PREDISPOSAL MANAGEMENT
OF RADIOACTIVE WASTE

GENERAL SAFETY
REQUIREMENTS

Modified from IAEA SAFETY STANDARDS SERIES No. GSR Part 5
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Department of Safety of Fuel Cycle & Materials
Safety of Waste Management Group
The safety requirements for the management of radioactive wastes, in Egypt, are established for the two stages; predisposal and disposal. According to IAEA [SSS-GSR-Part 5], predisposal management or stage is a term used for covering all the steps in the management of radioactive waste from its generation up to disposal, including processing (pretreatment, treatment and conditioning), storage and transport. Also, decommissioning is considered part of predisposal radioactive waste management. Each stage will be divided into three parts; 1) General Requirements, 2) Basic Requirements, and 3) Specific Requirements as shown in the figure below. The General Requirement is adapted to comply with the international safety principle of radioactive waste management. They act as essential boundaries of safety requirements for all waste types, processes and facilities. The basic Requirements shall be based on the general requirements. Specific Requirements are those requirements that deal with specific waste types, processes and facilities in Egypt. The General Requirements were under review by a specific committee. The present work considers the Basic Requirements, which deals with the national cases of all predisposal radioactive waste processes and facilities in Egypt.
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1. INTRODUCTION

1.1. Background

1.1.1. Waste that contains or is contaminated with radionuclides arises from a number of activities involving the use of radioactive material. Such activities include the operation and decommissioning of nuclear facilities; the use of radionuclides in medicine, industry, agriculture, research and education; the remediation of sites affected by radioactive residues from operations of various types or from accidents; and the processing of raw material containing naturally occurring radionuclides.

1.1.2. Predisposal’ is a contraction of ‘pre-disposal’; predisposal is defined as any radioactive waste management steps carried out prior to disposal, such as pretreatment, treatment, conditioning, storage and transport activities. Decommissioning and Remediation are considered to be part of predisposal management of radioactive waste [1].

1.1.3. Measures to prevent or restrict the generation of radioactive waste have to be put in place in the design of facilities and the planning of activities that have the potential to generate radioactive waste.

1.1.4. Radioactive waste may be cleared from regulatory control if it meets clearance criteria, [2] and effluents produced during operations may be discharged if this is authorized by the regulatory body. [3]

1.1.5. The reuse and recycling of material should be carried out as a means of minimizing the amount of radioactive waste from an activity or facility and for economic conservation.

1.1.6. The remaining radioactive waste from all sources that is not cleared discharged or reused needs to be managed safely over its entire lifetime as described in The National Policy and Strategy for the Safety of Radioactive Waste Management System in Egypt [4].

1.1.7. Processing of radioactive waste includes its pretreatment, treatment and conditioning and is primarily intended to produce a waste form that is compatible with the selected or anticipated disposal option. Radioactive waste shall be handled and may be stored between and within the basic steps in its management, in a form that is suitable for such handling and storage as well as for any transport according to the safety requirements of the NRRA. [5,6]

1.1.8. The type of processing necessary will depend on the particular type of waste, its form and characteristics, and the overall approach to its management, including consideration of the generation of secondary waste.
1.1.9. In case of no disposal facilities are available storage shall be necessary for considerable periods of time, according to the safe requirements of the NRRA (5) until disposal facilities become available.

1.1.10. The protection of the human health and the environment is the first priority when there are conflicting between risk implication, operational demands and costs.

1.1-11- In case of no disposal facility has been established the selection of the most appropriate predisposal processes for the radioactive waste shall be based on the proposed disposal option.

1.2. Objective

1.2.1. The objective of this Safety Requirements is to establish, on the basis of the principles established in Ref. [7], the requirements that must be satisfied in the predisposal management of radioactive waste.

1.2.2. This publication sets out requirements for the protection of human health and the environment that apply to the siting, design, construction, commissioning, operation, decommissioning 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.

1.3. Scope

1.3.1. These Safety Requirements publication shall publish through three parties; general, basic and specific requirements. These requirements shall apply to the predisposal management of radioactive waste of all types and covers all the steps in its management from its generation up to its disposal, including its processing (pretreatment, treatment and conditioning), storage and transport. Such waste may arise from the commissioning, operation and decommissioning of nuclear facilities; the use of radionuclides in medicine, industry, agriculture, research and education; the processing of materials that contain naturally occurring radionuclides; and the remediation of contaminated areas.

1.3.2. The safety requirements will be published in three parts; General Requirements; the general requirements are the general obligations that shall be considered in the waste management. These requirements will be compatible with the international requirements for radioactive waste management system and applicable for all type of wastes and facilities.
Basic Requirements; the basic requirements are addressed to the national situation. These requirements are based on the general international requirements and applicable for all type of wastes and facilities.
Specific Requirements; these requirements are considered national requirements for specific waste types and facilities

1.3.3. This publication establishes the safety requirements that apply to all facilities and activities that are involved in the management of radioactive waste before disposal.
1.3.4. The predisposal management of radioactive waste may take place in separate, dedicated waste management facilities or within larger facilities operated for other purposes, such as nuclear power plants. In this publication, the term ‘facility’ is used to refer to either of these possibilities.

2. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

2.1. Radioactive waste management

2.1.1. The main options for the management of radioactive waste are the principal approaches to the predisposal management of radioactive waste are commonly termed ‘delay and decay’, ‘concentrate and contain’ and ‘dilute and disperse’.

2.1.2. ‘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.

2.1.3. ‘Concentrate and contain’ means reduction of volume and confinement of the radionuclide content by means of a conditioning process to prevent or substantially reduce dispersion in the environment.

2.1.4. ‘Dilute and disperse’ means discharging effluent to the environment in such a way that environmental conditions and processes ensure that the concentrations of the radionuclides are reduced to such levels in the environment that the radiological impacts of the released material are acceptable. This approach is not applicable in case of high level waste and long-lived radionuclides.

2.1.5. The operator shall establish a management system that addresses safety, health, environmental, security, quality and economic requirements in an integrated manner and approved by NRRA.

2.2. Radiation protection

2.2.1. Radiation protection considerations are governed by the principles of justification of a practice, optimization of protection and limitation of individual dose and risk [8].

2.2.2. Radiation protection shall be optimized for any persons who are exposed as a result of activities in the predisposal management of radioactive waste, with due regard to dose constraints, and require the exposures of individuals to be kept within specified dose limits. [8]

2.2.3. In addition to the provision for protection against the exposures that will arise from normal operations, provision has to be made for protection against potential exposure. [8]

2.2.4. When choosing options for the predisposal management of radioactive waste, consideration has to be given to both the short term and the long term radiological impacts on workers and members of the public.
2.2.5. Doses and risks associated with the transport of radioactive waste have to be managed in the same way as those associated with the transport of any radioactive material. Safety in the transport of radioactive waste is ensured by complying with the IAEA Regulations for the Safe Transport of Radioactive Material [6].

3. RESPONSIBILITIES ASSOCIATED WITH THE PREDISPOSAL MANAGEMENT OF RADIOACTIVE WASTE

3.1. GENERAL

3.1.1. Safety requirements are established with a view to ensuring that the objectives defined are achieved and the principles are applied taken in consideration that the safety is the prime responsibility of the operator

3.1.2 Generators of radioactive waste, including organizations carrying out decommissioning activities, and operators of predisposal radioactive waste management facilities are considered to be engaged in the management of radioactive waste. Therefore in this Safety Requirements publication "they" are referred to operator(s), applicant, and/or user, and to whom the majority of the requirements apply.

3.1.3. It is possible that the predisposal management of radioactive waste will involve the transfer responsibility of radioactive waste from one operator to another, or that radioactive waste may even be processed in another governor. In such situations, continuity of responsibility for safety is necessary throughout.

3.2. LEGAL, REGULATORY AND POLICY FRAMEWORK

Requirement 1:
Legal and regulatory framework

According to the article 11 of the new Egyptian Nuclear Law No 7 for 2010 the nuclear and radiological regulatory authority (NRRA) was established as an independent authority under the supervision of prim-minister. This authority has the responsibilities of all regulatory and surveillance activities concerning the nuclear and radiological activities in the frame of peaceful uses of nuclear energy to ensure the protection of the human health, properties and environment from exposure of the ionizing radiation.

Requirement 2:
National policy and strategy on radioactive waste management

The national policy and a strategy for radioactive waste management document is under preparation, these policy will be appropriate for the nature and the amount of the radioactive waste in Egypt, in addition these documents will be compatible with the fundamental safety principles, conventions and codes that have been ratified by Egypt.
Requirement 3:
Responsibilities of the regulatory body

The responsibilities of the regulatory body in NRRA are defined in chapter 2, article 12 in the Law No. 7, 2010.

Requirement 4:
Responsibilities of the operator

According to the Nuclear Law no 7 for 2010, operators are responsible for the safety of predisposal radioactive waste management facilities or activities. Detailed responsibilities are described in chapter 2, article 38 in the Law.

3.3. INTEGRATED APPROACH TO SAFETY

Requirement 5:
Requirements in respect of security measures

Measures considered with respect of security are implemented in chapter 3 article 77, Law 7, 2010 to ensure an integrated approach to safety and security in the predisposal management of radioactive waste.

Requirement 6:
Interdependences

Interdependences among all steps in the predisposal management of radioactive waste, as well as the impact of the anticipated disposal option, shall be appropriately taken into account.

3.3.1. Owing to the interdependences among the various steps in the predisposal management of radioactive waste, all activities from the generation of radioactive waste up to its disposal, including its processing, are to be seen as parts of a larger entity, and the management elements of each step have to be selected so as to be compatible with those of the other steps. This will be achieved according to the basic and specific safety requirements (9,10).

3.3.2. There are two issues shall be considered in particular to be addressed: compatibility (i.e. taking actions that facilitate other steps and avoiding taking decisions in one step that detrimentally affect the options available in another step) and optimization (i.e. assessing the overall options for waste management with all the interdependences taken into account). The use of well managed information of good quality is the key to both aspects.

Requirement 7:
Management Systems

Management systems shall be applied to ensure the safety of predisposal radioactive waste management facilities and the fulfillment of waste acceptance criteria (11), quality assurance and control management systems are to be applied to the siting, design, construction, operation, maintenance, shutdown and
decommissioning of such facilities and to all aspects of processing, handling and storage of waste. Features that are important to safe operation, and that are considered in the management system, are to be identified on the basis of the safety case and the assessment of environmental impacts [11].

4. STEPS IN THE PREDISPOSAL MANAGEMENT OF RADIOACTIVE WASTE

4.1 GENERAL

4.1.1. Various factors, including the nature and the amount of radioactive waste, occupational and public exposures, environmental effects, and human health, safety, and social and economic factors, are to be considered when deciding between approaches in the predisposal management of radioactive waste "Delay and decay, Concentrate and contain, Dilute and disperse". The operator shall select the most appropriate approach considering as first priority the protection of the human health and the environment. However, the preferred option, as far as is reasonably practicable, is to concentrate and contain the waste (treatment processes) and to isolate it from the biosphere.

4.1.2. In the predisposal management of radioactive waste, decisions from the licensee holder, that achieved the safety and approved by the regulatory body have to be made at a time when no waste management processes are available and also waste acceptance criteria for disposal are unknown.

4.2. GENERATION OF RADIOACTIVE WASTE

Requirement 8: Radioactive waste generation and control

Radioactive waste arising shall be identified, controlled and kept to the minimum practicable.

4.2.1. Measures to minimize as possible the generation of radioactive waste, in terms of both volume and radioactivity content, have to be considered before the construction of a facility, beginning with the design phase, and throughout the lifetime of the facility, in the selection of the materials used for its construction, and in the control of the materials and the selection of the processes, equipment and procedures used throughout its operation and decommissioning.

Requirement 9: Characterization and classification of radioactive waste

At various steps in the predisposal management of radioactive waste, the radioactive waste shall be characterized and classified in accordance with requirements established or approved by the regulatory body.
4.2.2. Radioactive waste may be classified for different purposes, and different classification schemes may be used in the successive steps in waste management. The most common classification is that made from the perspective of its future disposal option. [12]

4.3. PROCESSING OF RADIOACTIVE WASTE

Requirement 10: Processing of radioactive waste

The processing of radioactive waste shall be based on appropriate consideration of the characteristics of the waste and of the demands imposed by the different steps in its management (pretreatment, treatment, conditioning, transport, storage and disposal).

4.3.1. The processing of radioactive waste can yield effluent that is suitable for authorized discharge or material that is suitable for authorized use or clearance from regulatory control.

4.3.2. Waste has to be processed in such a way that safety is appropriately ensured during normal operation, that measures are taken to prevent the occurrence of incidents or accidents, and that provisions are made to mitigate the consequences if accidents occur.

4.3.3. The processing has to be consistent with the type of waste, the possible need for its storage, the anticipated disposal option, and the limits, conditions and controls established in the safety case and in the assessment of environmental impacts.

Requirement 11: Radioactive Waste package

Waste packages shall be designed and produced so that the radioactive material is appropriately contained both during normal operation and in accident conditions that could occur in the handling, storage, transport and disposal of waste.

4.3.4. waste package material shall be selected to be durable during the expected life time of the disposal site.

4.4. STORAGE OF RADIOACTIVE WASTE

Requirement 12: Storage of radioactive waste

Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management. Due account shall be taken of the expected period of storage, and, to the extent possible, passive safety features shall be applied. For long term storage in particular, measures shall be taken to prevent degradation of the waste containment.
4.4.1. The design of the storage facility depends on the type of radioactive waste, its characteristics and associated hazards, the radioactive inventory, and the anticipated period of storage.

4.4.2. The adequacy of the storage capacity has to be periodically reviewed, with account taken of the predicted waste arising, both from normal operation and from possible incidents, of the expected lifetime of the storage facility and of the availability of disposal options. Consideration has to be given to the protection of present and future generations in accordance with the fundamental safety principles (Principle 7) [7]

4.5. RADIOACTIVE WASTE ACCEPTANCE CRITERIA

Requirement 13:
Radioactive waste acceptance criteria

Waste packages and unpackaged waste that are accepted for processing, storage and/or disposal shall conform to criteria that are consistent with the safety case.

4.5.1. The operators' procedures for the reception of waste have to contain provisions for safety managing waste that fails to meet the acceptance criteria; for example, by taking remedial actions or by returning the waste.

4.5.2. Waste acceptance criteria have to be developed that specify the radiological, mechanical, physical, chemical and biological characteristics of the waste packages and unpackaged waste that are to be processed, stored or disposed of; for example, their radionuclide content or activity limits, their heat output and the properties of the waste form and packaging.

5. DEVELOPMENT AND OPERATION OF PREDISPOSAL RADIOACTIVE WASTE MANAGEMENT FACILITIES AND ACTIVITIES

5.1. APPROACH TO SAFETY

Requirement 14:
Preparation of the safety case and supporting safety assessment

The operator shall prepare a safety case and a supporting safety assessment. In the case of a step by step development, or in the event of modification of the facility or activity, the safety case and its supporting safety assessment shall be reviewed and updated as necessary.

5.1.1. The safety case has to be prepared by the operator early in the development of a facility as a basis for the process of regulatory decision making and approval. The safety case has to be progressively developed and refined as the project proceeds.

5.1.2. It is the operator’s responsibility to compile the safety assessment as part of the safety case in accordance with the requirements of the regulatory body.
Requirement 15:
Scope of the safety case and supporting safety assessment

The safety case for a predisposal radioactive waste management facility shall include a description of how all the safety aspects of the site, the design, operation, shutdown and decommissioning of the facility and the managerial controls satisfy the regulatory requirements. The safety case and its supporting safety assessment shall demonstrate the level of protection provided and should provide assurance to the regulatory body that safety requirements will be met.

5.1.3. The safety case has to address operational safety and all safety aspects of the facility and activities. The safety case has to include considerations for reducing hazards posed to workers, members of the public and the environment during normal operation and in possible accident conditions.

5.1.4. The extent and detail of the safety case and the safety assessment have to be commensurate with the complexity of the operations and the magnitude of the hazards associated with the facility and activities.

Requirement 16:
Documentation of the safety case and supporting safety assessment

The safety case and its supporting safety assessment shall be documented at a level of detail and to a quality sufficient to demonstrate safety, to support the decision at each stage and to allow for the independent review and approval of the safety case and safety assessment. The documentation should be clearly written and shall include arguments justifying the approaches taken in the safety case on the basis of information that is traceable.

5.1.5. Justification has to involve explaining why particular choices were made and stating the arguments in favor of and against the decisions made, especially those decisions that relate to the main approaches taken in the safety case.

5.1.6. Traceability refers to the possibility of following the information that is provided in the documentation and that has been used in developing the safety case.

5.1.7. For the purposes of both justification and traceability, a well documented record is necessary of the decisions and assumptions that were made in the development and operation of the facility, and of the models and data used in the safety assessment to obtain the set of results. Good traceability is important for the purposes of technical and regulatory review and for building public confidence.

Requirement 17:
Periodic safety reviews

The operator shall carry out periodic safety reviews and shall implement any safety upgrades required by the regulatory body following this review. The results of the periodic safety review shall be reflected in the updated version of the safety case for the facility.
5.2. DEVELOPMENT OF PREDISPOSAL RADIOACTIVE WASTE MANAGEMENT FACILITIES

Requirement 18:
Location and design of facilities

Predisposal radioactive waste management facilities shall be located and designed so as to ensure safety for the expected operating lifetime under both normal and possible accident conditions, and for their decommissioning. Additionally, safety case can be ensured by operational maintenance, testing, examination and inspection.

Requirement 19:
Construction and commissioning of the facilities

Predisposal radioactive waste management facilities shall be constructed in accordance with the design as described in the safety case and approved by the regulatory body. Commissioning of the facility shall be carried out to verify that the equipment, structures, systems and components, and the facility as a whole, perform as planned.

Requirement 20:
Facility operation

Predisposal radioactive waste management facilities shall be operated in accordance with national regulations and with the conditions imposed by the regulatory body. Operations shall be based on documented procedures.

Requirement 21:
Emergency plan

Emergency preparedness and response plans, shall be developed by the operator, and approved of the regulatory body [13].

Requirement 22:
Shutdown and decommissioning of facilities

The operator shall develop, in the design stage, an initial plan for the shutdown and decommissioning of the predisposal radioactive waste management facility and shall periodically update it throughout the operational period. The decommissioning of the facility shall be carried out on the basis of the final decommissioning plan, as approved by the regulatory body. In addition, assurance shall be provided that sufficient funds will be available to carry out shutdown and decommissioning [14].

5.3. OTHER PROVISIONS

Requirement 22:
System of accounting for and control of nuclear material

For facilities subject to agreements on nuclear material accounting, in the design and operation of predisposal radioactive waste management facilities the system of accounting for and control of nuclear material shall be performed and
implemented in such a way as not conflict with their management as radioactive waste [15–17].

Requirement 23:
Existing facilities

The safety at existing facilities shall be reviewed to verify compliance with requirements. Safety related upgrades shall be made by the operator in line with national policies and as required by the regulatory body.

5.3.1. The requirements established in this publication are intended to apply to all facilities. Since existing facilities might not be in compliance with all the requirements, decisions have to be taken, in line with national policies, with regard to the safety of these facilities. In such a case, the regulatory body will initiate review to be used to identify those facilities that are not in compliance with all the requirements and that need additional modifications or operational restrictions, or that need to be shut down.

5.3.2. Safety analysis with safety case and safety assessment and decommissioning plan shall be prepared for the existing facility as required by regulatory body.

REFERENCES


[6] Safety requirements for transportation of radioactive materials (under preparation)


[10] Basic Safety Requirements for Predisposal of Radioactive Waste (under preparation)


[17] The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153 (Corrected), IAEA, Vienna (1972).