Designation: E1892 – 15 (Reapproved 2021)

Standard Guide for Preparing Characterization Plans for Decommissioning Nuclear Facilities[1]

This standard is issued under the fixed designation E1892; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard guide applies to developing nuclear facility characterization plans to define the type, magnitude, location, and extent of radiological and chemical contamination within the facility to allow decommissioning planning. This guide amplifies guidance regarding facility characterization indicated in ASTM Standard E1281 on Nuclear Facility Decommissioning Plans. This guide does not address the methodology necessary to release a facility or site for unconditional use. This guide specifically addresses:

1.1.1 the data quality objective for characterization as an initial step in decommissioning planning.

1.1.2 sampling methods,

1.1.3 the logic involved (statistical design) to ensure adequate characterization for decommissioning purposes; and

1.1.4 essential documentation of the characterization information.

1.2 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1167 Guide for Radiation Protection Program for Decommissioning Operations

E1281 Guide for Nuclear Facility Decommissioning Plans

2.2 *ANSI Standard:*[3]

ANSI N323AB American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments

3. Terminology

3.1 *Definitions:*

3.1.1 *characterization, n*—a systematic identification of the types, quantities, forms, and locations of contamination within a facility.

3.1.2 *decommission, vt*—to remove safely from service and to reduce residual contamination to a level that permits termination of any applicable licenses and release of the property for unrestricted use.

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

3.1.4 *facility, n—as applied to a decommissioning project*, includes the structure and the soil around and under the structure to an agreed upon distance.

4. Requirements

4.1 *General:*

4.1.1 As an initial part of facility decommissioning planning, a characterization plan is developed to define the nature, extent and location of contaminants, determine sampling locations and protocols, determine quality assurance objectives for characterization, and define documentation requirements. The characterization plan considers the historic use of the facility to identify the likely contaminants due to the radiological process involved, the chemicals introduced during the processing, and any resulting contaminants that may be formed during the processing. Records or recounting of any process upsets or spills that may have occurred during the operating life of the facility should be considered to help

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

Current edition approved Feb. 1, 2021. Published February 2021. Originally approved in 1997. Last previous edition approved in 2015 as E1892-15. DOI: 10.1520/E1892-15R21.

[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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

determine the likely location of contaminants. In addition to examining process records, interviews should be conducted with personnel knowledgeable in the past operation of the facility to identify conditions that may not have been recorded. During this pre-characterization data collection phase, an approach for the characterization plan is developed.

4.2 *Methodology:*

4.2.1 The actual characterization of a facility is an iterative process that involves initial sampling according to the characterization plan, field management (such as labeling, packaging, storing, and transport) of the samples, laboratory analysis, conformance to the data quality objectives (DQOs), and then identifying any additional sampling required, refining the DQOs, and modifying the characterization plan accordingly. The final product of the facility characterization is a document that describes the type, amount, and location of contaminants that will require consideration and removal during the decommissioning operations sufficient to prepare a decommissioning plan. Sufficient information must be provided to:

(1) estimate volumes for various waste types,

(2) plan work to keep radiation exposure as low as reasonably achievable (ALARA),

(3) plan work to keep exposures to hazardous materials ALARA, and

(4) support development of a decommissioning radiation protection program based on guidance from E1167.

5. Significance and Use

5.1 Knowledge of the nature and extent of contamination in a nuclear facility to be decommissioned is crucial to choosing the optimum methods for decontamination and decommissioning, and estimating the resulting waste volumes and personnel exposures. Implementing a characterization plan, developed in accordance with this standard, will result in obtaining or deriving the above information.

5.2 Information on the proposed decommissioning methods, waste volumes, and estimated personnel radiation exposures can be used to define the overall work scope, costs, schedules, and manpower needs for the decommissioning project. This information may be included in the Decommissioning Plan. The extent of over- or under-estimating these project parameters will be a function of the sampling plan and statistical designs, described in Sections 6.1.4 and 6.1.5.

6. Elements of Characterization Plan

6.1 Radiological and hazardous constituent characterization of a facility shall be conducted in accordance with a written plan. The plan must provide direction for the performance of effective sampling and inform concerned individuals as to the intent and methods used in the characterization process. Guidance on possible content and structure of such a written plan follows:

6.1.1 *Characterization Objectives*—The overall objective of the characterization task is to obtain information on the location, type, and amount of contaminants. This information will assist in the planning and performance of decommissioning operations; and, the data collected during the characterization activity is valuable for source term evaluations to support risk assessments. Specific objectives must be clearly stated in the characterization plan to ensure obtaining information that is relevant to the decommissioning process.

6.1.2 *Data Quality Objectives*—Data quality objectives (DQO) are quantitative and qualitative statements developed by data users to specify the quality of data needed from a particular data collection activity. The development of DQOs is an iterative process involving both the data users and the technical staff. Establishment of the characterization objective leads to defining DQOs in the characterization plan. These DQOs are typically specified in terms of six characteristics: precision, accuracy, representativeness, completeness, comparability, and detection limit. For decommissioning planning the DQOs ensure that sufficient information is obtained to prepare required National Environmental Policy Act (NEPA) documentation and to support the detailed engineering.

6.1.3 *Background Information:*

6.1.3.1 *Site Location*—The location and a description of the facility relative to other facilities on the site and surrounding communities or environment should be described.

6.1.3.2 *Site Characteristics*—A description of the entire nuclear facility to be decommissioned should be provided including results of surveys performed prior to initiation of other decommissioning activities. The multi-agency document MARSSIM describes site characteristics that should be addressed including topography, soils and geology, hydrology, seismology, demography, and meteorology.[4] Specific details such as those found in safety analysis reports may be provided in appendices or by reference. Facility characteristics that should be addressed include a general facility description, a facility structures description, and a facility systems description. Radiological and hazardous material characteristics of the nuclear facility shall be included as well. The radionuclide and hazardous chemical inventory for the facility should be presented with all of the major contributors identified and quantified. Environmental as well as radiological characteristics of the site should be discussed as they affect exposure pathways.

6.1.3.3 *Facility Uses*—The history of uses for the facility should be stated to give a perspective of the possible contaminants that may be found in the characterization process. Included should be a description of any process upsets or spills that may have occurred.

6.1.3.4 *Information Sources*—Sources of information should be identified and summarized, especially those relevant to possible contaminants, contaminating events, cleanup issues, and suspect areas. Previous samplings, facility waste plans, radiations surveys, and local sampling problems should also be included.

6.1.4 *Sampling Plan and Survey Methodology*—As described in the EPA document, *Test Methods for Evaluating Solid Waste*, the sampling plan should provide specific locations within the facility for instrument measurements and physical sampling.[5] Examples are radiation field measurements

[4] Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Rev 1, August 2000, Washington, DC NUREG-1575; DOE/EH-0624; EPA 402-R-97-0116.

[5] Environmental Protection Agency, *Test Methods for Evaluating Solid Waste*, Physical/Chemical Methods Chapter 9, "Sampling Plan," SW-846.

in all areas of the facility, scraping inside of piping, pumps, and other equipment, surface wipes for loose contamination, and coring samples from concrete surfaces, as practical. The sampling plan should be devised to minimize errors but must meet the practical objective of providing only information that is relevant to decommissioning planning and operations. Included in the sampling plan must be a consideration of ALARA for personnel exposure, contamination, and the costs associated with laboratory analyses and the possible benefit that may be obtained by additional samples.

6.1.4.1 The MARSSIM document provides information on instrument selection, measurement protocols, and sample acquisition.[4] This document is intended to provide guidance in these areas for EPA, NRC, DOE, and DOD and environmental cleanup activities.

6.1.5 *Statistical Design for Characterization*—A variety of statistical designs are available to meet characterization objectives. The designs range from random "grab" sampling (meeting specified statistical criteria) to a detailed grid specifically tailored to the expected contamination levels. The parameters of interest in any characterization effort introduce several sources of statistical uncertainty including those associated with sampling, instrumentation, and analyses. The development of the DQOs requires consideration of these sources of uncertainty, an estimate of their magnitude, and if necessary, a review of the methods to minimize the overall variability in a cost-effective manner.

6.1.5.1 The most common statistical tests used in decommissioning are tests about the mean of a population, such as the Student's t-test. For these tests one infers information about the mean of the population based on a comparatively small number of random measurements. These measurements are used to compute a sample average and standard deviation. These values are then used to estimate the population mean. Because of variation within the population and the randomness of the samples, an uncertainty will always be associated with this inferred sample mean.

6.1.5.2 Statistical design, error tolerance, etc will be influenced by the current state of the decommissioning project. During the early planning stages large error can be tolerated since one is trying to "get your arms around" the scope of the project. Later into the project when components are being surveyed for waste stream separation smaller error values are necessary. Finally when the decommissioning is completed and final surveys are being performed, the allowable uncertainty is very small.

6.1.5.3 The MARSSIM document provides information on statistical design.[4]

6.1.6 *ALARA Considerations*—The desire for accurate data from the characterization effort must factor in ALARA considerations for obtaining the data. In cases of high radiation fields or excessive contamination levels, accurate measurements and/or extensive sampling for laboratory analysis may not warrant the health risks associated with radiation dose to personnel or possible contact with hazardous materials. In these cases, it is acceptable to estimate the required information by calculational method or extrapolations utilizing conservative methods.

6.1.7 *Quality Assurance*—As characterization data are acquired, the information should be examined to assure that the objectives of the characterization plan are met. If the plan objectives are not being met, additional sampling may be required, which should be addressed. EPA documentation provides further guidance on quality assurance requirements for characterization activities.[6,7]

6.1.8 *Quality Control:*

6.1.8.1 *Quality Control Samples*—The characterization plan should specify that replicate, spike, and blank samples will be included in any set of samples to be sent to a laboratory for analyses.

6.1.8.2 *Sample Identification*—Unique labels for sample identification should be required by the characterization plan. The samples can then be tracked for chain of custody records, packing lists for transportation, laboratory verification of receipt, and sample tracking during analyses.

6.1.8.3 *Calibration Procedures*—Instrumentation used for characterization data collection should be calibrated using a standard source that has an activity level in the same range as the expected level of the sample or radiation level of the facility (ANSI N323AB). Laboratory analysis equipment calibration is a routine task performed by the laboratory and it is probably sufficient to specify that calibrations be performed before and after the sample measurements are made.

6.1.8.4 *Performance and System Audits*—Several methods are employed to ensure that correct analyses are performed. All analyses should be performed according to a workplan, following a QA/QC program. Data should be reviewed by a knowledgeable person and repeat analysis required for questionable data.

6.1.8.5 *Data Validation*—Data acquisition should be reviewed by a qualified person to ensure that the methodology and procedures used to acquire the information follow accepted practices. Data validation is also extended in some instances to include checking that proper methods were used to interpret the data. Data should be validated to the extent that DQOs are met.

7. Documentation

7.1 Adequate and thorough documentation during the characterization phase of decommissioning is important since the recorded information provides the basis and may affect decisions concerning other aspects of the decommissioning effort. The types, retention, and retrievability of documentation all need to be considered during the decommissioning effort. Guidance is provided in this section to accomplish these objectives.

7.2 *Types of Documentation:* The types of documentation that should exist depend on different influences (company needs, regulatory requirements, insurance requirements). Some examples of important records include:

7.2.1 *Records Directly Related to Characterization:*

(1) Past site operating records which support characterization and decommissioning efforts

[6] Environmental Protection Agency, "Guidance for Quality Assurance Project Plans," EPA QA/G-5, EPA/240/R-02/2009, December 2002.

[7] Environmental Protection Agency, "EPA Requirements for Quality Assurance Project Plans," EPA QA/R-5, EAP/240/B-01/003, March 2001.