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Standard Guide for Preparing Waste Management Plans for Decommissioning Nuclear Facilities[1]

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1. Scope

1.1 This guide addresses the development of waste management plans for potential waste streams resulting from decommissioning activities at nuclear facilities, including identifying, categorizing, and handling the waste from generation to final disposal.

1.2 This guide is applicable to potential waste streams anticipated from decommissioning activities of nuclear facilities whose operations were governed by the Nuclear Regulatory Commission (NRC) or Agreement State license, under Department of Energy (DOE) Orders, or Department of Defense (DoD) regulations.

1.3 This guide provides a description of the key elements of waste management plans that if followed will successfully allow for the characterization, packaging, transportation, and off-site treatment or disposal, or both, of conventional, hazardous, and radioactive waste streams.

1.4 This guide does not address the on-site treatment, long term storage, or on-site disposal of these potential waste streams.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D5283 Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation

D5792 Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives

E1892 Guide for Preparing Characterization Plans for Decommissioning Nuclear Facilities

E1893 Guide for Selection and Use of Portable Radiological Survey Instruments for Performing In Situ Radiological Assessments to Support Unrestricted Release from Further Regulatory Controls

2.2 *Code of Federal Regulations:*[3]

10 CFR 60 Disposal of High-Level Radioactive Wastes in Geologic Repositories

10 CFR 61 Licensing Requirements for Land Disposal of Radioactive Waste

10 CFR 71 Packaging and Transportation of Radioactive Materials

10 CFR 830.120 Quality Assurance Requirements

29 CFR 1910.120 Hazardous Waste Operations and Emergency Response

40 CFR 261 Identification and Listing of Hazardous Waste

40 CFR 262 Standards Applicable to Generators of Hazardous Waste

40 CFR 761 Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

40 CFR 763 Asbestos

49 CFR 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

49 CFR 173 Shippers—General Requirements for Shipments and Packagings

49 CFR 397 Transportation of Hazardous Materials; Driving and Parking Rules

2.3 *DOE Documents:*[3]

DOE Order 460.1A Packaging and Transportation Safety

DOE Order 460.2 Departmental Materials Transportation and Packaging Management

DOE Order 474.1 Control and Accountability of Nuclear Materials

DOE Order 414.1A Quality Assurance

DOE Manual M 435.1-1 Radioactive Waste Management

2.4 *United States Code:*[3]

[1] This guide is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.03 on Radiological Protection for Decontamination and Decommissioning of Nuclear Facilities and Components.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

United States Code, Title 42, Section 2014

2.5 *USACE Documents:*[4]

Engineering Manual EM 385-1-1.06E Ionizing Radiation (3 Nov. 2003)

Radiation Protection Manual EM 385-1-80 (30 May 1997)

2.6 *Other Documents:*

ASME Quality Assurance Requirements for Nuclear Facility Applications[5]

EPA QA/R-2 Requirements for Quality Management Plans[6]

EPA QA/G-4 Guidance for Data Quality Objectives[6]

NQA-1-2000 American Society of Mechanical Engineers, 2001[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *documents*—instructions, procedures and drawings that control policy, administrative, and technical information.

3.1.2 *records*—electronic, written, printed, microfilm, photographs, radiographs, or optical disks that contain data that are retained for their future value.

3.1.3 *waste acceptance requirements*—criteria and all other requirements that a facility receiving waste for treatment, storage, or disposal must meet to receive waste.

3.1.4 *waste acceptance criteria*—the technical and administrative criteria that a waste must meet to be accepted at a treatment, storage, or disposal facility.

4. Significance and Use

4.1 A waste management plan based on the contents of this guide will provide for the successful identification of potential waste streams anticipated from decommissioning activities, and provide a clear and concise methodology for the handling of identified waste from generation to final disposition.

4.2 The waste management plan will identify the general waste types, characterization, packaging, transportation, disposal, and quality assurance requirements for potential waste streams.

5. General Waste Types

5.1 *Radioactive*—Radioactive wastes are defined as discarded material in any form that must be managed for its radioactive content per federal or agreement state regulations. Radioactive wastes are further categorized into the following subclasses.

5.1.1 *High Level*—High level wastes are irradiated reactor fuel (spent nuclear fuel) and the highly radioactive material resulting from the reprocessing of irradiated reactor fuel, including liquid waste and any solid material derived from such liquid (10 CFR 60, DOE Manual M 435.1-1).

5.1.2 *Transuranic*—Transuranic wastes are any material containing alpha-emitting transuranic nuclides with half-lives greater than 20 years and in concentrations greater than 100 nanocuries per gram (3.7 kBq g^{-1}) (1×10^{-7} Ci/g) (DOE Manual M 435.1-1).

5.1.3 *By-Product Material*—By-product material wastes are 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, and the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content (42 U.S.C. 2014(e)).

5.1.4 *Naturally Occurring and Accelerator Produced Radioactive Materials*:

5.1.4.1 *NORM (Naturally Occurring Radioactive Material)*—Any material that contains naturally occurring radionuclides. By-product material and the natural radioactivity of rocks, soils, or background radiation are not to be included (DOE Manual M 435.1-1).

5.1.4.2 *NARM (Naturally Occurring or Accelerator Produced Radioactive Material)*—Any material that contains NORM or accelerator-produced radioactive materials.

5.1.4.3 *TENORM (Technologically Enhanced Naturally Occurring Radioactive Materials)*—NORM whose composition, radionuclide concentrations, availability, or proximity to man have been increased by or because of human practices.

5.1.5 *Low Level*—Low level wastes are radioactive wastes that are not spent fuel, high level radioactive wastes, transuranic radioactive wastes, by-product material, or naturally occurring radioactive materials. Low level wastes are defined into categories per 10 CFR 61.55(a)(2)(i) and accompanying tables. Those categories include:

5.1.5.1 *Class A*—Class A wastes contain the lowest concentrations of radioactivity and typically are composed of short-lived radionuclides that generate no decay heat, do not need to be shielded, and decay to levels posing minimal potential human dose within 100 years. Class A wastes typically have an average concentration less than 100 GBq m^{-3} (2.7 Ci m^{-3}) and constitute the majority of generated radioactive waste.

5.1.5.2 *Class B*—Class B wastes contain the next lowest concentrations of radioactivity and typically are composed of greater quantities of short-lived radionuclides than Class A. Class B wastes typically have an average concentration of 3 TBq m^{-3} (81 Ci m^{-3}).

5.1.5.3 *Class C*—Class C wastes contain the highest concentrations of radioactivity acceptable for near-surface disposal. Class C wastes are typically composed of greater concentrations of short-lived radionuclides than Class A or B wastes, and may contain long-lived radionuclides. Class C wastes on average have a concentration of 9 TBq m^{-3} (243 Ci m^{-3}) and will not decay to acceptable levels within 100 years.

5.1.5.4 *Greater Than Class C*—Greater Than Class C wastes are all radioactive wastes, defined as low level wastes, that do not qualify for near-surface disposal as defined in 10 CFR 61.

5.2 *Hazardous*—Hazardous wastes are solid wastes as defined in 40 CFR 261 that meet any one of the following four criteria:

5.2.1 Exhibits a characteristic such as ignitable, corrosive, reactive, or toxic as defined in 40 CFR 261, Subpart C,

[4] United States Army Corps of Engineers, USACE Publications Depot, ATTN: CEIM-IM-PD, 2803 52nd Ave., Hyattesville, MD 20781-1102.

[5] Available from American Society of Mechanical Engineers, ASME, ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

[6] U.S. Environmental Protection Agency, Quality Staff (281 1R), 1200 Pennsylvania Ave., NW, Washington, DC 20460. E-mail: quality@epa.gov

5.2.2 Is identified as a listed waste under the F, K, P, or U lists as defined in 40 CFR 261, Subpart D,

5.2.3 Is composed of a mixture of a solid waste and a listed waste as defined in 40 CFR 261.3(b), or

5.2.4 Is a derived waste from the treatment, storage, or disposal of a listed waste as defined in 40 CFR 261.3(c)(2)(i).

5.3 *Mixed Waste*—Mixed Waste containing a RCRA hazardous material and an NRC regulated radioactive material.

5.4 *Co-mingled Waste*—Waste containing any CERCLA hazardous substance other than the CERCLA radioactive hazardous substances and any radioactive materials.

5.5 *PCB*—Polychlorinated Biphenyl (PCB) wastes are PCBs and PCB items that are subject to the disposal requirements of 40 CFR 761, Subpart D.

5.6 *Conventional*—Conventional wastes are any non-hazardous discarded material in any form that does not contain residual amounts of radioactivity above the limits of the treatment or disposal facility.

6. Characterization

6.1 The waste management plan should include a description of the waste characterization methodology. The waste characterization methodology should be of sufficient detail to ensure that physical, chemical, and radiological properties of the wastes are identified and known throughout the waste management process and that they are characterized with sufficient accuracy to ensure worker protection, proper segregation, treatment, storage, and disposal. Useful information relative to the characterization of waste streams can be found in Guide E1892. Waste characterization methodologies should focus on total data acquisition and be based on direct methods (surveys and sampling and analysis), and indirect methods (process knowledge). Characterization data should include information obtained from direct measurement, and from sampling and analysis of the waste materials. Guidance on direct measurement is contained in Guide E1893.

6.2 *Sampling and Analysis*—The sampling and analysis of waste streams should be conducted in accordance with a written plan that identifies the data life cycle process. The data life cycle process is composed of three essential elements: planning, implementation, and assessment.

6.2.1 *Planning*—The planning process is a project management tool that identifies and documents the qualitative and quantitative statements that define the data quality objectives process (for example, Practice D5792). A graded approach to the planning process should be considered based on the size, complexity, available resources, and level of quality control.

6.2.2 *Implementation*—Sampling and analysis plans should identify the target analyte(s), the sampling design and methodology as determined during the planning process, the quality control parameters, and the analytical requirements per the approved statement of work.

6.2.3 *Assessment*—The three-step assessment process is based on verification, validation, and data quality assessment.

6.2.3.1 Verification is a systematic process performed externally from the data generator that evaluates the laboratory delivered data set (that is, data package) against the deliverable requirements as stated in the laboratory statement of work. It also checks for completeness, consistency, comparability, and correctness of the data set.

(1) A verification report should be generated that identifies any correctable and non-correctable discrepancies associated with the data set. The report should be in a standard format and remain as part of the data package.

(2) Data verification should be an interactive process with the laboratory. It should provide appropriate feedback to address correctable and non-correctable discrepancies which result in opportunities to improve the analytical work prior to project completion.

6.2.3.2 Validation is a systematic process performed externally from the data generator that addresses the reliability of the data and provides assurance of the presence or absence of analytes. This process reviews the verification report, and laboratory-delivered data set, and applies defined performance-based criteria to qualify the data.

(1) A data validation report should be generated that identifies all data qualified based on the performance-based criteria. The report should be in a standardized format and remain as part of the data package.

6.2.3.3 The data quality assessment process is the "scientific and statistical evaluation of data to determine if they are of the right type, quality, and quantity to support their intended use." This process should not be limited to the verification and validation of data, but should encompass the entire sample collection and analysis process and its impact on data quality and usability.

(1) A graded approach based on the intended use of the data should be applied to the data quality assessment process. This should be done in such a manner that the three fundamental premises are satisfied:

(a) Are the samples representative?

(b) Are the data accurate?

(c) Can a decision be made?

6.3 *Process Knowledge*—A characterization methodology that relies on the knowledge of the physical, chemical, and radiological constituents of the materials associated with the waste generation process.

6.3.1 Process knowledge can be derived from Material Safety Data Sheets, historical analytical data, historic records, living memory, system descriptions, plans and drawings, manufacturing specifications, mass balance documentation, procedures, and any other methods that adequately quantify the physical, chemical, and radiological constituents of a waste stream.

6.3.1.1 Process knowledge data should be within the acceptable range of certainty and precision as defined in the data quality objectives.

6.3.1.2 Process knowledge should be assembled into an auditable record such as a data package that at a minimum identifies the following: time of waste generation, waste generation process, analytical data, description of site-specific facilities, reference list of personnel interviewed, documents, databases, quality control methods, and data usability requirements.

6.3.1.3 To ensure proper characterization of the waste stream, limitations of process knowledge data should be