



Designation: **E1760–09 E1760 – 16**

## Standard Guide for Unrestricted Disposition of Bulk Materials Containing Residual Amounts of Radioactivity<sup>1</sup>

This standard is issued under the fixed designation E1760; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

The feasibility of ~~the recycle of~~ recycling bulk material containing trace amounts of radioactive contamination depends on the dose to the public that could occur as a result. However, the assessment of this dose depends not only on the measurements of contaminants present, but also on the future use of the material and the pathways by which persons can be exposed. This guide provides a recommended approach to support a petition (to a regulatory agency) seeking approval for the recycle or disposal of the material outside of the radioactive materials regulatory ~~arena~~ control.

Since dose rate limits to the public have been established by ~~regulation, this approach is a recommended way~~ regulation for decommissioning by NRC (25 mRem/y) and remediation sites by EPA (15 mRem/y), this guide provides an approach to demonstrate compliance with ~~them~~ those regulations.

The Scope defines the range of applicability of this guide; the Summary identifies the two major steps that comprise the method; and the significance of the guide is given in Section ~~5~~ 5. Section ~~6~~ 6 discusses the need for dose rate based release criteria, and Section ~~7~~ 7 delineates the steps for deciding whether or not a material should be considered for recycle. Section ~~8~~ 8 describes the steps needed to implement the recommendations of this guide including ~~recommendations for the development of a data package to support the petition and to serve as a permanent record~~.

### 1. Scope

1.1 This guide ~~covers the techniques for~~ provides an approach for developing a basis for obtaining approval for release of materials encountered in bulk materials to be removed from a decontamination and decommissioning (D&D) from restricted use or environmental remediation site from regulatory control. This would be addressed in the decommissioning plan ~~(Guide E1281)~~. It applies to materials that do not meet any of the requirements for regulatory control because of radioactivity content. ~~Fig. 1 shows~~ follows the logic diagram ~~described in the MARSAME~~ for determining the materials that could be considered for release. Materials that negotiate this logic tree are referred to as “candidate for release based on dose.”

1.2 For purposes of this guide, bulk materials shall consist of, for example, building materials, concrete rubble, soils, and internally contaminated or activated equipment and facility components.

1.3 ~~The objective of this~~ This guide is to provide a methodology for distinguishing between material that must be carefully isolated to prevent human contact from that that can be recycled or otherwise disposed of. It applies to material in which the radioactivity is dispersed more or less uniformly throughout the volume of the material (termed residual in bulk form) intended to apply to those equipment and materials to be removed from the site for their disposition as opposed to surface-contaminated objects real property (buildings and grounds) that are to remain.

1.3 ~~Surface contaminated objects are materials externally contaminated with radioactive material. Provisions already exist for their release for recycle if it can be shown that they meet applicable federal and state regulations for surface contamination. Regulatory Guide 1.86 and DOE Order 5400.5 specify the upper limits for radioactive surface contamination on material to be released for unrestricted use.~~

<sup>1</sup> 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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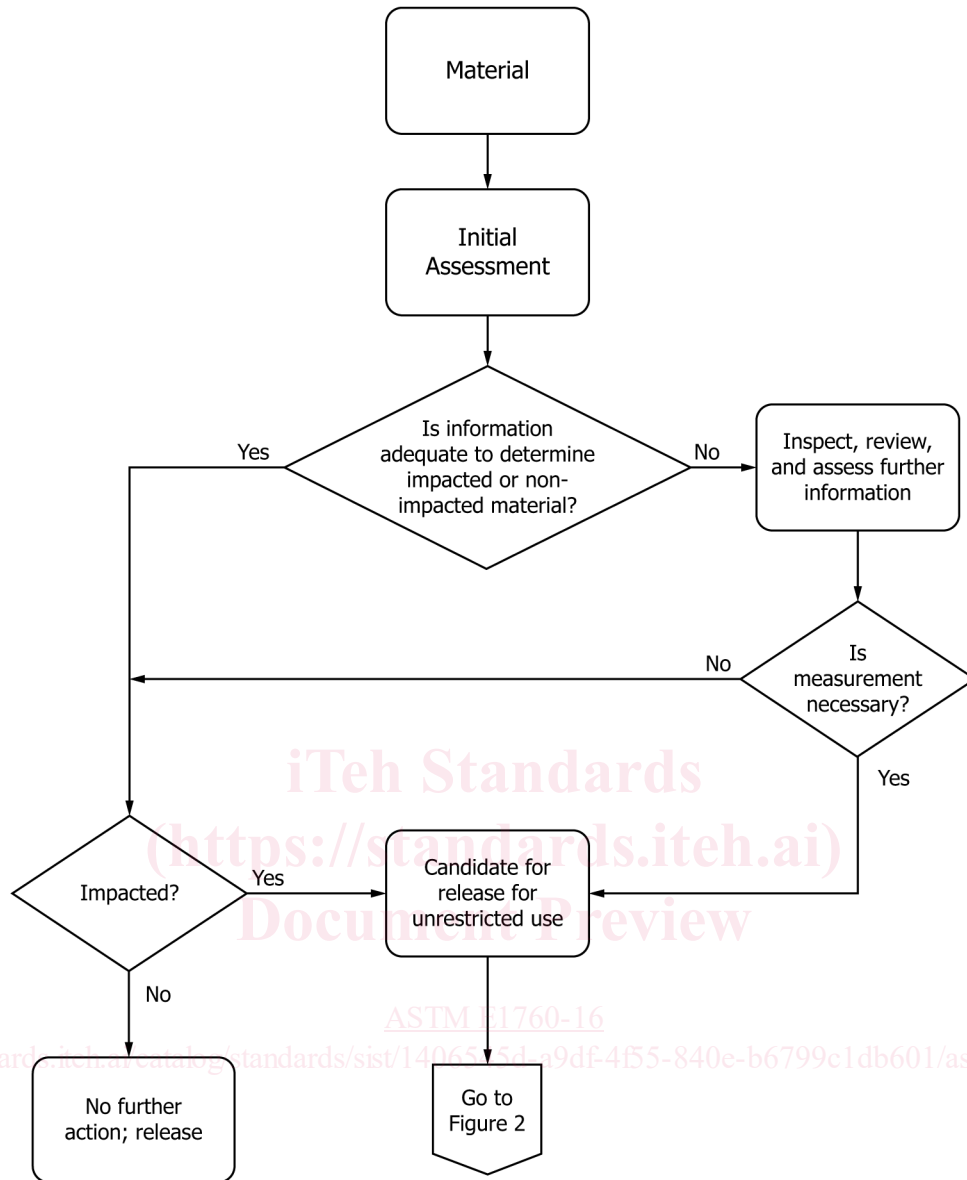


FIG. 1 Prerequisites for Material To Be Candidate For Release

1.4 The release of material containing residual radioactive material (except for <sup>226</sup>Ra) in bulk form (for example, soil or slightly activated metal) is based on the demonstration that the dose to a member of the public will be lower than a specified value (proposed by the petitioner or defined by regulation) for its intended use and lower than a second specified value via the most restrictive plausible scenario. The first proposed value should be lower than the second since the dose to any member of the public (via the intended use scenario) will almost certainly be realized, whereas the dose from the alternate scenario will only accrue if an unintended (and presumably less probable) circumstance arises. Federal regulation already exists for the release of <sup>226</sup>Ra contaminated soils.

1.4 **Warning**—Breathing of asbestos dust is hazardous. Asbestos and asbestos products present demonstrated health risks for users and for those with whom they come into contact. In addition to other precautions, when working with asbestos products, minimize the dust that results. For information on the safe use of chrysotile asbestos, refer to “Safe Use of Chrysotile Asbestos: A Manual on Preventive and Control Measures.”

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. For a specific hazard see [1.51.4](#).

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[E2216 Guide for Evaluating Disposal Options for Concrete from Nuclear Facility Decommissioning](#)

[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](#)

[E1281 Guide for Nuclear Facility Decommissioning Plans](#)

### 2.2 ~~American Nuclear Insurers Document~~:ANSI Standards:

~~ANI/MAELU Information Bulletin 80-1A~~, [ANSI N13.12 Nuclear Liability Insurance Records Retention Surface and Volume Radioactivity Standards for Clearance](#)

### 2.3 DOE Documents:

~~DOE Order 5400.5458.1~~ [Radiation Protection of the Public and the Environment](#)<sup>4</sup>

~~RESRAD~~ [RESidual RADioactivity Family of Computer Codes Developed for DOE by the Argonne National Laboratory](#)<sup>5</sup>

### 2.4 International Atomic Energy Agency Document:<sup>6</sup>

~~Safety Series No. HI-P-1.1~~, [Application of Exemption Principles to the Recycle and Reuse of Materials from Nuclear Facilities](#)

[IAEA TECDOC-855 Clearance Levels for Radionuclides in Solid Materials](#)

### 2.5 Nuclear Regulatory Commission Documents:<sup>7</sup>

[NUREG/CR-5512, Residual Radioactive Contamination from Decommissioning](#)

[NUREG-1575, Rev. 1 Multi-Agency Radiation Survey and Site Investigation Manual \(MARSSIM\)](#)

[NUREG-1576 Multi-Agency Radiological Laboratory Analytical Protocols \(MARLAP\)](#)

[NUREG-1575 Supplement 1, Multi-Agency Radiation Survey and Assessment of Materials and Equipment \(MARSAME\)](#)

[Regulatory Guide 1.86 Termination of Operating Licenses for Nuclear Reactors](#)

[NRC Inspection and Enforcement \(IE\) Circular 81-07 Control of Radioactively Contaminated Material](#)

### 2.6 U.S. Government Documents:<sup>7</sup>

[10 CFR 20 CFR 20, Standards for Protection Against Radiation, Subpart E, Radiological Criteria for License Termination](#)

[10 CFR 20, Standards for Protection Against Radiation, Subpart K, Waste Disposal](#)

[40 CFR 192 CFR 192, Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings](#)

[40 CFR 60 CFR 60, Disposal of High-Level Radioactive Wastes in Geological Repositories](#)

[10 CFR 61 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste](#)

[40 CFR 117 CFR 117, Determination of Reportable Quantities for Hazardous Substances](#)

[40 CFR 261 CFR 261, Identification and Listing of Hazardous Waste](#)

[40 CFR 268 CFR 268, Land Disposal Restrictions](#)

[40 CFR 712 CFR 712, Chemical Information Rules](#)

[40 CFR 716 CFR 716, Health and Safety Data Reporting](#)

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *credible*, *adj*—offering reasonable grounds for being believed.

3.1.2 *intended use*, *n*—the first use planned for the material proposed to be released from radiological controls.

3.1.3 *primary dose limit*, *n*—the limit for exposures that could occur via the intended use scenario.

3.1.4 *secondary dose limit*, *n*—the limit for exposure that could occur via the unplanned use scenario.

3.1.5 *unplanned use*, *n*—any use other than the planned use that may occur after the intended use or by accident.

3.1.6 *TRU*, *transuranic*, *n*—those elements above uranium in the periodic table.

3.1.7 *initial assessment*, *n*—the first step in the investigation of material and equipment, similar to the historical site assessment in [MARSSIM](#).

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

<sup>3</sup> Available from American Nuclear Insurers, 29 South Main, Suite 300 S, West Hartford, CT 06107-2445; National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>4</sup> Available from Department of Energy, National Technical Information Service, U.S. Dept. of Commerce, Springfield, VA 22161.

<sup>5</sup> C. Yu, et al., "Users Manual for RESRAD, ANL/EAD-4," "Users Manual for RESRAD-BUILD," ANL/EAD-03-1," "Users Manual for RESRAD-OFFSITE," NUREG/CR-6937 and "RESRAD-RECYCLE, A Computer Model for Analyzing the Radiological Dose and Risks Resulting from the Recycle of Scrap Metal and the Reuse of Surface Contaminated Material and Equipment," ANL/EAD-3. Available online at [www.ead.anl.gov](http://www.ead.anl.gov).

<sup>6</sup> International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

<sup>7</sup> Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3.1.8 non-impacted, adj—term that applies to material and equipment where there is no reasonable potential to contain radionuclide concentration(s) or radioactivity above background.

3.1.9 impacted, adj—term that applies to material and equipment that is not classified as non-impacted.

#### **4. Objective**

4.1 The objective of this guide is to provide a methodology for distinguishing between material that must be carefully isolated to prevent human contact from that which can be recycled or otherwise disposed of. It applies to material in which the radioactivity is dispersed more or less uniformly throughout the volume of the material (termed residual in bulk form) as opposed to surface contaminated objects.

4.2 Surface contaminated objects are materials externally contaminated with radioactive material. Provisions already exist for their release for recycle if it can be shown that they meet applicable federal and state regulatory requirements for surface contamination. NRC IE Circular 81–07, Regulatory Guide 1.86 and DOE Order 458.1 provide guidance on radioactive surface contamination levels on material to be released for unrestricted use.

4.3 The release of bulk material containing residual radioactive material (except for <sup>226</sup>Ra), such as soil, equipment and building rubble or slightly activated metal, is based on the demonstration that the dose to a member of the public will be lower than a specified value (proposed by the petitioner or defined by regulation) for its intended use *and* lower than a second specified value via the most restrictive plausible scenario. The first proposed value should be lower than the second since the dose to any member of the public (via the intended use scenario) will almost certainly be realized, whereas the dose from the alternate scenario will only accrue if an unintended (and presumably less probable) circumstance arises. Federal regulation already exists for the release of <sup>226</sup>Ra contaminated soils (40 CFR 192).

#### **5. Summary of Guide**

5.1 The owner of the material must first determine if the material is candidate for release. To do this one must take representative samples of the bulk material and identify the radioactive contaminants and concentrations. The MARLAP document presents laboratory protocols that provide assurances for the quality and accuracy of the sample analysis. Sampling should be done using standard statistical inspection methods. The MARSSIM document provides guidance for design of sampling protocols in accordance with accepted statistical standards. For bulk materials contaminated on the exposed surfaces only, Guide E1893 provides guidance for measurement and assessment of this radioactivity. The kinds of analyses shall be appropriate for the potential contaminant expected, and performed using standard techniques (E1892). For some of these analyses, for example, <sup>3</sup>H or <sup>14</sup>C in activated concrete or <sup>55</sup>Fe in steel, the standard techniques are beyond the capabilities of many laboratories. Material that passes the logic diagram shown in [Fig. 1](#) is candidate for release. The sampling, analysis, and determination of candidacy must be documented and included in the record package. The RESRAD family of computer codes, particularly RESRAD-RECYCLE, provide a methodology for correlating unrestricted disposition criteria with the measurable radiological quantities contained within the bulk materials. For example, end-point receptor dose may be correlated to radioactive concentration through site-specific pathways.

5.2 [Fig. 2](#) diagrammatically shows how a material that is candidate for release should be treated to justify its release from radiological restriction use. Section [78](#) describes the methodology shown.

#### **6. Significance and Use**

6.1 Materials encountered during D&D may contain residual radioactivity varying in amounts from that in irradiated fuel to barely detectable quantities in or on building materials. It is clear that highly radioactive materials have to be disposed as radioactive waste pursuant to 10 CFR 60 and 10 CFR 61. Conversely, it is not reasonable to expend a disproportionate amount of resources to isolate materials that contain minute quantities of radioactive materials that will not cause even statistically measurable health effects.

6.2 This guide provides a rationale and methodology for distinguishing between materials that contain sufficient radioactivity to warrant isolation of some type (storage (such as storage awaiting decay, near-surface disposal, disposal with intruder protection, or placement in a deep repository)) from materials with insignificant radioactive content. Materials with insignificant radioactive content can be recycled in the economy or disposed of in conventional (landfill) facilities without adverse health effects. Materials that meet the criteria identified in this guide are not simply excluded from regulation because they do not fall precisely in the regulatory scope. They are sufficiently free of radioactive material so that no further efforts at control are justified for radiation protection purposes. Therefore, the release of materials for unrestricted use in accordance with this guide meets the criteria for being an “as low as reasonably achievable” (ALARA) activity.

6.3 For the purpose of this guide, the return of materials containing residual radioactivity to society without regulatory restrictions is referred to as “unrestricted release based on the absence of the credible potential for adverse health effects.” This guide asserts that materials recycled this way will have no statistically measurable health effects regardless of use. It does not guarantee that the materials are suitable for use in every possible application, for example, trace amounts of radionuclides in materials may not be acceptable for certain photographic and electronic applications.