SAFETY SERIES No. 111-F

SAFETY FUNDAMENTALS

safety series

The Principles of Radioactive Waste Management

A PUBLICATION
WITHIN THE RADWASS PROGRAMME

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1995

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THE PRINCIPLES OF RADIOACTIVE WASTE MANAGEMENT

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FOREWORD

Radioactive waste is produced during the generation of nuclear power and the use of radioactive materials in industry, research and medicine. The importance of the safe management of radioactive waste for the protection of human health and the environment has long been recognized, and considerable experience has been gained in this field.

The IAEA's Radioactive Waste Safety Standards (RADWASS) programme is aimed at establishing a coherent and comprehensive set of principles and standards for the safe management of waste and formulating the guidelines necessary for their application. This is accomplished within the IAEA Safety Series in an internally consistent set of documents that reflect an international consensus. The RADWASS publications will provide Member States with a comprehensive series of internationally agreed documents to assist in the derivation of, and to complement, national criteria, standards and practices.

The Safety Series scheme consists of a four-level hierarchy of publications — with a Safety Fundamentals document at the highest level, followed by Safety Standards, Safety Guides and Safety Practices at the other three levels. With respect to the RADWASS programme, the set of publications is currently undergoing in-depth review to ensure a harmonized approach throughout the Safety Series.

The present document is the Safety Fundamentals document of the envisaged RADWASS hierarchy. It has been developed through a series of consultants and Technical Committee meetings. It was reviewed by the International Radioactive Waste Management Advisory Committee (INWAC) and by Member States and was recommended for publication by an Extended INWAC. It was approved by the IAEA's Board of Governors in March 1995 for publication in the Safety Series.

The IAEA wishes to express its appreciation to all those who assisted in the drafting and review of this document.

CONTENTS

1. INTRODUCTION

BACKGROUND

101. Since the beginning of the twentieth century, research and development in the field of nuclear science and technology have led to wide scale applications in research, medicine, industry and in the generation of electricity by nuclear fission. In common with certain other human activities, these practices generate waste that requires management to ensure the protection of human health and the environment now and in the future, without imposing undue burdens on future generations. Radioactive waste may also result from the processing of raw materials that contain naturally occurring radionuclides. To achieve the objective of safe radioactive waste management requires an effective and systematic approach within a legal framework within each country in which the roles and responsibilities of all relevant parties are defined.

102. Radioactive waste occurs in a variety of forms with very different physical and chemical characteristics, such as the concentrations and half-lives of the radionuclides. This waste may occur:

— in gaseous form, such as ventilation exhausts from facilities handling radioactive materials;
— in liquid form, ranging from scintillation liquids from research facilities to high level liquid waste from the reprocessing of spent fuel; or
— in solid form, ranging from contaminated trash and glassware from hospitals, medical research facilities and radiopharmaceutical laboratories to vitrified reprocessing waste or spent fuel from nuclear power plants when it is considered a waste.

Such wastes may range from the slightly radioactive, such as in those generated in medical diagnostic procedures, to the highly radioactive, such as those in vitrified reprocessing waste or in spent radiation sources used in radiography, radiotherapy or other applications. Radioactive waste may be very small in volume, such as a spent sealed radiation source, or very large and diffuse, such as tailings from the mining and milling of uranium ores and waste from environmental restoration. Basic principles for radioactive waste management have been developed even though there are large differences in the origin and characteristics of radioactive waste, for example, concentration, volume, half-life and radiotoxicity. Although the principles are generally applicable their implementation will vary depending on the types of radioactive waste and their associated facilities.

103. Radioactive waste, as a source of ionizing radiation, has long been recognized as a potential hazard to human health. National regulations and internationally recommended standards and guidelines dealing with radiation protection and radioactive waste management have been developed, based on a substantial body of scientific knowledge. It has been a feature of radioactive waste management that special attention has been given to the protection of future generations. Considerations related to future generations may include potential radiation exposure, economic consequences and the possible need for surveillance or maintenance.

104. Radioactive waste may also contain chemically or biologically hazardous substances and it is important that hazards associated with these substances are adequately considered in radioactive waste management.

105. Fundamental safety approaches for the management of radioactive waste are based on international experience. In its Radioactive Waste Safety Standards (RADWASS) series of publications, the IAEA integrates this experience into a coherent set of fundamental principles, standards, guides and practices for achieving safe radioactive waste management.

OBJECTIVE

106. This publication defines the objective of radioactive waste management and the associated set of internationally agreed principles. These principles provide a common basis for the development of more detailed IAEA Safety Standards, Safety Guides and Safety Practices under the RADWASS programme and a basis for national radioactive waste management programmes.

SCOPE

107. This publication presents radioactive waste management principles that apply to radioactive material, as defined to be radioactive waste by the appropriate national authorities, and to the facilities used for the management of this waste from generation through disposal. These principles apply to all aspects of radioactive waste management except where an activity is the specific subject of an IAEA document outside the RADWASS series or an international instrument, for example, the transportation of radioactive material and exports and imports of nuclear material. The principles also apply in the management of radioactive waste containing, for example, chemically or biologically hazardous substances, even though other specific requirements may also be applicable.

STRUCTURE

108. The Safety Fundamentals include the objective of radioactive waste management (Section 2) and fundamental principles of radioactive waste management (Section 3). The fundamental principles fall into the following general subject areas: protection of human health, protection of the environment, protection beyond national borders, responsibility to future generations and implementation procedures. Each principle is stated, and supporting and explanatory information pertaining to the principle is provided. The sequence in which the principles are presented does not necessarily reflect any order of priority.

109. The Annex describes the basic steps in radioactive waste management in order to provide a common understanding among users of RADWASS publications. The publication also contains a glossary.

2. OBJECTIVE OF RADIOACTIVE WASTE MANAGEMENT

201. The objective of radioactive waste management is to deal with radioactive waste in a manner that protects human health and the environment now and in the future without imposing undue burdens on future generations.

3. FUNDAMENTAL PRINCIPLES OF RADIOACTIVE WASTE MANAGEMENT

301. Responsible radioactive waste management requires the implementation of measures that will afford protection of human health and the environment since improperly managed radioactive waste could result in adverse effects to human health or the environment now and in the future.

302. The timely creation of an effective national legal framework and an associated organizational infrastructure provides the basis for appropriate management of radioactive waste. The individual steps in radioactive waste management as outlined in the Annex may be dependent on each other, and thus require co-ordination. Taking this interdependence into account will help to ensure safety in all radioactive waste management steps.

303. Observance of the principles of radioactive waste management will ensure that the above considerations are addressed, and thus contribute to achieving the objective of radioactive waste management. The principles and their supporting text should be considered as an entity and are presented in the following text.

Principle 1: Protection of human health

> **Radioactive waste shall be managed in such a way as to secure an acceptable level of protection for human health.**

304. Many of the hazards associated with radioactive waste are similar to those associated with toxic waste from, for example, mining and chemical plant operations and should be controlled. However, the nature of radioactive waste implies another hazard, namely the possibility of exposure to ionizing radiation. An acceptable level of protection therefore needs to be provided. Particular attention needs to be paid to controlling the various ways by which humans might be exposed to radiation, and to ensuring that such exposure is within established national requirements.

305. National radiation protection requirements are established for purposes broader than radioactive waste management. In the establishment of acceptable levels of protection, account is typically taken of the recommendations of the International Commission on Radiological Protection (ICRP) and the IAEA and specifically the concepts of justification, optimization and dose limitation. The relevance of these concepts depends on the type of radioactive waste management activities.

306. Radioactive waste management activities are associated either with a practice, for example nuclear power generation, or with an intervention, for example following an accident. In the case of a practice, radioactive waste management should be taken into account in the justification of the entire practice giving rise to the radioactive waste, and therefore need not be justified separately: optimization and dose limitation remain applicable. In the case of an intervention, justification and optimization are required, but not the concept of dose limitation.

307. Human activities and their consequences may be separated by long time periods, for example, in the case of radioactive waste disposal. In such cases, planning for safe radioactive waste management should take into account the facts that the benefits and the exposures might affect populations separated by many generations, that long time periods lead to increased uncertainties in the results of safety assessments and that radionuclides decay.

Principle 2: Protection of the environment

Radioactive waste shall be managed in such a way as to provide an acceptable level of protection of the environment.

308. Safe radioactive waste management includes keeping the releases from the various waste management steps to the minimum practicable. The preferred approach to radioactive waste management is concentration and containment of radionuclides rather than dilution and dispersion in the environment. However, as part of radioactive waste management, radioactive substances may be released within authorized limits as a legitimate practice into the air, water and soil, and also through the reuse of materials. Appropriate safety and control measures should be defined.

309. When radionuclides are released into the environment, species other than humans can be exposed to ionizing radiation, and the impacts of such exposures should be taken into consideration. Since humans are among the most radiation sensitive organisms, however, their presence should generally be assumed in the assessment of impacts on the environment.

310. Radioactive waste disposal may have adverse effects on the future availability or utilization of natural resources, for example, land, forests, surface waters, groundwaters and raw materials, over extended periods of time. Radioactive waste management, therefore, should be conducted in such a way as to limit, to the extent practicable, these effects.

311. Radioactive waste management activities may result in non-radiological environmental impacts, such as chemical pollution or alteration of natural habitats. These impacts need to be considered and radioactive waste management undertaken with a level of environmental protection at least as good as that required of similar industrial activities.

Principle 3: Protection beyond national borders

Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.

312. This principle is derived from an ethical concern for human health and the environment in other countries. It is based on the premise that a country has a duty to act responsibly and, as a minimum, not to impose effects on human health and the environment in other countries more detrimental than those which have been judged acceptable within its own borders. In fulfilling this duty a country should take into

account recommendations of international bodies such as the ICRP and the IAEA, notably the concept of optimization of radiological protection.

313. In the case of normal release, potential release or migration of radionuclides across national borders, the country of origin could choose to find agreement regarding elaboration of this principle, for example, through exchange of information or arrangements with neighbours or affected countries.

314. Import and export of radioactive waste is the subject of the IAEA "Code of Practice on the International Transboundary Movement of Radioactive Waste", which states in part that a State should receive radioactive waste for management or disposal only if it "has the administrative and technical capacity and regulatory structure to manage and dispose of such waste in a manner consistent with international safety standards".

Principle 4: Protection of future generations

> **Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.**

315. This principle is derived from an ethical concern for the health of future generations. In the establishment of acceptable levels of protection, the latest recommendations of international organizations, for example the ICRP and the IAEA, are typically taken into account.

316. While it is not possible to ensure total isolation of radioactive waste over extended time-scales, the intent is to achieve reasonable assurance that there will be no unacceptable impacts on human health. This is typically achieved by applying the multibarrier approach in which both natural and engineered barriers are utilized. The existence of suitable natural barriers is usually determined within a siting process. Furthermore, account should be taken of possible future exploration for, or exploitation of, valuable natural resources that could potentially result in adverse effects on the isolation capability of a disposal facility. In the implementation of radioactive waste management, particularly for disposal, uncertainties in long term safety assessment due to the inherent difficulty in predicting impacts far into the future should be taken into account.

Principle 5: Burdens on future generations

> **Radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.**

317. Consideration for future generations is of fundamental importance in the management of radioactive waste. This principle is based on the ethical consideration that the generations that receive the benefits of a practice should bear the responsibility to manage the resulting waste. Limited actions, however, may be passed to succeeding generations, for example, the continuation of institutional control, if needed, over a disposal facility.

318. The responsibility of the present generation includes developing the technology, constructing and operating facilities, and providing a funding system, sufficient controls and plans for the management of radioactive waste.

319. The timing and implementation of disposal of individual radioactive waste types will depend on scientific, technical, social and economic factors such as the availability, acceptability and development of suitable sites and the decrease of radioactivity levels and heat generation during interim storage.

320. The management of radioactive waste should, to the extent possible, not rely on long term institutional arrangements or actions as a necessary safety feature, although future generations may decide to utilize such arrangements, for example to monitor radioactive waste repositories or retrieve radioactive waste after closure has been effected. The identity, location and inventory of a radioactive waste disposal facility should be appropriately recorded and the records maintained.

Principle 6: National legal framework

> **Radioactive waste shall be managed within an appropriate national legal framework including clear allocation of responsibilities and provision for independent regulatory functions.**

321. Countries in which radionuclides are being produced or used should develop a national legal framework providing laws, regulations and guidelines for radioactive waste management, taking into account overall national radioactive waste management strategies. The responsibilities of each party or organization involved should be clearly allocated for all radioactive waste management activities that take place in a country.

322. Separation of the regulatory function, including enforcement, from the operating function is required to ensure safe operation of nuclear facilities. This separation will permit independent review and overseeing of radioactive waste management activities. The legal framework should specify the way in which separation of the functions is achieved.

323. Since radioactive waste management can span time-scales involving a number of human generations, appropriate consideration of present and likely future operations should be taken into account. Provisions for sufficiently long lasting continuity of responsibilities and funding requirements should be made.

Principle 7: Control of radioactive waste generation

Generation of radioactive waste shall be kept to the minimum practicable.

324. The generation of radioactive waste shall be kept to the minimum practicable, in terms of both its activity and volume, by appropriate design measures and operating and decommissioning practices. This includes the selection and control of materials, the recycle and reuse of materials, and the implementation of appropriate operating procedures. Emphasis should be placed on the segregation of different types of waste and materials to reduce the volume of radioactive waste and facilitate its management.

Principle 8: Radioactive waste generation and management interdependencies

Interdependencies among all steps in radioactive waste generation and management shall be appropriately taken into account.

325. Basic steps in radioactive waste management, depending on the type of waste, are pretreatment, treatment, conditioning, storage and disposal (see Annex). There are interdependencies among and between steps in waste management. Decisions on radioactive waste management made at one step may foreclose alternatives for, or otherwise affect, a subsequent step. Furthermore, there are relationships between waste management steps and operations that generate either radioactive waste or materials that can be recycled or reused. It is desirable that those responsible for a particular waste management step or operation generating waste adequately recognize interactions and relationships so that, overall, safety and effectiveness of radioactive waste management are balanced. This includes taking into account identification of waste streams, characterization of waste and the implications of transporting radioactive waste. Conflicting requirements that could compromise operational and long term safety should be avoided.

326. Since the steps of radioactive waste management occur at different times, there are, in practice, many situations where decisions must be made before all radioactive waste management activities are established. As far as reasonably practicable, the effects of future radioactive waste management activities, particularly disposal, should be taken into account when any one radioactive waste management activity is being considered.

Principle 9: Safety of facilities

> **The safety of facilities for radioactive waste management shall be appropriately assured during their lifetime.**

327. During the siting, design, construction, commissioning, operation and decommissioning of a facility or closure of a repository, priority needs to be given to safety matters including the prevention of accidents and limitation of consequences should accidents occur. Throughout this process account is typically taken of public issues.

328. Site selection should take into account relevant features which might affect the safety of the facility or which might be affected by the facility.

329. Design, construction, operation and activities during decommissioning of a facility or closure of a repository should provide and maintain, where applicable, an adequate level of protection to limit possible radiological impacts.

330. An appropriate level of quality assurance and of adequate personnel training and qualification should be maintained throughout the life of radioactive waste management facilities.

331. Appropriate assessments should be performed to evaluate the safety and the environmental impacts of the facilities.

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Annex

BASIC STEPS IN RADIOACTIVE WASTE MANAGEMENT

Effective management of radioactive waste considers the basic steps (shown schematically in Fig. A.1) in the radioactive waste management process as parts of a total system, from generation through disposal. Because decisions made in one step may foreclose certain alternatives in another step, the RADWASS programme emphasizes the importance of taking into account interdependencies among all steps during planning, design, construction, operation and decommissioning of radioactive waste management facilities.

This Annex describes the various steps in radioactive waste management in order to provide a common terminology and understanding among authors, reviewers and users of RADWASS documents. The considerations are intended to be general and to apply to the management of radioactive waste including that from mining and milling and environmental restoration programmes, that from nuclear power generation and that from medical and industrial application of radioactive materials. They apply to radioactive waste generated during the operational period as well as during the decommissioning of a facility. The applicability of these steps will vary depending on the types of radioactive waste.

The waste should be characterized in order to determine its physical, chemical and radiological properties, and to facilitate record keeping and acceptance of radioactive waste from one step to another. Characterization may be applied, for example, in order to segregate radioactive materials for exemption or for reuse or according to disposal methods or to assure compliance of waste packages with requirements for storage and disposal.

It should also be noted that transportation may be necessary between the radioactive waste management steps. Effective radioactive waste management should take the implications of transportation into account.

Storage of radioactive waste involves maintaining the radioactive waste such that: (1) isolation, environmental protection and monitoring are provided; and (2) actions involving, for example, treatment, conditioning and disposal are facilitated. In some cases, storage may be practised for primarily technical considerations, such as storage of radioactive waste containing mainly short lived radionuclides for decay and subsequent release within authorized limits, or storage of high level radioactive waste for thermal considerations prior to geological disposal. In other cases, storage may be practised for reasons of economics or policy.

Pretreatment of waste is the initial step in waste management that occurs after waste generation. It consists of, for example, collection, segregation, chemical adjustment and decontamination and may include a period of interim storage. This initial step is extremely important because it provides in many cases the best opportunity to segregate waste streams, for example, for recycling within the process or for disposal as ordinary non-radioactive waste when the quantities of radioactive materials they contain are exempt from regulatory controls. It also provides the opportunity to segregate radioactive waste, for example, for near surface or geological disposal.

Treatment of radioactive waste includes those operations intended to improve safety or economy by changing the characteristics of the radioactive waste. The basic treatment concepts are volume reduction, radionuclide removal and change of composition. Examples of such operations are: incineration of combustible waste or compaction of dry solid waste (volume reduction); evaporation, filtration or ion exchange of liquid waste streams (radionuclide removal); and precipitation or flocculation of chemical species (change of composition). Often several of these processes are used in combination to provide effective decontamination of a liquid waste stream. This may lead to several types of secondary radioactive waste to be managed (contaminated filters, spent resins, sludges).

Conditioning of radioactive waste involves those operations that transform radioactive waste into a form suitable for handling, transportation, storage and disposal. The operations may include immobilization of radioactive waste, placing the waste into containers and providing additional packaging. Common immobilization methods include solidification of low and intermediate level liquid radioactive waste, for example in cement or bitumen, and vitrification of high level liquid radioactive waste in a glass matrix. Immobilized waste, in turn, may be packaged in containers ranging from common 200 litre steel drums to highly engineered thick-walled containers, depending on the nature of the radionuclides and their concentrations. In many instances, treatment and conditioning take place in close conjunction with one another.

Disposal is the final step in the radioactive waste management system. It consists mainly of the emplacement of radioactive waste in a disposal facility with reasonable assurance for safety, without the intention of retrieval and without reliance on long term surveillance and maintenance. This safety is mainly achieved by concentration and containment which involves the isolation of suitably conditioned radioactive waste in a disposal facility. Isolation is attained by placing barriers around the radioactive waste in order to restrict the release of radionuclides into the environment. The barriers can be either natural or engineered and an isolation system can consist of one or more barriers. A system of multiple barriers gives greater assurance of isolation and helps ensure that any release of radionuclides to the environment will occur at an acceptably low rate. Barriers can either provide absolute containment for a period of time, such as the metal wall of a container, or may retard the release of radioactive materials to the environment, such as a backfill or host rock with high sorption capability. During the period when the radioactive waste is contained by the system of barriers, the radionuclides in the waste will decay. The barrier system is designed according to the disposal option chosen and the radioactive waste forms involved.

Although it is planned to dispose of most types of radioactive waste by concentration and containment, disposal may also comprise the discharge of effluents (for example, liquid and gaseous waste) into the environment within authorized limits, with subsequent dispersion. For all practical purposes this is an irreversible action and is considered suitable only for limited amounts of specific radioactive waste.

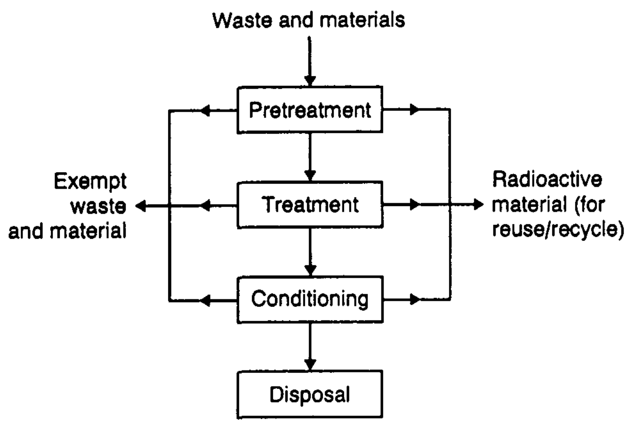

FIG. A.1. Basic steps in radioactive waste management.
Characterization, storage and transportation of waste and materials may take place between and within the basic radioactive waste management steps. The applicability of these steps will vary depending on the types of radioactive waste.

GLOSSARY

barrier. A physical obstruction that prevents or delays the movement (for example, migration) of radionuclides or other material between components in a system, for example, a waste repository. In general, a barrier can be (1) an engineered barrier or (2) a natural barrier which is inherent to the environment of the repository.

barriers, multiple. Two or more barriers. (See **barrier**.)

clearance levels. A set of values, established by the regulatory body in a country or state, expressed in terms of activity concentrations and/or total activities, at or below which sources of radiation can be released from nuclear regulatory control.

closure (permanent). The term closure refers to the status of, or an action directed at, a disposal facility at the end of its operating life. A disposal facility is placed into permanent closure usually after completion of waste emplacement, by covering of a near surface disposal facility, by backfilling and/or sealing of a geological repository and the passages leading to it, and termination and completion of activities in any associated structures.

conditioning. Those operations that produce a waste package suitable for handling, transportation, storage and/or disposal. Conditioning may include the conversion of the waste to a solid waste form, enclosure of the waste in containers and, if necessary, providing an overpack. (See **immobilization**.)

decommissioning. Actions taken at the end of the useful life of a nuclear facility in retiring it from service with adequate regard for the health and safety of workers and members of the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or use of the site. The time period to achieve this goal may range from a few to several hundred years. Subject to national legal and regulatory requirements, a nuclear facility or its remaining parts may also be considered decommissioned if it is incorporated into a new or existing facility, or even if the site in which it is located is still under regulatory or institutional control. This definition does not apply to some nuclear facilities used for mining and milling of radioactive materials or the disposal of radioactive waste.

discharge, routine. A planned and controlled release of radionuclides into the environment. Such releases should meet all restrictions imposed by the appropriate regulatory body.

dispersion. The resulting effect of processes such as transport, diffusion, and mixing of wastes or effluents (for example, liquid and gaseous releases) in water or air — ultimately resulting in dilution.

disposal. The emplacement of waste in an approved, specified facility (for example, near surface or geological repository) without the intention of retrieval. Disposal may also include the approved direct discharge of effluents (for example, liquid and gaseous wastes) into the environment with subsequent dispersion. (See **discharge, routine.**)

environmental remediation/restoration. Actions taken to rectify or clean up radioactively contaminated sites in which other hazardous substances may also be present.

fuel, spent (used). Irradiated fuel not intended for further use in its current form.

fuel cycle (nuclear). All operations associated with the production of nuclear energy, including mining, milling, processing and enrichment of uranium or thorium; manufacture of nuclear fuel; operation of nuclear reactors; reprocessing of nuclear fuel; decommissioning; and any activity for radioactive waste management and any research or development activity related to any of the foregoing.

immobilization. The conversion of a waste into a waste form by solidification, embedding or encapsulation. Immobilization reduces the potential for migration or dispersion of radionuclides during handling, transportation, storage and disposal. (See **conditioning.**)

institutional control. Control of a waste site (for example, disposal site) by an authority or institution designated under the laws of a country or state. This control may be active (monitoring, surveillance, remedial work) or passive (land use control) and may be a factor in the design of a nuclear facility (for example, near surface disposal facility).

long term. In radioactive waste disposal, refers to periods of time which exceed the time during which active institutional control can be expected to last.

migration. The movement of materials (for example, radionuclides) through various media (for example, barrier materials or soil) usually by being carried or transported by fluid flow.

monitoring. The measurement of radiological or non-radiological parameters for reasons related to the assessment or control of exposure and the interpretation of such measurements. Monitoring can be continuous or non-continuous.

multi-barrier or multiple barrier. (See **barriers, multiple.**)

nuclear facility. A facility and its associated land, buildings and equipment in which radioactive materials are produced, processed, used, handled, stored or disposed of (for example, repository) on such a scale that consideration of safety is required.

pretreatment. Any or all the operations prior to waste treatment, such as:
- collection
- segregation
- chemical adjustment
- decontamination.

radiation protection or radiological protection. Measures associated with limitation of the harmful effects of ionizing radiation on people, such as limitation of external exposure to radiation, limitation of incorporation of radionuclides as well as the prophylactic limitation of injury resulting from either of these.

radionuclide. A nucleus (of an atom) that possesses properties of spontaneous disintegration (radioactivity). Nuclei are distinguished by both their mass and atomic number.

release. (See **discharge, routine.**)

repository. A nuclear facility (for example, geological repository) where waste is emplaced for disposal. Future retrieval of waste from the repository is not intended. (See also **disposal.**)

storage (interim). The placement of radioactive waste in a nuclear facility where isolation, environmental protection and human control (for example, monitoring) are provided with the intent that the waste will be retrieved.

treatment. Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are:
(a) volume reduction
(b) removal of radionuclides from the waste
(c) change of composition.
After treatment, the waste may or may not be immobilized to achieve an appropriate waste form.

waste, exempt. In the context of radioactive waste management, waste that is released from nuclear regulatory control in accordance with clearance levels, because the associated radiological hazards are considered negligible. The designation may be in terms of activity concentration and/or total activity and may include a specification of the type, chemical/physical form, mass or volume of waste. (See also **clearance levels.**)

waste, long lived. Radioactive waste containing long lived radionuclides having sufficient radiotoxicity in quantities and/or concentrations requiring long term isolation from the biosphere. The term 'long lived radionuclide' refers to half-lives usually greater than 30 years.

waste, radioactive. For legal and regulatory purposes, radioactive waste may be defined as material that contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body, and for which no use is foreseen. (It should be recognized that this definition is purely for regulatory purposes, and that material with activity concentrations equal to or less than clearance levels is radioactive from a physical viewpoint — although the associated radiological hazards are considered negligible.)

waste form. The waste in its physical and chemical form after treatment and/or conditioning (resulting in a solid product) prior to packaging. The waste form is a component of the waste package.

waste management, radioactive. All activities, administrative and operational, that are involved in the handling, pretreatment, treatment, conditioning, storage and disposal of waste from a nuclear facility. Transportation is taken into account.

waste package. The product of conditioning that includes the waste form and any containers and internal barriers (for example, absorbing materials and liner), as prepared in accordance with requirements for handling, transportation, storage and/or disposal.

waste processing. Any operation that changes the characteristics of a waste, including waste pretreatment, treatment and conditioning.

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Consultants Meetings

Vienna, Austria: 13–17 May 1991
Vienna, Austria: 11–15 May 1992
Vienna, Austria: 6–10 December 1993
Vienna, Austria: 29–30 January 1994
Vienna, Austria: 13–17 June 1994

Technical Committee Meetings

Vienna, Austria: 4–8 November 1991
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Extended INWAC Meetings

Vienna, Austria: 14–16 September 1994
Vienna, Austria: 16–19 January 1995

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