

IAEA SAFETY STANDARDS SERIES

Predisposal Management of Radioactive Waste, Including Decommissioning

SAFETY REQUIREMENTS

No. WS-R-2



INTERNATIONAL
ATOMIC ENERGY AGENCY
VIENNA

IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish standards of safety for protection against ionizing radiation and to provide for the application of these standards to peaceful nuclear activities.

The regulatory related publications by means of which the IAEA establishes safety standards and measures are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety, and also general safety (that is, of relevance in two or more of the four areas), and the categories within it are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Safety Fundamentals (blue lettering) present basic objectives, concepts and principles of safety and protection in the development and application of nuclear energy for peaceful purposes.

Safety Requirements (red lettering) establish the requirements that must be met to ensure safety. These requirements, which are expressed as 'shall' statements, are governed by the objectives and principles presented in the Safety Fundamentals.

Safety Guides (green lettering) recommend actions, conditions or procedures for meeting safety requirements. Recommendations in Safety Guides are expressed as 'should' statements, with the implication that it is necessary to take the measures recommended or equivalent alternative measures to comply with the requirements.

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA.

Information on the IAEA's safety standards programme (including editions in languages other than English) is available at the IAEA Internet site

www.iaea.org/ns/coordinet

or on request to the Safety Co-ordination Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.

OTHER SAFETY RELATED PUBLICATIONS

Under the terms of Articles III and VIII.C of its Statute, the IAEA makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety and protection in nuclear activities are issued in other series, in particular the **IAEA Safety Reports Series**, as informational publications. Safety Reports may describe good practices and give practical examples and detailed methods that can be used to meet safety requirements. They do not establish requirements or make recommendations.

Other IAEA series that include safety related sales publications are the **Technical Reports Series**, the **Radiological Assessment Reports Series** and the **INSAG Series**. The IAEA also issues reports on radiological accidents and other special sales publications. Unpriced safety related publications are issued in the **TECDOC Series**, the **Provisional Safety Standards Series**, the **Training Course Series**, the **IAEA Services Series** and the **Computer Manual Series**, and as **Practical Radiation Safety Manuals** and **Practical Radiation Technical Manuals**.

**PREDISPOSAL MANAGEMENT OF
RADIOACTIVE WASTE,
INCLUDING DECOMMISSIONING**

The following States are Members of the International Atomic Energy Agency:

AFGHANISTAN	GUATEMALA	PANAMA
ALBANIA	HAITI	PARAGUAY
ALGERIA	HOLY SEE	PERU
ANGOLA	HUNGARY	PHILIPPINES
ARGENTINA	ICELAND	POLAND
ARMENIA	INDIA	PORTUGAL
AUSTRALIA	INDONESIA	QATAR
AUSTRIA	IRAN, ISLAMIC REPUBLIC OF	REPUBLIC OF MOLDOVA
BANGLADESH	IRAQ	ROMANIA
BELARUS	IRELAND	RUSSIAN FEDERATION
BELGIUM	ISRAEL	SAUDI ARABIA
BENIN	ITALY	SENEGAL
BOLIVIA	JAMAICA	SIERRA LEONE
BOSNIA AND HERZEGOVINA	JAPAN	SINGAPORE
BRAZIL	JORDAN	SLOVAKIA
BULGARIA	KAZAKHSTAN	SLOVENIA
BURKINA FASO	KENYA	SOUTH AFRICA
CAMBODIA	KOREA, REPUBLIC OF	SPAIN
CAMEROON	KUWAIT	SRI LANKA
CANADA	LATVIA	SUDAN
CHILE	LEBANON	SWEDEN
CHINA	LIBERIA	SWITZERLAND
COLOMBIA	LIBYAN ARAB JAMAHIRIYA	SYRIAN ARAB REPUBLIC
COSTA RICA	LIECHTENSTEIN	THAILAND
COTE D'IVOIRE	LITHUANIA	THE FORMER YUGOSLAV
CROATIA	LUXEMBOURG	REPUBLIC OF MACEDONIA
CUBA	MADAGASCAR	TUNISIA
CYPRUS	MALAYSIA	TURKEY
CZECH REPUBLIC	MALI	UGANDA
DEMOCRATIC REPUBLIC	MALTA	UKRAINE
OF THE CONGO	MARSHALL ISLANDS	UNITED ARAB EMIRATES
DENMARK	MAURITIUS	UNITED KINGDOM OF
DOMINICAN REPUBLIC	MEXICO	GREAT BRITAIN AND
ECUADOR	MONACO	NORTHERN IRELAND
EGYPT	MONGOLIA	UNITED REPUBLIC
EL SALVADOR	MOROCCO	OF TANZANIA
ESTONIA	MYANMAR	UNITED STATES OF AMERICA
ETHIOPIA	NAMIBIA	URUGUAY
FINLAND	NETHERLANDS	UZBEKISTAN
FRANCE	NEW ZEALAND	VENEZUELA
GABON	NICARAGUA	VIET NAM
GEORGIA	NIGER	YEMEN
GERMANY	NIGERIA	YUGOSLAVIA
GHANA	NORWAY	ZAMBIA
GREECE	PAKISTAN	ZIMBABWE

The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

© IAEA, 2000

Permission to reproduce or translate the information contained in this publication may be obtained by writing to the International Atomic Energy Agency, Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria.

Printed by the IAEA in Austria

July 2000
STI/PUB/1089

SAFETY STANDARDS SERIES No. WS-R-2

PREDISPOSAL MANAGEMENT OF RADIOACTIVE WASTE, INCLUDING DECOMMISSIONING

SAFETY REQUIREMENTS

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2000

VIC Library Cataloguing in Publication Data

Predisposal management of radioactive waste, including decommissioning. —

Vienna : International Atomic Energy Agency, 2000.

p. ; 24 cm. — (Safety reports series, ISSN 1020-525X ; no. WS-R-2)

STI/PUB/1089

ISBN 92-0-100300-5

Includes bibliographical references.

1. Radioactive waste disposal. 2. Nuclear facilities — Decommissioning.

I. International Atomic Energy Agency. II. Series.

VICL

00-00237

FOREWORD

by **Mohamed ElBaradei**
Director General

One of the statutory functions of the IAEA is to establish or adopt standards of safety for the protection of health, life and property in the development and application of nuclear energy for peaceful purposes, and to provide for the application of these standards to its own operations as well as to assisted operations and, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of nuclear energy.

The following advisory bodies oversee the development of safety standards: the Advisory Commission on Safety Standards (ACSS); the Nuclear Safety Standards Advisory Committee (NUSSAC); the Radiation Safety Standards Advisory Committee (RASSAC); the Transport Safety Standards Advisory Committee (TRANSSAC); and the Waste Safety Standards Advisory Committee (WASSAC). Member States are widely represented on these committees.

In order to ensure the broadest international consensus, safety standards are also submitted to all Member States for comment before approval by the IAEA Board of Governors (for Safety Fundamentals and Safety Requirements) or, on behalf of the Director General, by the Publications Committee (for Safety Guides).

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA. Any State wishing to enter into an agreement with the IAEA for its assistance in connection with the siting, design, construction, commissioning, operation or decommissioning of a nuclear facility or any other activities will be required to follow those parts of the safety standards that pertain to the activities to be covered by the agreement. However, it should be recalled that the final decisions and legal responsibilities in any licensing procedures rest with the States.

Although the safety standards establish an essential basis for safety, the incorporation of more detailed requirements, in accordance with national practice, may also be necessary. Moreover, there will generally be special aspects that need to be assessed by experts on a case by case basis.

The physical protection of fissile and radioactive materials and of nuclear power plants as a whole is mentioned where appropriate but is not treated in detail;

obligations of States in this respect should be addressed on the basis of the relevant instruments and publications developed under the auspices of the IAEA. Non-radiological aspects of industrial safety and environmental protection are also not explicitly considered; it is recognized that States should fulfil their international undertakings and obligations in relation to these.

The requirements and recommendations set forth in the IAEA safety standards might not be fully satisfied by some facilities built to earlier standards. Decisions on the way in which the safety standards are applied to such facilities will be taken by individual States.

The attention of States is drawn to the fact that the safety standards of the IAEA, while not legally binding, are developed with the aim of ensuring that the peaceful uses of nuclear energy and of radioactive materials are undertaken in a manner that enables States to meet their obligations under generally accepted principles of international law and rules such as those relating to environmental protection. According to one such general principle, the territory of a State must not be used in such a way as to cause damage in another State. States thus have an obligation of diligence and standard of care.

Civil nuclear activities conducted within the jurisdiction of States are, as any other activities, subject to obligations to which States may subscribe under international conventions, in addition to generally accepted principles of international law. States are expected to adopt within their national legal systems such legislation (including regulations) and other standards and measures as may be necessary to fulfil all of their international obligations effectively.

EDITORIAL NOTE

An appendix, when included, is considered to form an integral part of the standard and to have the same status as the main text. Annexes, footnotes and bibliographies, if included, are used to provide additional information or practical examples that might be helpful to the user.

The safety standards use the form 'shall' in making statements about requirements, responsibilities and obligations. Use of the form 'should' denotes recommendations of a desired option.

CONTENTS

1. INTRODUCTION 1

 Background (1.1–1.14) 1

 Objective (1.15) 3

 Scope (1.16–1.19) 4

 Structure (1.20) 4

2. PROTECTION OF HUMAN HEALTH AND
THE ENVIRONMENT (2.1–2.8) 5

3. RESPONSIBILITIES ASSOCIATED WITH PREDISPOSAL
MANAGEMENT OF RADIOACTIVE WASTE, INCLUDING
DECOMMISSIONING 6

 General (3.1–3.4) 6

 Regulatory body (3.5–3.9) 7

 Operators (3.10–3.18) 8

4. INTERDEPENDENCE (4.1–4.2) 9

5. ELEMENTS OF PREDISPOSAL MANAGEMENT OF RADIOACTIVE
WASTE (5.1–5.4) 9

 Waste generation (5.5–5.8) 10

 Waste processing (5.9–5.20) 11

 Storage of radioactive waste (5.21–5.30) 13

 Acceptance criteria for radioactive waste disposal (5.31–5.32) 14

6. DECOMMISSIONING 15

 Decommissioning plan (6.1–6.4) 15

 Decommissioning operation (6.5–6.10) 15

 Completion of decommissioning (6.11–6.13) 16

7. SAFETY OF FACILITIES 17

 General (7.1) 17

 Safety and environmental impact assessments (7.2–7.5) 17

Quality assurance (7.6–7.7) 18

REFERENCES 18

GLOSSARY 20

CONTRIBUTORS TO DRAFTING AND REVIEW 23

ADVISORY BODIES FOR THE ENDORSEMENT
OF SAFETY STANDARDS 26

1. INTRODUCTION

BACKGROUND

1.1. Waste containing or contaminated with radionuclides arises from a number of activities involving the use of radioactive materials, such as the operation and decommissioning of nuclear facilities and the application of radionuclides in industry, medicine and research. Radioactive waste is also generated in the cleanup of sites affected by radioactive residues from various operations or from accidents, and can arise in the processing of raw materials containing naturally occurring radionuclides. The nature of this waste is likely to be such that its safe management must take into account radiation safety considerations. In addition to the waste that must be managed and eventually disposed of, some of the materials arising during the aforementioned activities are of value and may be reused or recycled.

1.2. Predisposal management of radioactive waste, as the term is used in this Safety Requirements publication, comprises all waste management steps prior to disposal. These include the processing of operational and decommissioning waste as well as that of waste from cleanup activities. The decommissioning of a nuclear facility at the end of its useful lifetime is included in this definition of predisposal waste management. In the sense that decommissioning is the management of nuclear facilities for which no further use is foreseen, it is considered to be a part of radioactive waste management.

1.3. The general principles of managing radioactive waste in a safe manner have been set out in a Safety Fundamentals publication [1]. The present publication is concerned with the application of these principles to the predisposal area of radioactive waste management. A brief description of the general approach and the technical steps in predisposal management of radioactive waste is given in the following paragraphs.

1.4. In the design of facilities and the planning of activities that have the potential to generate radioactive waste, measures are put in place to avoid or reduce, to the extent practicable, its generation. Waste and other residual materials are appropriately collected or segregated after collection, as necessary. They may be released from regulatory control if they do not require further consideration from the viewpoint of radiation safety. This includes the controlled discharge of effluents produced during predisposal operations. As far as reasonably practicable, the reuse and recycling of materials are applied as means of minimizing waste generation. The remaining waste is processed in accordance with the national strategy for radioactive waste management for storage or disposal.

1.5. The principal approaches to the management of radioactive waste are commonly termed 'delay and decay', 'concentrate and contain' and 'dilute and disperse'. 'Delay and decay' involves holding the waste in storage until the desired reduction in activity has occurred through radioactive decay of the radionuclides contained in the waste. 'Concentrate and contain' means reduction of volume and confinement of the radionuclide contents by means of a conditioning process to prevent dispersion in the environment. 'Dilute and disperse' means discharging waste to the environment in such a way that environmental conditions and processes ensure that the concentrations of the radionuclides are reduced to such levels that the radiological impact of the released material is acceptable. In establishing policies in this area, consideration has to be given to the radiological impacts of the different management options. From a radiological protection perspective, a balance has to be struck between the present exposures resulting from the dispersal of radionuclides in the environment and potential future exposures which could result as a consequence of radioactive waste disposal [2].

1.6. The first two approaches ('delay and decay', 'concentrate and contain') require that radioactive waste be held in storage for varying lengths of time or placed in a disposal facility with a view to preventing its release to the environment. Radioactive waste must therefore be processed, as necessary, in such a way that it can be safely placed and held in a storage or disposal facility.

1.7. The third approach ('dilute and disperse') is a legitimate practice in the management of radioactive waste and has to be carried out within authorized limits established by the regulatory body [1].

Processing and storage of radioactive waste

1.8. Waste processing includes pretreatment, treatment and conditioning of radioactive waste and is intended to produce a waste form compatible with the selected or likely disposal option. Storage may take place between and within the basic steps of radioactive waste management [1]. The conditioned waste must be in a form suitable for handling, transport, storage and disposal.

1.9. It may be that not all processing steps are necessary. The type of processing necessary depends on the particular waste, its form and characteristics, and the overall strategy for waste management. Where appropriate, waste or material resulting from processing can be reused or recycled, or released from regulatory control.

1.10. Waste is prepared for disposal by means of the aforementioned processing steps. However, in many instances disposal facilities are not available and storage may be necessary for extended periods of time.