

Characterisation principles for soils, buildings and infrastructures contaminated by radionuclides for remediation purposes (ISO 18557:2017) (Corrected version 04-2020)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 18557:2020 sisaldab Euroopa standardi EN ISO 18557:2020 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 18557:2020 consists of the English text of the European standard EN ISO 18557:2020.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 26.02.2020.	Date of Availability of the European standard is 26.02.2020.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 13.020.40, 27.120.30

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:

Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Characterisation principles for soils, buildings and
infrastructures contaminated by radionuclides for
remediation purposes (ISO 18557:2017)

Principes de caractérisation des sols, bâtiments et
infrastructures contaminés par des radionucléides, à
des fins de réhabilitation (ISO 18557:2017)

Charakterisierungsgrundsätze für mit Radionukliden
kontaminierte Böden, Gebäude und Infrastrukturen zu
Sanierungszwecken (ISO 18557:2017)

This European Standard was approved by CEN on 6 January 2020.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO 18557:2017 has been prepared by Technical Committee ISO/TC 85 "Nuclear energy, nuclear technologies, and radiological protection" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 18557:2020 by Technical Committee CEN/TC 430 "Nuclear energy, nuclear technologies, and radiological protection" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 18557:2017 has been approved by CEN as EN ISO 18557:2020 without any modification.

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Strategy applied to the remediation of contaminated sites	6
4.1 Principle	6
4.2 Characterization and remediation objectives	8
4.3 Historical analysis	9
4.4 Documents	9
4.5 Interviews	9
4.6 Functional analysis	10
4.7 Preliminary characterization	10
4.8 Definition of the zones of interest and contamination tracers	10
4.9 Surface and/or volumetric characterization program	11
4.10 Data processing and contamination assessment	12
4.11 Conformity of the results to the characterization objectives	13
4.12 Remediation programme	13
4.13 Final characterization	15
5 Surface characterization programme	16
5.1 Principle	16
5.2 Non-destructive analysis	18
5.2.1 Characterization programme; Determination of the sampling design and the number of data points	18
5.2.2 Implementation	19
5.3 Destructive analysis	19
5.3.1 Characterization programme	19
5.3.2 Implementation and laboratory analyses	19
5.4 Preliminary consolidation	20
5.5 Data processing	20
5.5.1 Spatial structure of the phenomenon	20
5.5.2 Data processing in the case of spatially structured contaminations	20
5.5.3 Result mapping in the case of spatially structured contaminations	20
5.5.4 Statistical processing in the case of non-structured contaminations	20
5.6 Conformity of the results with the characterization objective	21
5.7 Surface characterization file	21
6 Volumetric characterization programme	21
6.1 Principle	21
6.2 Volumetric investigations	24
6.2.1 Characterization programme	24
6.2.2 Implementation and laboratory analyses	24
6.3 Preliminary consolidation	24
6.4 Volumetric Data processing	25
6.4.1 Case of structured contaminations	25
6.4.2 Case of non-structured contaminations	25
6.5 Compatibility of the results with the objectives	25
6.6 Volumetric characterization file	25
7 Final characterization programme	27
7.1 Principle	27
7.2 Final characterization programme	27
7.3 Processing the final characterization results	28
7.4 Final characterization file	29

8	Final report	29
Annex A (informative)	Geostatistical data processing and examples of good practices	31
Bibliography		35

This document is a preview generated by EVS

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*, Sub-committee SC 5, *Nuclear fuel cycle*.

Introduction

The remit of WG 13 covers all aspects of the decommissioning phase, and thus it interfaces with other Sub-Committees and Working Groups whose work intersects with this phase.

[Figure 1](#) below indicates some of the topics that could be included in SC 5 and/or WG 13. It provides a view of how the scope of this ISO Standard links with both generic and more detailed topics.

This document contains both guidance and references to documents which may be useful in relation to this work area. Read in conjunction with the supporting references, it gives a generic approach to the topic. It also may have connections with many other blocks across the whole diagram (e.g. Decommissioning strategy, Waste Management, Site remediation, Dismantling/Demolition, Cost issues, Safety).

Moreover, it was not intended to establish this document as a stand-alone document. When a member country already has national tools in this field (e.g. regulatory requirements, national standards), these requirements and national standards are applicable in conjunction with this document.

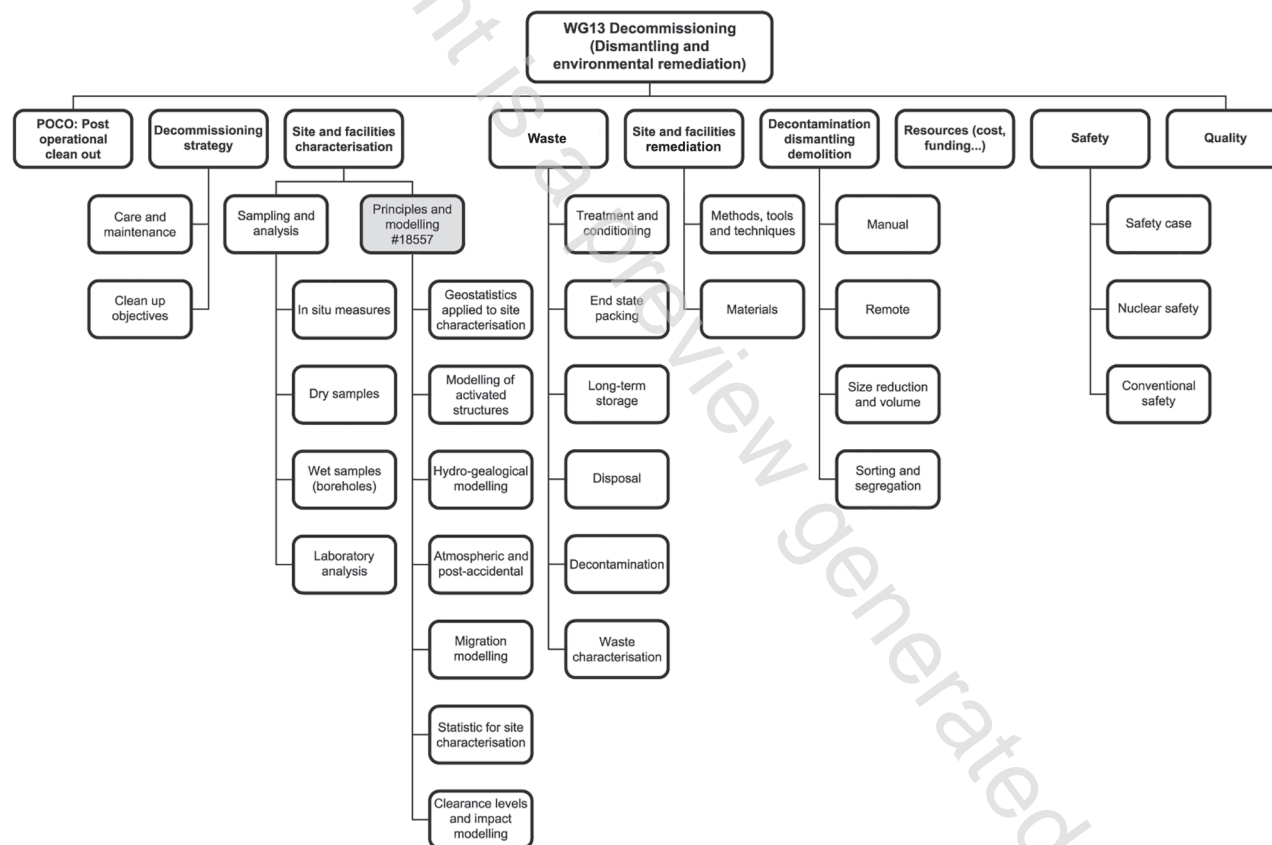


Figure 1 — Indicative chart of the topics included in WG 13, showing how this document is linked to other topics

This work stream structure can be used to clarify the scope of WG publications and to ensure that areas of joint interest between ISO teams and working groups are coordinated. The ISO shadow committee for a member body identifies proposals for further work and, if appropriate, submits them to the Working Group for international consideration as potential new work items. [Figure 1](#) can be a useful prompt in this process. This document is part of an overall decommissioning and environmental remediation strategy including, for example, the monitoring and/or remediation of groundwater which might be addressed in a new work item.

Since the discovery of radioactivity at the end of the 19th century, numerous laboratories and facilities have dealt with radioactive substances (notably radium). In addition, the development and considerable expansion of the nuclear industry, both civilian and defence, has generated many nuclear facilities built since the 1940s, resulting today in legacy sites.

More recently, nuclear operators and state organisations have intensively undertaken the dismantling and remediation of shutdown nuclear facilities. Remediation projects also concern former mining sites, other legacy sites and industrial sites having produced NORM (Naturally Occurring Radioactive Material) and TENORM (Technologically Enhanced NORM) waste, where the main issue is the large volume of waste involved. The aim is primarily to demonstrate that the entire nuclear cycle is well managed. A large number of issues need to be considered:

- The nuclear regulatory framework did not exist at the beginning and it has evolved over time (release procedures, health and safety, environmental considerations...). In addition, there is more and more stakeholder involvement today, and this needs to be considered at the early stages of any project.
- The availability of waste management facilities and disposal sites varies between countries and through time. The classification based on activity levels: e.g. very low level waste (VLLW), low level waste (LLW), intermediate level waste (ILW), high level waste (HLW) and nuclide half-lives (short-lived or long-lived radionuclides) impacts remediation projects. These factors sometimes result in the partial clean-up of sites, due to the absence of a final solution for waste disposal. Waste may also have had to be temporarily stored on site for economic reasons.
- Remediation costs and schedules are optimized and rationalized using a graded approach, as these projects are generally expensive and time consuming. They also need to be securely funded and planned.
- In order to optimize waste categories, volumes and costs, characterization is a crucial issue enabling the best knowledge of the radiological state of the site (soils, buildings and infrastructures) to be obtained before making project decisions.

Lessons learned from the first sites to be remediated have demonstrated that poor characterization (based on incomplete historical information and too limited a number of data points or samples) strongly impacts the success of a remediation project, with inappropriate choices having been made (over-estimation of volumes and over-categorization of waste, unexpected contamination).

As a consequence, it is now recognized that accurate characterization is the key to successful dismantling and remediation projects. There are many characterization steps necessary throughout a project, each with specific objectives.

The main potential improvement concerns the sampling effort, sample representativeness and assessment of activity levels assessments. Combined with data analysis and processing, all the uncertainties involved are combined to deliver a result with a corresponding confidence interval. Therefore the characterization strategy and programme should be set well before the actual measurements, to ensure efficiency.

The preparation of any nuclear facility's remediation programme requires knowledge of its operational history. This covers the entire period from design, licensing and through to final shutdown, in order to establish the nature and location of potential or known radioactive contamination, together with possible associated chemical products, with the appropriate accuracy. The overall remediation strategy requires an estimation of the quantity and the volume of waste to be produced, and an assessment of its level of contamination. This enables appropriate optimized waste management.

In addition, a final characterization is compulsory for sites to be released and/or re-used in order to demonstrate compliance with remediation objectives (clearance levels, if any, or a release threshold set by, or agreed with, the regulatory body).

This document outlines the principles of characterization for remediation purposes of soils, buildings and infrastructures contaminated by radionuclides and possible associated chemical pollutants.

As the preparation of a sampling plan is an iterative process, decision-taking steps will be defined throughout this document taking into account constraints imposed by operations, budgets and regulations, while respecting the ALARA and ALARP principles.

The application of this methodology will aid the user to obtain the information necessary for compiling the files associated with remediation operations, as required by the regulatory authorities. It is applicable to each of the steps necessary for the remediation of sites, depending on the objectives (release into the public domain, re-use). It can enable an assessment to be established for contaminated soils, or in preparing to carry out post-remediation checks (even including the facility's civil engineering structures), in order to confirm that the remediation objectives have been met.

With regards to the recommendations of the International Atomic Energy Agency (IAEA), a graded approach should be considered for the characterization of soils, buildings and infrastructures for remediation purposes. The characterization strategy, programme and planning should be commensurate with the complexity of the remediation problem and with the established end state. A graded approach can limit occupational exposure for workers, as well as saving time and money [ref. IAEA = DeSa project (Evaluation and Demonstration of Safety for Decommissioning of Facilities Using Radioactive Material)].

Characterisation principles for soils, buildings and infrastructures contaminated by radionuclides for remediation purposes

1 Scope

This document presents guidelines for sampling strategies and characterization processes to assess the contamination of soils, buildings and infrastructures, prior to remediation and/or to check that the remediation objectives have been met (final release surveys). The principles presented need to be appropriately graded as regards the specific situations concerned (size, level of contamination...). *It can be used in conjunction with each country's key documentation.*

This document deals with characterization in relation to site remediation. It applies to sites contaminated after normal operation of older nuclear facilities. It could also apply to site remediation after a major accident, and in this case the input data will be linked to the accident involved.

The document complements existing standards, notably concerning sampling, sample preservation and their transport, treatment and laboratory measurements, but also those related to *in situ* chemical and radiological measurements. *References in the Bibliography contain links to appropriate documentation and techniques as required by individual member countries.*

The document does not apply to the following issues: execution of clean-up works, sampling and characterization of waste (conditioned or unconditioned) or to waste packages.

It does not apply to groundwater characterization (saturated zone).

Given the case-by-case nature of site remediation and decommissioning, the principles and guidance communicated in this document are intended as general guidance only, not prescriptive requirements.

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:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

characterization

determination of the nature, concentration and spatial extent of radiological and chemical contents present in a specified place

Note 1 to entry: See also radiological and chemical survey.