INTERNATIONAL STANDARD

ISO 19461-1

First edition
2018-07

Radiological protection — Measurement for the clearance of waste contaminated with radioisotopes for medical application —

Part 1: Measurement of radioactivity

Radioprotection — Mesurage pour la libération des déchets contaminés par des radioisotopes lors des applications médicales —

Partie 1: Mesurage de la radioactivité

Reference number
ISO 19461-1:2018(E)

© ISO 2018



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

 © ISO 2018 – All rights reserved

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Fundamentals ... **2**
4.1 Radioisotopes for medical application ... 2
4.1.1 General ... 2
4.1.2 Nuclear medicine ... 3
4.1.3 Radiation therapy ... 3
4.2 Application of clearance level ... 4
4.3 Classification and characteristics of radioactive waste ... 5
5 Measurement method and procedure ... **5**
5.1 General ... 5
5.2 Procedure for ^{125}I ... 6
5.3 Procedure for other radionuclides ... 6
6 Requirements ... **7**
6.1 Control of the radioactive waste to be stored for disposal ... 7
6.2 Measurement before storage ... 7
6.3 Storage of radioactive waste ... 7
6.4 Disposal method ... 7
7 Uncertainty ... **8**
8 Documentation of radioactivity measurement results ... **8**
9 Reporting of results ... **8**
10 Quality control ... **9**
Annex A (informative) **Example of the procedure for the clearance of radioactive waste** ... **10**
Annex B (informative) **Measurement result of the radioactivity of the radioactive waste** ... **14**
Bibliography ... **18**

© ISO 2018 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy nuclear technologies and radiological protection*, Subcommittee SC 2, *Radiation protection*.

A list of all the parts in the ISO 19461 series can be found on the ISO website.

© ISO 2018 – All rights reserved

Introduction

This document addresses the method for radioactivity measurement, the procedure for determining the storage period, the condition for the clearance of waste contaminated with radioisotopes for medical application based on the initial condition of each type of waste, and the equation to obtain radioactivity from counting measurements using a detector. From the equation, the appropriate duration of storage for the radioactive waste before final disposal can be evaluated.

The amounts of radioisotopes used in medical facilities that are disposed of as waste have been increasing rapidly, due to the development of various technologies applied to diagnosis and radiation treatment using nuclear medicine.

Most of the nuclear medicine applications employ radioisotopes with a short half-life, such as ^{18}F being used in positron emission tomography/computed tomography (PET/CT) diagnosis and ^{99m}Tc being used for a bone or thyroid scan. However, the quantities used in the medical facility can be so large that the disposal of the consequent radioactive waste becomes a serious concern.

The International Atomic Energy Agency (IAEA) proposed criteria for the clearance level of radioactive waste depending on the individual dose (10 μSv/y) and collective dose (1 man-Sv/y) (IAEA Safety Series No 111-P-1.1)[10], and concentration of each nuclide (IAEA RS-G-1.7)[11], and methods for determining the clearance level from the criteria by evaluating the dose or concentration of the radioactive waste on a case-by-case basis.

However, the practical application of the IAEA methods is so complicated that most countries use an alternative method to determine the minimum storage time based on the measurement of radioactivity and radioactive decay for the mainly short-lived radioactive wastes instead of the direct application of IAEA criteria. Therefore, the measurement of radioactivity becomes more significant for obtaining an accurate minimum storage time for each radioactive waste before its disposal.

By considering the current situation regarding the clearance level, this document proposes radioactivity measurement methods useful for establishing the minimum storage duration necessary to attain the applicable clearance level for radioactive wastes, and for verifying wastes have decayed to below the applicable clearance level prior to disposal as non-radioactive waste.

The medical administration of radioactive material is carefully controlled. Therefore, in most cases an estimate of initial activity in waste, sufficient for calculating the minimum storage time for decay to clearance levels, can be derived from knowledge of the administration process, and no initial measurement is necessary or warranted. In such cases the method described in 5.3 can be used to estimate the appropriate storage time.

© ISO 2018 – All rights reserved

Radiological protection — Measurement for the clearance of waste contaminated with radioisotopes for medical application —

Part 1: Measurement of radioactivity

1 Scope

This document establishes a method for radioactivity measurement and determination of the storage periods of the radioactive wastes produced as a result of the medical application of radioisotopes based on counting measurements using a detector and decay correction of the initial activity concentration of the radioisotopes contained in the waste stream.

It provides a set of controls and measurements for the self-clearance of the radioactive wastes by which the medical facility can be assured of meeting the clearance level.

This document can also be used by testing laboratories or radioactive waste disposal operators.

This document can also be useful for the guidance of the regulatory body.

NOTE Due to the nature of the tests outlined, this document cannot be applied to pure beta emitting nuclides nor to alpha emitting nuclides with low energy gamma rays.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
activity
number of spontaneous nuclear disintegrations per unit time.

Note 1 to entry: The activity is expressed in becquerels (Bq).

3.2
bulk
anything greater than the amount of moderate quantities

Note 1 to entry: The term of moderate quantities indicates quantities that “are at most on the order of a ton” of material.

© ISO 2018 – All rights reserved

3.3
calibration
set of operations that establishes, under specific conditions, the relationship between values of a quantity and the corresponding values traceable to primary standards

3.4
certified reference material
CRM
reference material characterized by a metrologically valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability

3.5
clearance level
value established by the competent authority, expressed in terms of activity, activity concentration or surface contamination (fixed and non-fixed) at or below which radioactive material or radioactive objects within authorized practice may be removed from any further regulatory control by the regulatory body

3.6
decay
spontaneous transformation of one radioisotope into one or more different isotopes (known as "decay products" or "daughter products"), accompanied by a decrease in radioactivity of the parent material

Note 1 to entry: The rates of these transformations are unique for each radioisotope and are stated in terms of "half-life," which is the period of time for the activity of a specified isotope to fall to half its original value. The transformations can be a result of electron capture, fission, or the emission of alpha particles, beta particles, or photons (gamma radiation) from the nucleus of an unstable atom.

3.7
medical application
intentional internal or external administration of radioactive material or radiation from radioactive material to patients or research subjects under the supervision of an authorized user

3.8
radioactive waste
radioactive materials at the end of their useful life or in a product that is no longer useful and requires proper disposal

3.9
radioisotope
unstable isotope of an element that decays or disintegrates spontaneously, thereby emitting radiation

Note 1 to entry: Approximately 5 000 natural and artificial radioisotopes have been identified.

3.10
storage container
container in which radioactive waste is secured and stored

4 Fundamentals

4.1 Radioisotopes for medical application

4.1.1 General

Many countries have worked to promote the use of radioactive material in medicine by collaborating with international organizations through projects, programs and agreements. The use of nuclear techniques in medicine has become one of the most widespread peaceful applications of atomic energy.

© ISO 2018 – All rights reserved