed as LLW and meet the following criteria:

i. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

ii. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

iii. Are to be managed, pursuant to DOE's authority under the AEA, and in accordance with the provisions of section 8 of this Order.

(g) Will be managed as TRU waste and meet the following criteria:

i. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

ii. Will be managed to meet 40 CFR 191 standards; and

iii. Have been or will be incorporated into a solid physical form at the time of disposal and are to be managed pursuant to DOE's authority under the AEA, in accordance with the provisions of Section 7 of this Order.

b. Application of the High-Level Radioactive Waste Interpretation.

(1) Consistent with DOE's interpretation of the statutory definition of high-level radioactive waste in the *Atomic Energy Act of 1954*, as amended, and the *Nuclear Waste Policy Act of 1982*, as amended, as explained in the Supplemental Notice Concerning U.S. Department of Energy Interpretation of High-Level Radioactive Waste (Supplemental Notice, 84 FR 26835; June 10, 2019), spent nuclear fuel reprocessing plant waste is not high-level radioactive waste if the waste:

(a) does not exceed concentration limits for Class C LLW as set forth in 10 CFR 61.55 and meets the performance objectives of a disposal facility; or

(b) does not require disposal in a deep geologic repository and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable requirements.

(2) Proper record-keeping practices and quality assurance processes must be applied to ensure adequate supporting documentation for any determinations that either of the criteria in subsection (1) is met.

(3) Waste meeting either criteria is not high-level radioactive waste and may be classified and disposed in accordance with its radiological characteristics, regardless of origin or previous categorization. The waste shall be disposed of in an appropriate facility in accordance with its WAC, provided all applicable requirements of the disposal facility are met.

(4) Consistent with the Supplemental Notice, the provisions of this paragraph 6.b are not applicable to reprocessing wastes from the West Valley Demonstration Project in New York governed by Public

Law 96-368.

c. Section 3116. Sections 6.a(2) and 6.b do not apply to waste from reprocessing disposed of in Idaho or South Carolina and covered by section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* (Section 3116). Determinations that such waste is non-HLW may be made under Section 3116.

d. Ex-Situ Soil Contaminated with Reprocessing Waste. Soil contaminated with waste from SNF reprocessing that has been or will be removed (ex situ soil) is not HLW if a brief written soil characterization report demonstrates that the physical and chemical characteristics and radionuclide concentrations of the ex-situ soil meet the WAC of the applicable LLW disposal facility.

e. A new determination under sections 6.a(2) and 6.c must be made if any change(s) in the facts, assumptions, or analysis adversely affects the extent to which the applicable criteria under sections 6.a(2) and 6.c are met.

f. Immobilized or vitrified HLW must be produced, stored, and transported under DOE/RW-0333P, *Quality Assurance Requirements and Description*, current version, to meet the requirements of the current versions of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, or DOE/RW-0351P, *Waste Acceptance Systems Requirements Document* (for non-vitrified immobilized HLW), or the requirements of a receiving facility, as applicable.

7. TRANSURANIC WASTE REQUIREMENTS. The following requirements apply in addition to those in Section 5 of this Order

a. TRU waste shall be disposed in accordance with the requirements of 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes.

b. Management of Specific Types of Transuranic Waste. Specific types of TRU waste must be managed in accordance with the requirements below.

(1) Transuranic Waste Associated with Classified Matter. In addition to the requirements in section 5 of this Order, TRU waste containing classified matter must comply with the requirements below.

(a) A security plan must be developed or updated that identifies planned loading, transportation, handling, communication, and disposal activities and when security operations will cease.

(b) Potential security vulnerabilities must be identified and mitigated.

c. Inventory. An estimated inventory of defense TRU waste must be maintained and

must include estimates of waste disposed of, stored waste, and projected waste to be generated.

d. Defense and non-defense TRU wastes must be packaged separately when it is feasible to do so.

8. LOW-LEVEL WASTE REQUIREMENTS. The following requirements apply in addition to those in section 5 of this Order.

a. Authorization and approval is required for DOE facilities that dispose of LLW, including MW. The authorization must specify the conditions and limits under which the disposal facility must be designed, constructed, operated, and closed.

b. Disposal facilities must be designed and constructed using a risk-informed, total systems evaluation approach that considers natural and engineered barriers, based on a Performance Assessment (PA). The PA should be concise and should leverage other applicable PAs to the extent practical. Each PA must be maintained and updated as necessary to confirm its continued adequacy.

c. Performance Objectives. LLW disposal facilities must be sited, designed, operated, maintained, and closed to provide a reasonable expectation that the performance objectives listed below will not be exceeded. The point of compliance for the all-pathway performance objective must correspond to the point of highest projected dose or concentration beyond a 100-meter buffer zone surrounding the perimeter of the disposal facility.

(1) All-Pathways Dose. Dose to a member of the public must not exceed the limit set forth in NE O 458.1, current version, of a total effective dose (TED) in a year from all exposure pathways, excluding the dose from radon and its progeny in air.

(2) Air-Pathway Dose. 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*.

d. Inadvertent Human Intrusion Performance Measures.

(1) For Section 3116 determinations[2] and waste-incidental to-reprocessing evaluations that involve disposal in a new NE LLW disposal facility, the PA must consider an assessment of impacts to a hypothetical person who inadvertently intrudes into the LLW disposal facility. An acceptable approach is set forth in paragraph 2 below.

(2) As an acceptable approach, the PA may assess impacts to a hypothetical person who inadvertently intrudes into the LLW disposal facility after at least 100 years of institutional control. The results may

2 Section 3116 of the National Defense Authorization Act for Fiscal Year 2005, *infra*.

be used to establish the WAC and radionuclide concentration limits for disposal. The intruder analyses should use a performance measure TED equal to the public dose limit specified in NE O 458.1 (current version), excluding radon and its progeny in air. This performance measure is not a required limit but a consideration in development of the WAC and radionuclide concentration limits for new, NE-authorized LLW disposal facilities. The point of calculation for the inadvertent human intrusion performance measures should be established within the bounds of the disposal facility where the intruder will receive the maximum dose.

9. IMPLEMENTATION. The requirements of this Order apply to all new and existing waste at, from or associated with nuclear facilities under the responsibility of NE. Implementation of the requirements shall begin at the earliest possible date, and compliance shall be achieved not later than one year of issuance of this Order. Any of the requirements in this Order, including this compliance deadline, may be waived or modified by the SBAA, or via applicable or relevant and appropriate requirements identification process for actions taken pursuant to the Department's CERCLA authorities.

10. DEFINITIONS. Definitions for NE O 435.1, *NE Radioactive Waste Management*, are provided in Attachment 2.

11. REFERENCES. References for NE O 435.1, *NE Radioactive Waste Management*, are provided in Attachment 3.

12. CONTACT. Contact the Office of Nuclear Energy with questions about this Order.

BY ORDER OF THE SECRETARY OF ENERGY:

JAMES P. DANLY
Deputy Secretary

**ATTACHMENT 1**
**CONTRACTOR REQUIREMENTS DOCUMENT**
**NE O 435.1, *NE Radioactive Waste Management***

GENERAL REQUIREMENTS.

1. Regardless of the performer of the work or the location of the work, the contractor is responsible for complying with the requirements in this Order and this Contractor Requirements Document (CRD) unless waived, modified, or alternative requirements are approved by the NE Safety Basis Approval Authority (SBAA), or unless requirements are modified through the applicable or relevant and appropriate requirements (ARARs) identification process for actions taken pursuant to the Department's CERCLA authorities. References and definitions relative to this CRD are provided in Attachments 2 and 3 of this Order.

2. The contractor is responsible for flowing down CRD requirements (or the approved alternative or modified requirements) to subcontractors at any tier, to the extent necessary to ensure compliance with the requirements.

3. Contractors must comply with the requirements in this Order using a graded approach that considers the quantities and characteristics of the waste types being managed and the hazards, risks, and complexities of the facilities, operations, safeguard and security, and activities.

4. Waste Stream Life Cycle.

    a. Contractors must systematically plan, document, execute and evaluate radioactive waste management activities.

    b. Prior to waste generation, contractors must develop plans to address the entire life cycle for all waste streams. Contractors that generate radioactive waste must develop and implement a program for waste generation, characterization, classification, certification, storage, disposal, transfer, and transportation in compliance with this Order. The program must be approved by the SBAA.

    c. Contractors must identify and justify waste with no identified path for disposal prior to generation or as soon as practicable upon discovery. Such waste must be approved by the SBAA.

5. The contractor's design for new radioactive waste management facilities, or modifications to existing radioactive waste management facilities, must have waste confinement consistent with the design basis. Facilities must be designed and operated to:

    a. prevent flammable and explosive conditions,

    b. facilitate decontamination and decommissioning,

    c. incorporate engineered instrumentation and controls

d. contain leaks, and

e. provide monitoring systems for early leak detection or other releases from tanks or confinement systems.

6. Waste Characterization and Monitoring.

a. Contractors must characterize waste, using direct or indirect methods, document and maintain characterization information, and develop adequate controls to ensure safe management during generation, consolidation, staging, storage, treatment, transport, and disposal.

b. Contractors must have appropriate monitoring, container inspection and controls to detect any change in the waste's physical and/or chemical characteristics.

7. Waste Containers. Contractors must inspect and maintain waste containers to ensure container integrity is not compromised. Containers must be accessible to perform visual and/or remote inspections. Contractors must ensure the chemical compatibility of waste, stabilizing materials, and containers.

8. Staging and Storage.

a. Contractors may stage waste for the purpose of accumulating such quantities of waste as necessary to facilitate characterization, transportation, storage, treatment, or disposal. Staging durations should be limited to those necessary to efficiently manage the waste.

b. Contractors must select and maintain storage containers to ensure that the waste containers remain in a sound and unimpaired condition for the expected storage duration.

c. For liquid radioactive waste facilities, contractors must maintain contingency storage capacity to receive the largest volume of radioactive waste that could be released from a single storage vessel, pipe, valve, or component failure.

9. Spent Nuclear Fuel.

a. Irradiated fissionable material that is not fuel (as defined in this Order) is not spent nuclear fuel following withdrawal from a reactor.

b. If there is debris, regardless of physical state, resulting from the destructive examination of SNF, the contractor should classify the debris as radioactive waste and manage it in accordance with this Order, when separating the debris from other contaminated material is technically infeasible, cost prohibitive, or would increase worker exposure.

c. Irradiated (including partly irradiated) fuel that is intended for re-use in a reactor is not spent nuclear fuel following withdrawal from a reactor.

10. Classified Waste and Matter. The contractor must ensure that any handling of classified waste is coordinated with the Officially Designated Federal Security (ODFSA) Authority to ensure compliance with applicable DOE Safeguards and Security requirements prior to any storage, transportation, and classification associated with it. Matter that is classified in accordance with the current versions of DOE O 471.6, *Information Security*, and/or DOE O 475.2, *Identifying Classified Information*, must be minimized by the contractor prior to disposal by sanitization, as practicable and appropriate, in accordance with applicable laws, policies, and DOE directives. Sanitization technologies must be evaluated by the generator, if available and feasible (i.e., safe and cost effective), prior to determining whether permanent burial is the proper disposition path for classified matter.

11. Disposal.

    a. The contractor must classify radioactive waste prior to disposal to ensure that it is disposed of in the appropriate facility. Waste must be classified in accordance with the HLW, TRU waste, or LLW definitions in this Order for disposal. The contractor must base classification on documented characterization results. The classification must reflect properties resulting from any treatment and/or waste consolidation.

    b. The contractor must ensure that radioactive waste, in its final disposal configuration, meets the following waste form criteria in addition to the disposal facility's Waste Acceptance Criteria (WAC):

        (1) Liquid waste or waste containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable while ensuring that the liquid, in no case, exceeds 1% by volume of the disposal container or 0.5% of the waste volume after it is processed to a stable form.

        (2) Waste must not be readily capable of detonation, explosive decomposition, or reaction that could result in pressures and/or temperatures that exceed container design limits. Pyrophoric materials must be treated, prepared, and/or packaged to remove the pyrophoricity hazard.

        (3) Waste must not contain or be capable of generating, (e.g., by radiolysis or biodegradation) quantities of toxic gases, vapors, or fumes harmful to workers, the public, or the long-term structural stability of the disposal facility.

        (4) Void spaces within the waste or, if containers are used, between the waste and its container, must be reduced to the extent practical.

12. Disposal Facilities.

    a. The contractor must design and construct disposal facilities using a risk-informed, total systems evaluation approach that considers natural and engineered barriers to ensure performance objectives will not be exceeded.

    b. The contractor must not locate the disposal facility within a floodplain, a tectonically active area, a water table fluctuation zone, or an area subject to other natural phenomena hazards (e.g., high seismic ground motions, volcanic activity) without mitigation through facility design.

    c. The contractor's facility design must consider the effect of natural and engineered barriers on the disposal system performance. Systems and components must be designed to maintain waste confinement.

    d. The contractor's disposal facility design must demonstrate that the facility is able to:

        (1) accommodate the projected volume of waste to be received;

        (2) control radionuclides to meet applicable requirements;

        (3) control water contact with the waste during operations;

        (4) mitigate, to the extent practical, the potential for erosion or subsidence; and

        (5) achieve long-term stability and minimize, to the extent practical, the need for active maintenance following final closure.

13. The contractor should conduct monitoring for chemical, physical, radiological, structural, and other changes that could indicate failure of system confinement, integrity, safety, or performance.

14. The contractor must ensure that waste transfers to any storage, treatment, or disposal facility are authorized in accordance with this Order.

    a. The contractor must ensure that the WAC of the treatment, storage, or disposal facility is met unless a variance has been obtained. If the WAC will not be met, the transferring contractor must obtain a variance prior to transfer of waste. For transfers to a DOE treatment, storage or disposal facility, the variance must be approved by the receiving facility, or the SBAA or cognizant FEM as applicable.

    b. The contractor must transfer waste characterization data, container information, and generation, storage, treatment, and transportation information with or be traceable to the waste.

15. The contractor must ensure that transportation of radioactive waste complies with applicable DOE, NRC, and DOT requirements, including packaging requirements. The contractor must minimize the volume of waste shipped and number of radioactive waste shipments to the extent practical.

16. The contractor should, if practical, ensure that radioactive waste that contains RCRA, TSCA, and/or other Federal- or State-regulated constituents is segregated from other radioactive waste. The contractor must manage waste containing RCRA constituents and/or toxic components in accordance with applicable requirements derived from RCRA and TSCA, as applicable, and this Order.

HIGH-LEVEL WASTE REQUIREMENTS.

In addition to the General Requirements in this CRD, contractors shall comply with the following requirements.

1. Waste Incidental to Reprocessing.

   a. Citation. Contractors shall prepare draft waste-incidental-to- reprocessing determinations by citation in accordance with this Order, for approval by the SBAA.

   b. Evaluation. Contractors shall prepare draft waste-incidental-to- reprocessing evaluations and draft determinations in accordance with this Order, for finalization, approval and issuance by the SBAA.

2. Application of High-Level Radioactive Waste Interpretation. Contractors shall draft supporting documentation and draft determinations in accordance with this Order, for finalization, approval and issuance by the SBAA.

3. Section 3116 of the Ronald W. Reagan National Defense Authorization Act. Contractors shall prepare drafts of draft and final basis documents, subject to finalization by DOE, to support potential determinations under Section 3116 by the Secretary of Energy.

4. Ex Situ Soil Contaminated with Reprocessing Waste. Contractors shall prepare draft soil characterization reports to support determinations by the SBAA under this Order.

5. Contractors shall produce, store, and transport immobilized or vitrified HLW under DOE/RW-0333P, *Quality Assurance Requirements and Description,* current version, to meet the requirements of the current versions of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance Systems Requirements Document* (for non-vitrified immobilized HLW), as applicable, or the requirements of the receiving facility.

TRANSURANIC WASTE REQUIREMENTS.

In addition to the General Requirements in this CRD, contractors shall comply with the following requirements.

1. Contractors shall draft documentation, for finalization and approval by the SBAA, to demonstrate compliance with the requirements of 40 CFR Part 191 for TRU waste to be disposed of onsite.

2. Contractors shall assist in preparing documents for management of TRU waste containing classified matter in accordance with the following requirements:

    a. A security plan must be developed or updated that identifies planned loading, transportation, handling, communication, and disposal activities and when security operations will cease.

    b. Potential security vulnerabilities must be identified and mitigated.

3. Contractors shall maintain an estimated inventory of defense TRU waste and must include estimates of disposed of, stored, and projected to be generated.

4. Contractors shall ensure that TRU waste complies with the receiving and disposal facility's WAC at the earliest point in the waste's life cycle, to the extent practical. Defense and non-defense TRU wastes must be packaged separately when it is feasible to do so.

LOW-LEVEL RADIOACITVE WASTE DISPOSAL REQUIREMENTS.

In addition to the General Requirements in this CRD, contractors shall comply with the following requirements.

1. Contractors must obtain authorization and approval from the SBAA for contractor-designed, NE-authorized facilities that dispose of LLW, including MW. Contractors must comply with the conditions and limits specified in the authorization for the design, construction, operation, and closure of the LLW disposal facility.

2. Contractors must design and construct LLW disposal facilities using a risk-informed, total systems evaluation approach that considers natural and engineered barriers, based on a Performance Assessment (PA). The contractor shall prepare a draft PA, for approval by the SBAA. The draft PA should be concise and should leverage other applicable PAs to the extent practical. The contractor must maintain and update the PA as necessary to confirm its continued adequacy.

3. Performance Objectives. Contractors must site, design, operate, maintain, and close their NE-authorized LLW disposal facilities to provide a reasonable expectation that the performance objectives listed below will not be exceeded. The point of compliance for the all-pathway performance objective must correspond to the point of highest projected dose or concentration beyond a 100-meter buffer zone surrounding the perimeter of the disposal facility.

   a. All-Pathways Dose. Dose to a member of the public must not exceed the limit set forth in NE O 458.1, current version, of a total effective dose (TED) in a year from all exposure pathways, excluding the dose from radon and its progeny in air.

   b. Air-Pathway Dose. 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*.

4. Inadvertent Human Intrusion Performance Measures.

   a. For Section 3116[3] and waste-incidental to-reprocessing evaluation that involve disposal in a new, NE-authorized LLW disposal facility, the contractor's PA must consider an assessment of impacts to a hypothetical person who inadvertently intrudes into the LLW disposal facility. An acceptable approach is set for in paragraph b. below.

   b. As an acceptable approach, the PA may assess impacts to a hypothetical person who inadvertently intrudes into the LLW disposal facility after at least 100 years of institutional control. The intruder analyses should use a performance measure TED equal to the public dose limit specified in NE O 458.1 (current version), excluding radon and its progeny in air. This performance measure is not a required limit but may be a consideration in development of the WAC and radionuclide concentration limits for new, NE-authorized LLW disposal facilities. The point of calculation for the inadvertent human intrusion performance measure should be established within the bounds of the disposal facility where the intruder will receive the maximum dose.

3 Section 3116 of the *National Defense Authorization Act for Fiscal Year 2005*, *infra*.

# ATTACHMENT 2
# DEFINITIONS

As used in this Order, the following terms have the meanings indicated.

1. BYPRODUCT MATERIAL. (a) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material; (b) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content; (c) (1) any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or (2) any material that – (i) has been made radioactive by use of a particle accelerator; and (ii) is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and (d) any discrete source of naturally occurring radioactive material, other than source material, that – (1) the Nuclear Regulatory Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and (2) before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

2. FISSIONABLE MATERIAL. Radionuclides capable of sustaining a neutron-induced chain reaction (e.g., uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, neptunium-237, americium-241, and curium-244).

3. FUEL (ALSO NUCLEAR FUEL). Fissionable material that supports a self-sustaining fission chain reaction when used to fuel a nuclear reactor, thereby producing energy (usually in the form of heat or useful radiation) for use in other processes.

4. GRADED APPROACH. The process of ensuring that the level of analysis, documentation, and actions used to comply with a requirement are commensurate with (1) the relative importance to safety, safeguards, and security; (2) the magnitude of any hazard involved; (3) the life-cycle stage of a facility; (4) the programmatic mission of a facility; (5) the particular characteristics of a facility; (6) the relative risk of radiological and non-radiological hazards; and (7) any other relevant factor.

5. HIGH-LEVEL RADIOACTIVE WASTE (HLW). High-level waste is the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that the NRC, consistent with existing law, determines by rule requires permanent isolation.

6. LOW-LEVEL RADIOACTIVE WASTE (LLW). Low-level radioactive waste is radioactive waste that is not HLW, SNF, TRU waste, byproduct material (as defined in section 11e.(2), (3), or (4) of the *Atomic Energy Act of 1954*, as amended.

7. MIXED WASTE (MW). Waste that contains both (1) a radioactive component subject to the AEA and (2) a hazardous waste component subject to RCRA.

8. PERFORMANCE ASSESSMENT (PA). An analysis of a radioactive waste disposal facility conducted to demonstrate there is a reasonable expectation that performance objectives established for the long-term protection of the public and the environment will not be exceeded following closure of the facility.

9. REPROCESSING. Actions necessary to separate fissile elements (U-235, Pu-239, U-233, and Pu-241) and/or transuranium elements (e.g., Np, Pu, Am, Cm, Bk) from other materials (e.g., fission products, activated metals, cladding) contained in SNF for the purposes of recovering desired materials. Separation processes include aqueous separation processes (e.g., the Redox and the Purex processes) and nonaqueous processes (e.g., pyrometallurgical and pyrochemical processes). Processes upstream of these separations processes, such as chemical or mechanical decladding, cladding separations, conditioning, fuel dissolution, or accountability measuring are not reprocessing. Wastes that are produced upstream of the separations processes are not HLW. Processes downstream of these separations processes involving useful products including plutonium and uranium, such as purification, decontamination, rinsing, washing, treating, or solidifying, are not reprocessing. Wastes that are produced downstream of the separations processes and involve useful products are not HLW.

10. SOURCE MATERIAL. (1) Uranium, thorium, or any other material which is determined, pursuant to the provisions of section 61 of the AEA, to be source material; or (2) ores containing one or more of the foregoing materials, in such concentration as may by regulation be determined from time to time.

11. SPECIAL NUCLEAR MATERIAL. (1) Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which is determined, pursuant to the provisions of section 51 of the AEA, to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.

12. SPENT NUCLEAR FUEL (SNF). Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

13. STAGING. Storing waste for the purpose of accumulation to facilitate transfer, transport, treatment, storage, and/or disposal.

14. STORAGE. The holding of radioactive waste for a temporary period, at the end of which the waste is treated, disposed of, or stored elsewhere.

15. TRANSURANIC WASTE (TRU waste). Radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) HLW; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

16. WASTE ACCEPTANCE CRITERIA (WAC). The technical and administrative requirements that a waste must meet in order for it to be accepted at a storage, treatment, or disposal facility.

**ATTACHMENT 3**
**REFERENCES**

1. Public Law 98-525, *Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1985*

2. Public Law 102-579, *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*

3. Public Law 108-375, *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005*

4. Public Law 118-67, *Atomic Energy Act of 1954*

5. Public Law 117-286, *Nuclear Waste Policy Act of 1982*

6. Public Law 94-469, *Toxic Substances Control Act of 1976*

7. 42 United States Code, Section 6901 et seq. (1976), *Resource Conservation and Recovery Act*

8. 10 Code of Federal Regulations Part 50, *Licensing of Production and Utilization Facilities*

9. 10 Code of Federal Regulations Part 61, Subpart C, *Performance Objectives*

10. 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*

11. 34 Federal Register 8712, "Atomic Energy Commission, 10 CFR Part 50, Licensing of Production and Utilization Facilities"

12. 84 Federal Register 26835, "Supplemental Notice Concerning U.S. Department of Energy Interpretation of High-Level Radioactive Waste," June 10, 2019

13. DOE O 250.1, *Civilian Radioactive Waste Management Facilities Exemptions from Departmental Orders*

14. DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*

15. DOE 5633.3B, *Control and Accountability of Nuclear Materials*

16. DOE/RW-0333P, *Quality Assurance Requirements and Description*

17. DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*

18. DOE/RW-0351P, *Waste Acceptance System Requirements Document.*