

The Radioactive Waste Safety Standards (RADWASS) Programme

A SERIES
OF INTERNATIONAL
CONSENSUS
DOCUMENTS ON THE
SAFE MANAGEMENT
AND DISPOSAL OF
RADIOACTIVE WASTE



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**THE RADIOACTIVE WASTE SAFETY STANDARDS
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RADIOACTIVE WASTE**

**INTERNATIONAL ATOMIC ENERGY AGENCY
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INTRODUCTION

The IAEA is regularly requested to assist Member States in providing evidence that radioactive wastes can be managed safely. More specifically, it is being asked to help demonstrate that there is harmonization of approach at the international level by promulgating standards.

Although more than thirty publications in the IAEA Safety Series have been issued on the subject of radioactive waste management, covering most areas of importance, the documents were prepared during the phase when philosophies and technologies were still emerging and, as a result, some are considered as being interim documents. During this phase, it was not easy to establish an ordered structure. There was therefore a need to revise and reorganize the IAEA publications in the waste management area.

The Radioactive Waste Safety Standards (RADWASS) series is being developed to: (i) improve the visibility and status of IAEA safety related publications in the waste management area and thereby to make more evident the harmonization which exists in the approaches to establishing safety in this area at the international level; and (ii) impose a more logical structure on safety publications in the waste management area.

A number of basic points regarding the new series are as follows:

- (a) The RADWASS series will be structured in a manner which reflects the way in which safety is achieved in the waste management area. It will be consistent with other IAEA safety related publications (e.g. the NUSS series).
- (b) The series will encompass all safety related documents in the waste management area.
- (c) RADWASS will be headed by one publication in the Fundamentals category of the Safety Series.
- (d) The existing waste management publications in the Safety Series will gradually be replaced by new and revised publications developed within the RADWASS framework.

SAFETY SERIES PUBLICATIONS OF THE IAEA

The approach adopted for the organization of the IAEA's safety related publications involves a matrix concept. A number of technical areas have been identified to group together those publications which are devoted mainly to some particular

topic, e.g. to waste management, radiation protection or research reactor safety. Within each of these groups, called application areas, a hierarchical structure of four levels has been established.

The four hierarchical levels are described below. The hierarchy defines different levels of technical detail and legal relevance and the standardization of certain terminology within each category.

(i) Safety Fundamentals

Publications in this category form the top level and are characterized by the presentation of safety concepts, safety objectives and fundamental principles or requirements.

Safety Fundamentals do not go into any technical detail and generally do not present the application of principles. They are considered to represent basic objectives and principles to achieve an acceptable safety level. The safety objectives and principles of these publications are intended to be implemented via the Safety Standards and Safety Guides which form the next lower levels in the hierarchy.

(ii) Safety Standards

Normally, each application area (or in some cases subdivision of an application area) will have a publication in this category.

Safety Standards represent the compilation of the basic safety requirements for the area concerned and are formulated on the basis of a broad international consensus. Although they concentrate on basic requirements, explaining what has to be done rather than how it could be done, they present realistic requirements in view of their practical basis.

The language of Safety Standards is similar to that of legal documents so as to facilitate their application. They essentially contain firm requirements ('shall statements') of a mostly regulatory nature with little explanatory text.

These publications are obligatory for the IAEA's technical assistance activities and may be adopted, on a voluntary basis, by Member States for application to their national activities.

(iii) Safety Guides

In the hierarchy of the Safety Series, these publications form the next lower level and are characterized by the presentation of recommendations for fulfilling one or more requirements or principles of a publication higher in the hierarchy. They may take the form of more specific requirements written in an obligatory format ('shall statements') because these are consequential requirements to those in a Safety

Standard, or they may recommend certain ways to implement such requirements ('should statements').

The language of Safety Guides is accordingly less formal than that of Safety Standards and they may contain larger amounts of background information.

(iv) Safety Practices

These publications give practical examples and detailed methods of implementing certain safety requirements. They may show how to perform specific calculations, suggest a number of forms to be used in an auditing process, give a collection of data or limits to be used in a specific judgement, etc.

PROPOSED RADWASS PUBLICATIONS

The scheme adopted for the organization of RADWASS publications attempts to take account of the needs of the user by identifying particular user groups in the waste management field, e.g. planners and regulators, designers, safety assessors, and those concerned with decommissioning, underground disposal and the management of mining and milling wastes. At the same time consideration has been given to the different characteristics of the various waste streams and the methods for their management. Separate publications are proposed to accommodate the most important differences, e.g. the pre-disposal management of low and intermediate level wastes, spent fuel¹, high level and alpha bearing wastes, and short lived wastes in the disposal context.

RADWASS is intended to provide requirements, criteria and guidance for the management of radioactive wastes. To the extent that chemically hazardous wastes may also be present, these will be considered, as long as the characteristics of the radioactive waste determine the hazard and the means of disposal. Disposal of what are primarily chemically hazardous wastes is a subject addressed by other United Nations organizations.

Five subject areas have been identified in RADWASS: Planning, Pre-disposal, Disposal, Uranium and Thorium Waste Management, and Decommissioning. One Safety Standard will be developed under each of these subject areas, except for Disposal, where two Standards, one for Near Surface Disposal and one for Geological Disposal, are planned. In total, the present scheme envisages 24 publications comprising 1 at the Fundamentals level, 6 Safety Standards and 17 Safety Guides. The scheme (developed to the level of Safety Guides) is set out in the Annex.

¹ Storage of spent fuel will be considered in RADWASS when it has been determined that spent fuel is to be treated as waste. Spent fuel which is considered to be part of the nuclear fuel cycle is being addressed in other IAEA programmes.

Each publication will contain a section of definitions of the key words used. These will be drawn from a common glossary, which is published on a periodic basis as an IAEA-TECDOC.

Safety Fundamentals

The proposed scheme envisages an overlying publication at the Safety Fundamentals level which will set out the basic safety principles for radioactive waste management. This publication is intended to serve as a guide for the development of waste management programmes in Member States.

It will have considerable status as the lead publication in RADWASS. It may be expected to be read by many people, including politicians and laymen who are not very familiar with the details of waste management. It will therefore contain an introductory overview, emphasizing a 'systems approach'.

The scope of the publication will encompass all aspects of waste management from minimization of the generation of waste to disposal. It will discuss the main safety issues in radioactive waste management, in particular those which arise from the need to minimize the possible burden of risk to future generations, while maintaining doses to the current generation 'as low as reasonably achievable'. It will set out objectives and principles for:

- radiation and environmental protection, both now and in the future (workers and members of the public)
- minimizing the burden on future generations (financial, social and health impacts).

The publication will set out the main approaches by which these objectives should be achieved, including: waste minimization, waste immobilization and containment, storage for decay, release within acceptable limits, isolation in storage and disposal. It will describe a generic waste management system as a reference for use in other IAEA publications. This will help to provide a common understanding among authors, reviewers and users of the RADWASS series.

Safety Standards and Safety Guides

The planned hierarchy of Safety Standards and Safety Guides is set out in the Annex. The proposed contents are described in the following paragraphs.

Standard 1

Establishing a National Radioactive Waste Management System

This Standard will deal with policy, laws and regulations and organizational structure (e.g. regulatory and implementing organization roles), management principles, institutional responsibilities, surveillance, funding, research, liability, principles for classification of waste generation, exemption or release, minimization of waste, quality assurance and quality control, approval and licensing requirements, control and tracking (flow control), safety and performance assessment, records, coordinating requirements and safety and environmental documentation.

Standard 2

Pre-disposal Management of Radioactive Waste

This Standard will address: generation of all types of waste and waste minimization, collection and treatment, including management of liquid and gaseous effluents that arise during collection and treatment, conditioning to produce storable or disposable forms of waste and interim storage for decay or before disposal. It will apply to facilities for enrichment, fuel fabrication, nuclear power generation, reprocessing, waste processing, decontamination and environmental restoration, supporting laboratories, and other facilities for medicine, industry and research. Transportation will be addressed by reference to other IAEA Standards.

Standard 3

Near Surface Disposal of Radioactive Waste

This Standard will cover the disposal of radioactive wastes in repositories which are constructed on the surface or in shallow ground and for which the post-closure safety relies, at least for some period of time, on institutional controls in addition to engineered barriers. It will address the classification of waste suitable for disposal in a near surface repository (including definition of acceptable levels of contamination of waste with long lived nuclides), site selection, design and construction of repositories and of engineered barriers, operation, quality assurance and quality control (in particular with respect to waste acceptance), surveillance, closure, safety assessment, radiological protection during operation and in the post-closure period, institutional requirements for the post-closure period, and administrative requirements.

Standard 4

Geological Disposal of Radioactive Waste

This Standard will cover the disposal of all types of radioactive waste (including both long lived and short lived waste but *excepting* mine and mill tailings) in consolidated geological media below the surface at appropriate depth. In addition to engineered barriers, the post-closure safety relies on geological barriers but not on institutional control. The Standard will address site selection, design and construction of the repository, operation, quality assurance and quality control, safety assessment, sealing and closure, radiological protection during operation and in the post-closure period, and administrative requirements. For the case of long lived waste, it will also include consideration of the long term safety aspects of geological disposal.

Standard 5

Management of Wastes from Mining and Milling of Ores Containing Uranium and Thorium

This Standard will address the requirements for: the minimization, collection, treatment and discharge/disposition of the solid, liquid and airborne wastes from the development and operation of mines handling radioactive ores (including in situ leaching) and the operation of the ore mills and the decommissioning of the mining and milling facilities. Emphasis will be given to siting, design, operational control, stabilization, environmental restoration and long term surveillance of mill tailings impoundments and waste rock piles (including controlling their use as construction material). It will primarily address the radiological hazard of the waste but will also give due consideration to chemical hazards. The Standard will also address the mining and milling of other ores producing wastes containing radiologically significant amounts of uranium, thorium and their decay products.

Standard 6

Decommissioning

In addition to complete decommissioning of facilities that handle radioactive material, the Standard will address temporary sealing and entombment. Also emphasized will be the need to design facilities for ease of decontamination and decommissioning. The Standard will cover decommissioning of all facilities except for those related to mining and milling. The scope will include exemption levels for the release of materials for other uses whether recycled within the facility or used externally.

The use of appropriate designs and materials for future decontamination and decommissioning will be discussed as part of the requirements to reduce the radiation dose and the amount of waste resulting from discontinued operations.

Safety Guides

Standard 1, Establishing a National Radioactive Waste Management System, will be accompanied by two Safety Guides:

- 1.1. Classification of Radioactive Waste
- 1.2. Planning and Implementation of National Waste Management Programmes (to include infrastructure, organizational and planning requirements and the means and methods for their implementation).

Standard 2, Pre-disposal Management of Radioactive Waste, will have five Safety Guides:

- 2.1. Collection and Treatment of Low and Intermediate Level Waste at Nuclear Facilities (not including alpha and high level waste)
- 2.2. Collection and Treatment of Low and Intermediate Level Waste at Medical, Industrial and Research Institutions (not including alpha and high level waste)
- 2.3. Collection and Treatment of Radioactive Waste at Facilities Producing Spent Fuel, High Level and Alpha Waste
- 2.4. Conditioning and Storage of Low and Intermediate Level Waste (including storage of conditioned waste)
- 2.5. Conditioning and Storage of Spent Fuel, High Level Waste and Alpha Waste (including storage of conditioned waste).

The storage considered in Guides 2.4 and 2.5 would be that done before disposal in long term centralized facilities. Storage of unconditioned waste is included in Guides 2.1, 2.2 and 2.3. Transportation would be covered by reference to other IAEA Safety Standards and Guides.

Standard 3, Near Surface Disposal of Radioactive Waste, will have three Safety Guides:

- 3.1. Siting of Near Surface Disposal Facilities
- 3.2. Design, Construction, Operation and Closure of Near Surface Repositories
- 3.3. Safety Assessment and Institutional Controls for Near Surface Disposal.

Standard 4, Geological Disposal of Radioactive Waste, will have three Safety Guides:

- 4.1. Siting of Geological Disposal Facilities
- 4.2. Design, Construction, Operation and Closure of Geological Repositories
- 4.3. Safety Assessment for Geological Disposal.

Standard 5, Management of Wastes from Mining and Milling of Ores Containing Uranium and Thorium, will have two Safety Guides:

- 5.1. Management of Waste from Mining and Milling Operations (including effluents)
- 5.2. Decommissioning of Uranium and Thorium Mines and Mills and Environmental Restoration for Mines and Mills, Waste Rock and Mill Tailings (including facility decontamination, environmental restoration of the site and disposition of the waste rock/soil and closure of the site).

Standard 6, Decommissioning, will have two Safety Guides:

- 6.1. Decommissioning of Nuclear Power and Fuel Cycle Facilities
- 6.2. Decommissioning of Medical, Industrial and Research Facilities (including research reactors and accelerators).

Other possible documents

A Standard on Environmental Restoration and Post-Accident Waste Management is likely to be required in the future in connection with the remedial action needed to deal with the results of accidents and with pre-existing situations (old facilities and their environments). This need is likely to grow as a result of changing regulations in Member States. Public demands to restore previously used areas for other uses will require environmental restoration. The evolution of this activity is not yet mature enough to warrant the production of a Standard at the present time.

A Standard on disposal at sea is not included in the RADWASS plans at present, given the current London Dumping Convention moratorium on sea disposal. Sufficient information has already been developed by the IAEA to fulfil its role in relation to the Convention.

The RADWASS plans described in this document do not extend below the Safety Guide level. Later phases of RADWASS will, however, include Safety Practice publications within the framework established here.

RADWASS PRIORITIES

The priority to be given to the RADWASS publications is as follows:

Very high priority

Principles for Radioactive Waste Management

High priority Standards

Establishing a National Radioactive Waste Management System
Pre-disposal Management of Radioactive Waste
Near Surface Disposal of Radioactive Waste
Decommissioning

High priority Safety Guides

Classification of Radioactive Waste
Collection and Treatment of Low and Intermediate Level Waste at Medical, Industrial and Research Institutions
Siting of Near Surface Disposal Facilities
Siting of Geological Disposal Facilities

The Standard on Geological Disposal of Radioactive Waste is not listed as a high priority document primarily because Safety Series No. 99, "Safety Principles and Technical Criteria for the Underground Disposal of High Level Radioactive Wastes", has only recently been issued (1989) and covers much the same area. It can provide the higher level criteria needed for Safety Guide 4.1.

All other documents are of medium priority. It should be noted that the priority listing reflects a compromise. It takes account of the need for Safety Series publications in the field of radioactive waste management by Member States on the one hand and the available resources for RADWASS on the other.

RADWASS AND EXISTING SAFETY SERIES PUBLICATIONS

Many of the existing Safety Series publications on radioactive waste management can be used as a basis for the planned RADWASS publications. This is particularly true for those prepared within the IAEA's programme on underground disposal. The contents of these publications have, however, to be reorganized, reviewed and in some cases considerably expanded (e.g. planning of waste management systems, uranium mining and milling) in order to fit into the RADWASS scheme.

MANAGEMENT AND IMPLEMENTATION OF RADWASS

Management

A RADWASS management scheme has been developed to ensure that the publications have extensive scrutiny by technical experts and when appropriate, policy makers, in Member States to reflect internationally agreed standards and

criteria. First, the terms of reference for each RADWASS document will be developed by the IAEA Secretariat and reviewed and approved by the International Radioactive Waste Management Advisory Committee (INWAC). Draft documents will be reviewed by specialist Technical Committees covering the following areas:

- Planning and regulations
- Pre-disposal (collection, handling, processing and storage)
- Disposal
- Mining and milling wastes
- Decommissioning

These will be Standing Committees containing eight to ten experts in each of the subject areas, nominated by Member States in consultation with the Secretariat. In the case of the Safety Fundamentals publication, the Technical Committee will be a subgroup of INWAC. Safety Fundamentals and Standards will be reviewed and approved by INWAC.

Following approval by INWAC, the Fundamentals and the Safety Standards will be reviewed and approved by Member States and by the IAEA Board of Governors before final publication. This rather elaborate approval procedure is considered to be necessary since these publications establish basic principles and requirements for safety and they must be shown to have achieved international consensus. Publications at the Safety Guide and Safety Practice level do not normally require the same degree of review and approval since they recommend approaches, procedures and methods for complying with the Standards. It will usually be sufficient for them to be approved by the Standing Technical Committee.

Implementation

On the basis of the available resources, the Secretariat envisages the completion of nine high priority publications by 1994. It is envisaged that a formal review of the programme will be undertaken in 1993 to define publication production rates and the resources needed for the post-1994 period.

Annex

RADWASS PUBLICATION PLAN

WASTE MANAGEMENT FUNDAMENTALS – Principles of radioactive waste management

	<i>Planning</i>	<i>Pre-Disposal</i>	<i>Disposal</i>	<i>Uranium and Thorium Waste Management</i>	<i>Decommissioning</i>	
S T A N D A R D S	1	2	3	4	5	6
	Establishing a national radioactive waste management system	Pre-disposal management of radioactive waste	Near surface disposal of radioactive waste	Geological disposal of radioactive waste	Management of waste from mining and milling of ores containing uranium and thorium	Decommissioning
G U I D E S	1.1	2.1	3.1	4.1	5.1	6.1
	Classification of radioactive waste	Collection and treatment of low and intermediate level waste at nuclear facilities	Siting of near surface disposal facilities	Siting of geological disposal facilities	Management of waste from mining and milling operations	Decommissioning of nuclear power and fuel cycle facilities
	1.2	2.2	3.2	4.2	5.2	6.2
	Planning and implementation of national waste management programmes	Collection and treatment of low and intermediate level waste at medical, industrial and research institutions	Design, construction, operation and closure of near surface repositories	Design, construction, operation and closure of geological repositories	Decommissioning of uranium and thorium mills and environmental restoration for mines and mills, waste rock and mill tailings	Decommissioning of medical, industrial and research facilities

	<i>Planning</i>	<i>Pre-Disposal</i>	<i>Disposal</i>	<i>Uranium and Thorium Waste Management</i>	<i>Decommissioning</i>
G U I D E S		2.3 Collection and treatment of radioactive waste at facilities producing spent fuel, high level waste and alpha waste	3.3 Safety assessment and institutional controls for near surface disposal	4.3 Safety assessment for geological disposal	
		2.4 Conditioning and storage of low and intermediate level waste			
		2.5 Conditioning and storage of spent fuel, high level waste and alpha waste			