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Management of radioactive waste from nuclear facilities — Part 1: General principles, objectives and practical approaches

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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).

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For an explanation on 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.

The committee responsible for this document is Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 5, *Nuclear installations, processes and technologies*.

A list of all parts in the ISO 24389 series can be found on the ISO website. www.iso.org/iso/24389-1-2022

Introduction

The IAEA outlines a framework for the long-term management of radioactive waste, including waste from operational activities and waste from decommissioning activities. This framework sets out the objectives, criteria and requirements for the protection of human health and the environment that apply to the siting, design, construction, commissioning, operation and shutdown of facilities for the predisposal management of radioactive waste, and the requirements that must be met to ensure the safety of such facilities and activities.

However, additional practical guidance is required to assist development of processes for the safe, secure, efficient, effective management of radioactive waste. This document has been developed to provide the guidance needed for consistent implementation of the framework provided by the IAEA, while also enabling member states to develop processes that meet their own applicable requirements. This includes considerations with regards to:

- Safety;
- Waste prevention;
- Security (non-proliferation)
- Lifecycle management (e.g., waste minimization, repurposing or reuse, effectiveness, efficiency, acceptance criteria for disposal); and
- Applicable requirements for waste certification.

The guidance provided in this document considers the need to demonstrate fitness for purpose of applied solutions and the requirement for continuous improvement. Long-term disposal requirements are not addressed in this document.

This series of standards provides guidance in the following areas:

- Part 1 (24389-1): General principles, objectives and practical approaches
- Part 2 (24389-2): Pre-Disposal
- Part 3 (24389-3): Disposal
- Part 4 (24389-4): Governance
- Part 5 (24389-5): Data Quality
- Part 6 (24389-6): Documentation
- Part 7 (24389-7): Supporting Systems

Management of radioactive waste from nuclear facilities —

Part 1: General principles, objectives and practical approaches

1 Scope

This document is the first of a suite of seven (7) documents which outlines the general principles to manage the various type of radioactive waste, and provides guidance for the practical implementation of those principles.

The purpose of this document is to address the following:

- 1) Principles, objectives and practical approaches for radioactive waste management;
- 2) Outline of the structure of suite from ISO 24389 part-1 through part-7.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12749-3, *Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 3: Nuclear fuel cycle*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12749-3, and the following 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 <https://www.electropedia.org/>

3.1 General terms

NOTE General terms are arranged alphabetically (English).

3.1.1

decommissioning

administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a *nuclear facility* (3.1.3)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1], modified – “nuclear” added]

3.1.2

non-proliferation

prevention of the spread of nuclear weapons, fissionable material, and weapons-applicable nuclear technology and information

3.1.3

nuclear facility

facility (including associated buildings and equipment) in which nuclear material is produced, processed, used, handled, stored or disposed of

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.1.4

proportional

corresponding in size or amount to something else

EXAMPLE Punishment should be proportional to the offense.

3.1.5

resource(s)

stock or supply of money, materials, staff, and other assets that can be drawn upon to achieve a specific function or outcome

3.1.6

safeguards

preventing the diversion of civil nuclear materials to non-peaceful applications

3.1.7

stakeholder

person, group or organization that has interests in, or can affect, be affected by, or perceive itself to be affected by, any aspect of a project, programme or portfolio

[SOURCE: ISO 21500:2021^[2], 3.18, modified – “the project” changed to “a project”]

3.2 Terms related to waste management

NOTE These terms are arranged conceptually based on the order of concepts as presented in this document.

3.2.1

radioactive waste

material for which no further use is foreseen that contains, or is contaminated with, radionuclides

Note 1 to entry: For legal and regulatory purposes, waste is considered to be radioactive if the concentrations or activities are greater than clearance levels as established by the regulatory body.

[SOURCE: ISO 12749-3:2015, 3.7.1]

3.2.2

radioactive waste management

all administrative and operational activities involved in the handling, pretreatment, treatment, conditioning, transport, storage and disposal of *radioactive waste* (3.2.1)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.3

waste handling

physical manipulation (sorting, moving, etc.) of waste or waste packages.

[SOURCE: IAEA Radioactive Waste Management Glossary]

Note 1 to entry: INTERNATIONAL ATOMIC ENERGY AGENCY, Radioactive Waste Management Glossary, Non-serial Publications, IAEA, Vienna (2003)

3.2.4 waste predisposal predisposal management

any waste management steps carried out prior to disposal, such as pretreatment, treatment, conditioning, storage and transport activities.

Note 1 to entry: Predisposal is not a form of disposal: predisposal is used as a contraction of 'pre-disposal management of radioactive waste'.

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.5 recycle

convert [*radioactive waste* (3.2.1)] into reusable material

3.2.6 reduce

make smaller or less in amount

3.2.7 waste processing

any operation that changes the characteristics of waste, including pretreatment, treatment and conditioning

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.8 waste pre-treatment

any or all of the operations prior to waste treatment, such as collection, segregation (3.2.10), chemical adjustment (3.2.11) and decontamination (3.2.12)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.9 waste retrieval

process of recovering *radioactive waste* (3.2.1) from a storage facility for *waste disposal* (3.2.20)

3.2.10 segregation

activity where types of *radioactive waste* (3.2.1) or material (radioactive or exempt) are separated or are kept separate on the basis of radiological, chemical and/or physical properties, to facilitate *waste handling* (3.2.3) and/or *waste processing* (3.2.7)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.11 chemical adjustment

change to the state, condition or properties of a material using chemical means

3.2.12 decontamination

complete or partial removal of contamination by a deliberate physical, chemical or biological process

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.13 volume reduction

step or steps taken to *reduce* (3.2.6) the volume of *radioactive waste* (3.2.1)

3.2.14

waste treatment

operations intended to benefit safety and/or economy by changing the characteristics of *radioactive waste* (3.2.1)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.15

waste conditioning

operations that produce a waste package suitable for *waste handling* (3.2.3), transport, *waste storage* (3.2.19) and/or *waste disposal* (3.2.20)

Note 1 to entry: Conditioning can include the conversion of the waste to a solid waste form, enclosure of the waste in containers and, if necessary, provision of an overpack.

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.16

waste immobilization

conversion of waste into a waste form by solidification, embedding or encapsulation

Note 1 to entry: The intent is to reduce the potential for migration or dispersion of radionuclides during *waste handling* (3.2.3), transport, *waste storage* (3.2.19) and/or *waste disposal* (3.2.20).

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.17

waste packaging

preparation of *radioactive waste* (3.2.1) for safe *waste handling* (3.2.3), transport, *waste storage* (3.2.19) and/or *waste disposal* (3.2.20) by means of enclosing it in a suitable container

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.18

waste overpack

secondary (or additional) outer container for one or more waste packages, used for *waste handling* (3.2.3), transport, *waste storage* (3.2.19) and/or *waste disposal* (3.2.20)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.19

waste storage

holding of *radioactive waste* (3.2.1) in a facility that provides for its containment, with the intention of *waste retrieval* (3.2.9)

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

Note 1 to entry: The main distinguishing factor between waste storage and *waste disposal* (3.2.20) is the intention of *waste retrieval* (3.2.9), which applies to storage but not to disposal.

3.2.20

waste disposal

emplacement of waste in an appropriate facility without the intention of *waste retrieval* (3.2.9).

[SOURCE: IAEA Safety Glossary, 2018 edition^[1]]

3.2.21

repository

nuclear facility where *radioactive waste* (3.2.1) is emplaced for disposal

[SOURCE: ISO 12749-3:2015, 3.7.9.1]

4 Principles, objectives and practical approaches

IAEA has published a document on radioactive waste management objectives^[3] which describes principles and objectives for radioactive waste management. These are summarized below, and are explained within the context of this document.

4.1 Principles and objectives

4.1.1 Principle 1: Benefits

Objective: *Minimization of generation and optimization of the management of radioactive waste.*

The main benefit of nuclear energy is in the electricity produced from it and related improvements in quality of life, while the management of radioactive waste generated in the process of electricity production is one of its costs. The overall benefit of nuclear energy is therefore enhanced if generation of radioactive waste is minimized by proper measures applied at source and during its processing and the waste is optimally (i.e. safely and cost effectively) managed.

4.1.2 Principle 2: Transparency

Objective: *Establishment of methods and approaches for building trust among persons involved and affected by the management of radioactive waste.*

Issues surrounding radioactive waste management have raised concerns among the wider stakeholder community (including the public). Experience has shown that progress towards the goal of optimally and safely managing and ultimately disposing of radioactive waste can only be made if the concerned members of the stakeholder community believe and respect the persons and organizations responsible for waste management.

To build this trust, the stakeholders, many of whom have no formal role in the decision-making process, have to see that their views are being taken seriously and that they can influence events. Openness, consistency and transparency are key elements in building trust.

4.1.3 Principle 3: Protection of people and the environment

Objective: *Implementation of radioactive waste management methods that ensure the protection of people and the environment.*

Radioactive waste is potentially hazardous, and it must be managed in ways that ensure the protection of the public and the environment for as long as it remains hazardous. Policies for safely managing radioactive waste have been agreed and published.

Technologies have been developed for handling, processing, storing and disposing of radioactive waste so as to ensure that people and the environment are protected. Well established infrastructures are in place in many states to provide for the implementation of safe management procedures for radioactive waste.

Appropriate management techniques have been developed for most types of radioactive waste; however, there are some waste streams where additional attention is needed to ensure that the public and environment are properly protected. In these situations, technology enhancement and development are necessary to ensure adequate protection of the public and the environment.

4.1.4 Principle 4: Security

Objective: *Implementation of physical protection systems relevant to radioactive waste.*

Some types of radioactive material, although considered to be waste, can still pose a security threat. Consequently, consideration must be given to adequate and appropriate control, accounting and security measures to prevent this happening.