

IAEA SAFETY STANDARDS SERIES

Management of Radioactive Waste from the Mining and Milling of Ores

SAFETY GUIDE

No. WS-G-1.2



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IAEA SAFETY STANDARDS

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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".

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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 bodies oversee the development of safety standards: the Commission on Safety Standards (CSS); the Nuclear Safety Standards Committee (NUSSC); the Radiation Safety Standards Committee (RASSC); the Transport Safety Standards Committee (TRANSSC); and the Waste Safety Standards Committee (WASSC). 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 site evaluation for or the 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 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.

The English version of the text is the authoritative version.

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1. INTRODUCTION

BACKGROUND

1.1. The radioactive waste generated in mining and milling activities, especially those involving uranium and thorium (U, Th) ores, differs from that generated at nuclear power plants and most other industrial operations and medical facilities. Waste from mining and milling activities contains only low concentrations of radioactive material but it is generated in large volumes in comparison with waste from other facilities. The management methods to be employed are therefore different and will usually involve waste disposition on or near the surface, in the vicinity of the mine and/or mill sites. Furthermore, the waste will contain long lived radionuclides, and this has important implications for its management because of the long time periods for which control will be necessary.

1.2. Radioactive waste arises from all stages of mining and milling processes and includes, in addition to mill tailings, waste rock¹, mineralized waste rock² and process water, including leaching solutions. Rainfall and snowmelt runoff and seepage from stockpiles and areas of uranium process plants should also be managed.

1.3. The hazards to humans or to the environment posed by mining and milling waste arise not only from its radioactivity but also from the presence of toxic chemicals and other materials in the waste. Achieving a consistent regulatory approach to protect against these different hazards is a challenge for national regulators. This publication is focused on the management of the radiological hazards associated with the waste, but where there is a particular need for regulators to take account of the non-radiological hazards, this is also indicated.

1.4. This publication supersedes Safe Management of Wastes from the Mining and Milling of Uranium and Thorium Ores, Safety Series No. 85, issued in 1987.

¹ Waste rock is material that is excavated from a mine and which does not present any significant radiological hazard requiring management to protect human health or the environment. Waste rock may still require management for other reasons, such as to control erosion to prevent the siltation of local surface water bodies.

² Mineralized waste rock is material that is excavated from a mine and which has chemical and/or radiological characteristics which necessitate its management to protect human health or the environment.

OBJECTIVE

1.5. The objective of this Safety Guide is to provide recommendations and guidance on the safe management of radioactive waste that results from the mining and milling of ores. The recommendations of this Safety Guide apply primarily to new facilities. Existing facilities may not necessarily be in compliance with all of these recommendations. However, in accordance with national policies, appropriate steps may be taken to review the safety of existing facilities and, where reasonably practicable, to upgrade their safety in line with the relevant recommendations set out in this Safety Guide.

SCOPE

1.6. This Safety Guide addresses strategies and protocols for the siting, design, construction, operation and closure of facilities that are necessary to protect workers, the public and the environment from the impacts, both now and in the future, of radioactive waste arising from the mining and milling of ores. Closure means the technical and administrative actions required to place a waste management or disposal facility in an acceptable condition at the end of its operating life. Closure may apply to mill tailings: piles of mining debris and heap leach piles. Other parts of facilities used for the mining and milling of U/Th ores (for example, surface structures) can be decommissioned by adopting the approach taken in other parts of the nuclear industry. Recommendations and guidance for such decommissioning are provided in another IAEA publication [1].

1.7. This Safety Guide provides recommendations on those waste management activities associated with the mining and milling of ores that are deemed to be practices.³ Owing to poor waste management practices employed in the past, the mining and milling of some ores have frequently resulted in the generation of waste for which the application of all the principles developed for practices is inappropriate.

³ A practice, as defined in the Basic Safety Standards (BSS), is “Any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed” [2]. It should be noted that in some regional organizations the term practice does not cover activities in which naturally occurring radioactive material is involved, where this material is not used for its radioactive or fissile properties. This material may therefore be subject to different provisions of the regulations.

In such cases, the regulatory body should decide whether to treat waste management activities for these situations as practices or as interventions.⁴

1.8. The guidance contained in this publication is particularly applicable to the mining and milling of U/Th ores. However, it may also be applicable to the management of waste arising from the mining and milling of other ores having elevated activity concentrations (for example, mineral sands, metals and phosphate rock). This waste requires management because the radionuclides it contains could cause harm to humans and to the environment. In these cases, regulatory bodies should determine the relevance of the guidance on the basis of the requirements for protection and safety established in the BSS and in national regulations.

1.9. This Safety Guide does not address the use of facilities intended for the management of mining and milling waste for the disposal of radioactive and non-radioactive hazardous waste arising from other parts of the nuclear fuel cycle or from other practices. The chemical, physical and radiological nature of such waste may be substantially different from that of mining and milling waste; for example, materials contaminated with fission or activation products may need different engineering for handling and disposal. Consequently, other safety and environmental aspects, in addition to those dealt with in this Safety Guide, should be taken into account in considering the co-management of other waste [3, 4].

1.10. Radiological safety in the production and processing of U/Th ores is addressed in other IAEA publications [5, 6].⁵ The control of occupational and public exposures and environmental impacts due to routine radioactive releases or transport of waste are also discussed in other IAEA safety standards [7, 8].

1.11. Certain non-radiological characteristics of the waste may pose significant hazards and risks which need to be addressed. Detailed consideration of the requirements to protect human health and the environment against these hazards and risks is outside the scope of this Safety Guide. However, such hazards should be considered in the comprehensive optimization of protection, which this Safety Guide covers.

⁴ An intervention, as defined in the BSS, is “Any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident” [2].

⁵ A Safety Guide on occupational radiation protection in the mining and processing of raw materials is in preparation.

STRUCTURE

1.12. The administrative, legal and regulatory framework needed for the safe management of waste resulting from mining and milling is described in Section 2. Principles and criteria used for defining an acceptable level of safety during the operation and after the closure of waste management facilities are discussed in Section 3. The extent to which human health and the environment are protected from waste arising from the mining and milling of ores will depend on the characteristics of the waste, the site and the waste management facilities. Strategies for managing waste are discussed in Section 4. Safety considerations for waste management in all phases of mining and milling activities are discussed in Section 5. A process for considering all the relevant issues associated with developing a waste management strategy and waste management facilities to ensure that human health and the environment are afforded an acceptable level of protection ('safety assessment') is discussed in Section 6. Guidance on the design and implementation of a quality assurance programme for waste management is provided in Section 7. A monitoring and surveillance programme for waste management facilities is discussed in Section 8. Institutional control of waste management facilities after closure is discussed in Section 9.

2. ADMINISTRATIVE, LEGAL AND REGULATORY FRAMEWORK

NATIONAL POLICY AND STRATEGY

2.1. States planning to engage in mining and milling activities are required to develop:

- (a) A national policy for managing the associated waste;
- (b) A strategy for implementing this policy, including the provision of necessary resources (Ref. [3], Principle 6).

2.2. The policy and strategy should reflect, and be consistent with, the principles for radioactive waste management as set out in Ref. [3] and Sections 3–6 of this publication.

2.3. Most U/Th mining and milling waste contains non-radiological hazardous components similar to those present in waste from other mining activities. States, in developing a national policy and strategy, should seek to deal in a consistent manner with all hazardous components arising during the mining and milling.

2.4. States should consider the need for, and the extent of, public involvement and consultation during the regulatory process. Increasing public consultation is a feature of the authorization process in many States. However, the responsibility for the regulatory decision remains with the regulatory body. The decision making process should be transparent, independent and defensible, such that if a decision is challenged the regulatory body can explain how it was reached.

2.5. The regulatory body should maintain a high level of understanding of the technical issues facing, and the financial circumstances of, the operator so as to ensure that the facility is operated safely and that sufficient funding has been allocated to allow for response to any accidents and closure operations.

RESPONSIBILITIES

2.6. The requirements for overall responsibilities in the management of radioactive waste are set out in detail in Ref. [9]. This includes the establishment of a legal framework and an appropriate regulatory body.

Regulatory body

2.7. The regulatory body is responsible for developing appropriate rules, criteria and guidelines, and for establishing a suitable licensing system within the legal framework. This implementation process should provide for general requirements and activities (e.g. rule making and setting licensing criteria) and specific requirements (e.g. requirements for inspections and radiological safety reviews), and should clearly define the responsibilities of the parties involved. It should also address the entire mining and milling life-cycle in relation to issues pertinent to the management of waste. An example of the regulatory process for a new mining and milling facility is provided in Fig. 1, from which the regulatory process in individual States may differ in detail. The regulatory body should ensure that all legal requirements have been fulfilled by the operator.

2.8. After closure of a mining and milling facility and assurance that the operator has fulfilled its obligations, the regulatory body should ensure that responsibility for the waste is transferred from the operator to an appropriate body with the powers to implement any required institutional control [4]. In many cases, the body having the greatest potential for maintaining these controls is a governmental organization. The regulatory framework should provide a mechanism for this transfer of responsibility. A mechanism should also be provided to ensure that the funding necessary to support institutional control is, and continues to be, available. These mechanisms or plans for their establishment should be identified early in the development of the operations.