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Standard Guide for Nuclear Facility Decommissioning Plans[1]

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INTRODUCTION

As a nuclear facility approaches the end of its operational life, the operator should initiate final preparations for decommissioning. As part of this program, a decommissioning plan should be developed to comply with applicable federal and state requirements and regulations, as well as to provide generic and detailed information relevant to decommissioning project planning. This standard is a guideline for the preparation and content of the decommissioning plan.

1. Scope

1.1 This guide applies to decommissioning plans for any nuclear facility whose operation was (is) governed by Nuclear Regulatory Commission (NRC), Agreement State license, under Department of Energy (DOE) orders, or whose operation was overseen by another federal, state, or local agency.

1.2 The guide applies to the preparation and content of the decommissioning plan document itself.

1.3 The detailed description and development of implementation plans identified in Section 4 is outside the scope of this guide.

NOTE 1—Nuclear facilities operated by the U.S. DOE are not licensed by the U.S. NRC, nor are other nuclear facilities which may come under the control of the U.S. Department of Defense or individual agreement states. The references in this guide to licensee, U.S. NRC Regulatory guides, and Title 10 of the U.S. *Code of Federal Regulations* are to imply appropriate alternative nomenclature with respect to DOE, DOD, or agreement state nuclear facilities. This distinction should not alter the content of decommissioning plans for nuclear facilities.

1.4 *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]

E1034 Specification for Nuclear Facility Transient Worker Records

E1167 Guide for Radiation Protection Program for Decommissioning Operations

E1168 Guide for Radiological Protection Training for Nuclear Facility Workers

E1760 Guide for Unrestricted Disposition of Bulk Materials Containing Residual Amounts of Radioactivity

E1819 Guide for Environmental Monitoring Plans for Decommissioning of Nuclear Facilities

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

E2216 Guide for Evaluating Disposal Options for Concrete from Nuclear Facility Decommissioning

E2420 Guide for Post-Deactivation Surveillance and Maintenance of Radiologically Contaminated Facilities

E2421 Guide for Preparing Waste Management Plans for Decommissioning Nuclear Facilities

2.2 *Code of Federal Regulations:*[3]

10 CFR 19 Notices, Instructions and Reports to Workers; Inspections

[1] This guide is under the jurisdiction of 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 Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

10 CFR 20 Standards for Protection Against Radiation
10 CFR 30 Rules of General Applicability to Domestic Licensing of Byproduct Material
10 CFR 40 Domestic Licensing of Source Material
10 CFR 50 Domestic Licensing of Production and Utilization Facilities
10 CFR 51 Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions
10 CFR 61 Licensing Requirements for Land Disposal of Radioactive Waste
10 CFR 70 Domestic Licensing of Special Nuclear Material
10 CFR 71 Packaging and Transportation of Radioactive Materials
10 CFR 73 Physical Protection of Plants and Materials
10 CFR 140 Financial Protection Requirements and Indemnity Agreements
10 CFR 150 Exemption and Continued Regulatory Authority in Agreement States Under Section 274
10 CFR 170 Fees for Facilities, Materials, Import and Export Licenses and Other Regulatory Services Under the Atomic Energy Act of 1954, as Amended
10 CFR 830 Nuclear Safety Rules
10 CFR 835 Occupational Radiation Safety
29 CFR 1910.120 Hazardous Waste Operations and Emergency Response
40 CFR 190 Environmental Radiation Protection Standards for Nuclear Power Operations
40 CFR 191 Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High Level Waste and Transuranic Waste
40 CFR 192 Health and Environmental Protection for Uranium and Thorium Mill Tailings
40 CFR 260 Land Disposal Restrictions
49 CFR 190 and above Hazardous Materials Transportation Regulations

2.3 *Nuclear Regulatory Commission Standards:*[4]
NRC Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors
NUREG-1757 Consolidated Decommissioning Guidance; Volume 1, Decommissioning Process for Material Licenses; Volume 2, Characterization, Survey and Determination of Radiologial Criteria; Volume 3, Financial Assurance, Recordkeeping, and Timeliness
NUREG-1575 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Rev 1, August 2000
NUREG-1575 Supplement 1, Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME)
NUREG-2082 Monitoring for Compliance with Decommissioning Termination Survey Criteria
Regulatory Guide 1.179 Standard Format and Content for License Termination Plans for Nuclear Power Reactors (NRC 1999)

2.4 *Department of Energy Standard:*[5]
DOE Order O 435.1-1 "Radioactive Waste Management" and Supporting Guides and Manuals
DOE Order 430.1B Real Property Assess Management
DOE Guide G430.1-3 Deactivation Implementation Guide

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *decommission, vt*—to remove a nuclear facility safely from service and reduce residual radioactivity to levels that permit release of the property or facility for unrestricted use and termination of any applicable license(s).

3.1.2 *decontamination, n*—those activities employed to reduce the levels of (radioactive) contamination in or on structures, equipment, materials, and personnel.

3.1.3 *dismantlement, n*—the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations.

3.1.4 *entombment, n*—consists of placing the facility into protective storage. Initial entombment activities consist of removing the balance of plant contaminated components, systems, and structures from the site and sealing all the remaining contaminated and activated plant components and systems within the entombment boundary. This structure provides for containment of the entire radioactive inventory remaining on site during the entombment period. Other initial activities would consist of processing and removing radioactive waste, securing a possession-only license, and implementing security and surveillance plans for the delay period. Decommissioning is completed by either radioactive decay to unrestricted use levels or by dismantlement to unrestricted use levels. If dismantlement were selected following entombment, additional activities would be initiated after 30 or more years and would consist of radiation surveys, removal of the entombment structure and materials within it, processing and removal of any remaining solid and liquid radioactive wastes, and restoring/releasing the site for unrestricted use.

3.1.5 *nuclear facility, n*—a facility whose operations involve (or involved) radioactive materials in such form or quantity that a radiological hazard potentially exists to the employees or the general public. Included are facilities that are (or were) used to produce, process, or store radioactive materials. Some examples are nuclear reactors (power, test, or research), fuel fabrication plants, fuel reprocessing plants, uranium/thorium mills, UF-6 production and enrichment plants, radiochemical laboratories, and radioactive waste disposal sites.

3.1.6 *safe storage, n*—consists of placing and maintaining the facility in protective storage. Initial safe storage operations would consist of general plant decontamination activities, radiation surveys, the processing and removal of radioactive waste materials, securing a possession-only license, and the implementation of security, surveillance, and maintenance

[4] Available from Nuclear Regulatory Commission, Public Document Room, 1717 H St., N.W., Washington, DC 20555.

[5] Available from Dept. of Energy, National Technical Information Service, U.S. Dept. of Commerce, Springfield, VA 22161.

plans for the delay period. Decommissioning is completed by dismantling following the protective storage period. The additional activities initiated after 30 or more years would be essentially the same as those described for entombment, except that there would be more systems removed after safe storage than after entombment.

4. Significance and Use

4.1 The standardization of decommissioning plans will provide the nuclear facility owner with a greater assurance that all basic planning elements and requirements have been identified, examined, and addressed.

4.2 In applying the guidance contained in this standard, the nuclear facility owner will address the significant subject areas necessary to describe a comprehensive decommissioning plan. Additional guidance on the planning of decommissioning projects, and the preparation of decommissioning plans can be found in such references as NUREG-1757 on decommissioning standard review plans, and Regulatory Guide 1.179 on the format and content of license termination plans. Recent new guidance on all aspects of decommissioning is contained in an ASME publication titled The Decommissioning Handbook.[6]

4.3 This decommissioning plan will be developed to serve as the executive document that describes the objectives of the decommissioning program and identifies and defines the elements necessary to accomplish the program.

4.4 A detailed implementation plan describing how the objectives of the decommissioning plan will be met should be prepared. Some of the documents or implementation plans that may be required to support the overall decommissioning program include an engineering plan; a cost, schedule, and financing plan (10 CFR 140 and 170); a field implementation plan; a health and safety plan (29 CFR 1910.120, Guide E1167); a quality assurance plan (10 CFR 50.59 and 10 CFR 830.120); an emergency plan; an environmental monitoring plan (Guide E1819); a radiological protection plan (10 CFR 20, 10 CFR 835, Guide E1167); and a physical security plan (10 CFR 73). These implementation plans shall be separate from and consistent with the decommissioning plan.

5. Elements of the Decommissioning Plan

5.1 The plan should identify and describe the major elements of the decommissioning program. These elements should be addressed in their approximate chronological order and should be expanded to provide descriptive information and details.

5.2 The following are provided as typical decommissioning elements for some types of nuclear facilities:

5.2.1 Facility description,

5.2.2 Operating history, and

5.2.3 A description of the history of operation at the nuclear facility should be included to provide general information and an indication of the scope of effort required for decommissioning. This description should include the initial construction and licensing history, the operating record, and a summary of all operating events that could affect decommissioning activities (such as spills or releases of radioactive or contaminated materials).

6. Characterization

6.1 A description of the entire nuclear facility to be decommissioned should be provided including results of a radiation survey prior to initiation of other decommissioning activities. Site characteristics that should be addressed include topography, soils and geology, hydrology, seismology, demography, and meteorology. Specific details such as those found in safety analysis reports may be provided in appendices or by reference. Plant characteristics that should be addressed include a general plant description, a plant structures description, and a plant systems description. Radiological and hazardous material characteristics of the nuclear facility shall be included as well. The radionuclide inventory for the facility should be presented with all of the major contributors identified and quantified. Environmental radiological characteristics of the site should be discussed. Guidance for developing the Characterization Plan may be found in the MARSSIM manual (NUREG-1575), the MARSAME manual, and Guide E1892. Guidance for selection of appropriate instrumentation for obtaining the radiological data is provided in Guide E1893.

7. Program Objectives

7.1 The objective(s) of the decommissioning program should be stated concisely. The selected or proposed decommissioning alternative (dismantlement, safe storage followed by dismantlement, or entombment to unrestricted use levels) shall be included as a minimum (DOE Order 430.1B).

7.2 A qualitative description of any interim status of the facility should be provided when applicable, that is, when the safe storage or entombment alternatives are selected, and when a surveillance/maintenance period is proposed for the facility (DOE Guide G430.1-1, Guide E2420).

7.3 Cleanup criteria should be stated herein, such as NRC Regulatory Guide 1.86, or other specific federal and state requirements. Termination survey requirements should be as detailed in 13.5.

7.4 The interim and ultimate desired status of all facility licenses should be discussed. For facilities where the unrestricted release criteria will be achieved without a planned and significant delay period, this should be stated. For this case, an ongoing surveillance/maintenance program will not be necessary.

8. Program Management and Administration

8.1 The decommissioning plan should include a description of the organization and responsibilities with respect to the overall program. The discussion should address the decommissioning project team, decommissioning manpower; worker health and safety training (Specification E1034 and Guide E1168); and the use, control, and management of subcontractors. When safe storage or entombment alternatives are selected, then the organization and responsibilities structure for

[6] Taboas, A. L., Moghissi, A. A., and LaGuardia, T. S., Eds., ASME, Three Park Ave., New York, NY, 2004.

the protected storage and delayed dismantlement phases of the program should be provided as well (DOE Guide G430.1-3, Guide E2420).

9. Program Schedule and Cost

9.1 *Major Milestone Schedule*—The plan should include decommissioning schedule information. Identification of major decommissioning phase start and finish dates as well as major decommissioning task milestones should be addressed. A figure or chart as well as a written explanation should be provided. A logic diagram may be included to depict the sequence of activities.

9.2 *Cost Estimate*—A summary of the detailed, site-specific decommissioning cost estimate should be provided. A copy of the detailed cost estimate may be referenced or provided as an appendix.

10. Decommissioning Activities

10.1 The plan should address the major activities of the decommissioning program. A typical list of decommissioning activities is presented in Appendix X1.

10.2 The plan should include a concise description of how these major activities will be carried out in a manner that protects the worker and public health and safety. Persons or organizations responsible for each activity should be designated.

11. Facility Modification

11.1 The plan should identify major additions to the facility in support of decommissioning operations. Changes to the facility resulting from decommissioning activities (such as removal of structures and systems) need not be addressed herein.

11.2 Examples of major facility modifications to be identified include additions of a waste processing facility, a waste staging/storage facility, a water cleanup/clarification facility, or a cask handling/staging facility. The amount of detail necessary will vary, depending on the type of modification. In general, however, the information should be adequate to describe the extent and purpose of the modification, including the decommissioning of these modifications. Detailed design and analytical information may be provided as appendices.

12. Waste Management

12.1 *Radioactive Materials*—Anticipated types, quantities, and dose rate ranges of radioactive waste materials should be identified. Projected dispositions of these materials should also be identified with respect to packaging, interim storage, transportation, and disposal. (Guides E1760, E2216, and E2421)

12.2 *Radioactive Hazardous Materials*—Anticipated types, quantities, and dose rate ranges of radioactive hazardous materials should be identified. Expected dispositions of these materials should also be identified with respect to treatment, packaging, interim storage, transportation, and disposal. (10 CFR 61)

12.3 *Hazardous Materials*—Anticipated types and quantities of hazardous waste materials should be identified. Expected dispositions of these materials should also be identified with respect to treatment or salvage, packaging, interim storage, transportation, and disposal. (40 CFR 260)

12.4 *Nonradioactive Materials*—Anticipated types and quantities of nonradioactive waste materials should be identified. Expected dispositions of these materials should be addressed with respect to salvage or disposal. (E1760)

13. Licensing and Regulatory Issues

13.1 The plan should discuss compliance with current regulatory requirements and modification of the operating license to a possession-only license and address major licensing and regulatory issues. If detailed information is included in other parts of the decommissioning plan or other licensing documents, it is sufficient to provide a brief discussion herein and include a reference to the detailed information provided elsewhere.

13.2 *Compliance with Current Requirements*—Compliance with the current NRC regulations and other federal regulations applicable to the decommissioning of nuclear facilities should be addressed. The NRC requirements are contained in Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 19, 20, 30, 40, 50, 51, 70, 71, 73, 140, 150, and 170. Other federal regulations also contain requirements that must be complied with during the decommissioning of a nuclear facility. They include Environmental Protection Agency (40 CFR 190, 191, and 192) and Department of Transportation regulations (49 CFR 190 and above). They also include the DOE orders, for example, DOE Order O 435.1, and DOD requirements for decommissioning of that departments' facilities.

13.3 *License Modification*—At the end of the plant operating life, the operating license may be terminated or converted to a possession-only license in accordance with 10 CFR 50.90 and NRC Regulatory Guide 1.86. Additional information required for the license conversion should be provided. This should include the following:

13.3.1 A description of the current status of the facility,

13.3.2 A description of the measures that will be taken to prevent criticality and to minimize release of radioactivity, and

13.3.3 A safety analysis of the activities to be accomplished, of plant modifications to facilitate decommissioning, and of changes to the technical specifications in accordance with 10 CFR 50.59 and 10 CFR 830.

13.4 *Technical Specifications*—Any proposed changes to the technical specifications that reflect the possession-only status and the necessary decommissioning activities to be performed may be included herein. The technical specifications should be modified to provide for appropriate reduction in staffing, consistency with a possession-only status, and allowances for elimination of periodic surveillance requirements consistent with the removal of safety-related systems.

13.5 *Residual Radioactivity*—The final radiation survey program and certification requirements should be described. The levels of residual radioactivity that support the decommissioning objective should also be specified. Guidance for

defining the final survey protocols may be found in NUREG-1575 (MARSSIM), NUREG-1575, Supplement (MARSAME), NUREG-2082, and Guide E1893.

14. Future Supporting Documents

14.1 The plan may briefly define and discuss any programmatic support documents that will be developed in the future to implement the decommissioning program. Some of the following types of documents may be necessary:

14.1.1 Engineering plan.
14.1.2 Cost, schedule, and financing plan.
14.1.3 Field implementation plan.
14.1.4 Health and safety plan.
14.1.5 Quality assurance plan.
14.1.6 Emergency plan.
14.1.7 NEPA documentation.
14.1.8 Radiological protection plan.
14.1.9 Physical security plan.
14.1.10 Possession-only surveillance and maintenance plan.
14.1.11 Environmental monitoring plan.

15. Keywords

15.1 decommissioning; decommissioning plans; decommissioning project planning

APPENDIX

(Nonmandatory Information)

X1. TYPICAL DECOMMISSIONING ACTIVITIES

X1.1 Plant Radiological Characterization

X1.1.1 Radiological survey and sampling program.

X1.1.2 Activation analyses.

X1.2 Physical Inventory

X1.2.1 Facility physical inventory.

X1.2.2 Site physical inventory.

X1.3 Facility and Site Preparations

X1.3.1 Temporary structures.

X1.3.2 Laydown areas.

X1.3.3 Office facilities.

X1.3.4 Support services (for example, power, telephone, water, refuse removal, etc.).

X1.4 Storage or Surveillance Phase Activities

X1.4.1 Surveillance of entombed or safe stored facilities.

X1.4.2 Maintenance of safe stored facilities.

X1.5 Decontamination

X1.5.1 End product criteria and objectives.

X1.5.2 Chemical cleaning (for example, detergents, solvents, etc.).

X1.5.3 System flushing.

X1.5.4 Nonchemical decontamination (for example, sandblasting, grinding, high-pressure water spray, etc.).

X1.5.5 Partial removal of component.

X1.5.6 Cost/benefit analysis.

X1.6 Rigging of Heavy Components

X1.7 Liquid Radwaste Processing

X1.7.1 Present capacity and capability.

X1.7.2 Services to be added (for example, mobile evaporators, demineralizers, etc.).

X1.7.3 Solidification.

X1.8 Solid Radwaste Handling, Packaging, and Burial

X1.8.1 Low specific activity containers and casks.

X1.8.2 Packaging and transportation.

X1.8.3 Disposal.

X1.8.4 Interim storage/staging.

X1.9 Radioactive Hazardous Waste

X1.9.1 Stabilization.

X1.9.2 Packaging and transportation.

X1.9.3 Disposal.

X1.10 Nonradioactive Hazardous Waste Handling and Disposal

X1.10.1 Transportation.

X1.10.2 Disposal or stabilization.

X1.11 Clean Waste Handling and Disposal

X1.11.1 Identification of laydown areas.

X1.11.2 Traffic management of waste site.

X1.11.3 Local landfill site.

X1.12 Removal of Radioactive Equipment

X1.12.1 Isolation of system and cutting pipe (radioactive).

X1.12.2 Sampling and characterization of radioactivity.

X1.12.3 Size/volume reduction.

X1.12.4 Removal and packaging.

X1.12.5 Onsite transportation.

X1.13 Removal of Nonradioactive Equipment

X1.13.1 Isolation of system and cutting pipe (nonradioactive).

X1.13.2 Verification of noncontaminated status.

X1.13.3 Removal and packaging.

X1.13.4 Delivery to holding area.

X1.13.5 Salvage or disposal.

X1.14 Major System Removal

X1.14.1 Segmentation and removal of large vessels and components.

X1.14.2 Removal of other equipment.

X1.14.3 Verification of noncontaminated status (if contaminated see X1.5 and X1.12).

X1.14.4 Size/volume reduction.

X1.14.5 Packaging and transportation.

X1.14.6 Salvage or disposal.

X1.15 Removal of Power and Control Systems

X1.15.1 Decontamination.

X1.15.2 Operations interface.

X1.15.3 Switch-over to construction power.

X1.15.4 Verification of noncontaminated status (if contaminated see X1.5 and X1.12).

X1.15.5 Salvage or disposal.

X1.16 Removal of Activated/Contaminated Concrete

X1.16.1 Activated shields.

X1.16.2 Walls, floors, and structures.

X1.16.3 Removal controls.

X1.16.4 Removal methods (controlled blasting, surface removal, cleaning, etc.).

X1.17 Demolition and Removal of Structures

X1.17.1 Removal of all contamination.

X1.17.2 Removal techniques.

X1.17.3 Verification of noncontaminated status (if contaminated see X1.5 and X1.12).

X1.17.4 Salvage or disposal.

X1.18 Scrap or Salvage of Materials

X1.18.1 Criteria established.

X1.18.2 Health physics assessment and controls.

X1.18.3 Size/volume reduction.

X1.18.4 Salvage or disposal process.

X1.18.5 Decontamination cost/benefit analysis.

X1.19 Final Radiation Survey

X1.19.1 Sampling and statistical analyses.

X1.19.2 Environmental monitoring.

X1.19.3 Establish survey plan and schedule for dormancy.

X1.19.4 Criteria for terminating possession-only license.

X1.19.5 Confirm structures meet disposition objectives.

X1.20 Restoration of Site

X1.20.1 Removal of site boundary structures (fences, guard houses, etc.).

X1.20.2 Grading.

X1.20.3 Landscaping.

X1.20.4 Facility and site closeout.

X1.21 Facility Release and Reporting

X1.21.1 Certification of unrestricted level for release.

X1.21.2 Release of site and structures (nonlicensed).

X1.21.3 Terminating of possession-only license.

X1.21.4 Final program report.