

IAEA Safety Standards

for protecting people and the environment

Storage of Spent Nuclear Fuel

Specific Safety Guide
No. SSG-15 (Rev. 1)



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IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Information on the IAEA's safety standards programme is available on the IAEA Internet site

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The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at: Vienna International Centre, PO Box 100, 1400 Vienna, Austria.

All users of IAEA safety standards are invited to inform the IAEA of experience in their use (e.g. as a basis for national regulations, for safety reviews and for training courses) for the purpose of ensuring that they continue to meet users' needs. Information may be provided via the IAEA Internet site or by post, as above, or by email to Official.Mail@iaea.org.

RELATED PUBLICATIONS

The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, 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 in nuclear activities are issued as **Safety Reports**, which provide practical examples and detailed methods that can be used in support of the safety standards.

Other safety related IAEA publications are issued as **Emergency Preparedness and Response** publications, **Radiological Assessment Reports**, the International Nuclear Safety Group's **INSAG Reports**, **Technical Reports** and **TECDOCs**. The IAEA also issues reports on radiological accidents, training manuals and practical manuals, and other special safety related publications.

Security related publications are issued in the **IAEA Nuclear Security Series**.

The **IAEA Nuclear Energy Series** comprises informational publications to encourage and assist research on, and the development and practical application of, nuclear energy for peaceful purposes. It includes reports and guides on the status of and advances in technology, and on experience, good practices and practical examples in the areas of nuclear power, the nuclear fuel cycle, radioactive waste management and decommissioning.

STORAGE OF SPENT NUCLEAR FUEL



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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".

IAEA SAFETY STANDARDS SERIES No. SSG-15 (Rev. 1)

STORAGE OF SPENT NUCLEAR FUEL

SPECIFIC SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2020

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PREFACE

This publication is a revision of IAEA Safety Standards Series No. SSG-15. This current revision incorporates the result of an analysis of the Safety Requirements publications of the IAEA Safety Standards Series, on the basis of recommendations and findings from studying the accident at the Fukushima Daiichi nuclear power plant in Japan. The revisions in this Safety Guide relate to the following main areas: (a) strengthening accident management; (b) protection against internal and external hazards; and (c) practical elimination of the possibility of conditions arising that could lead to early releases of radioactive material or to large releases of radioactive material.

The revision was undertaken by amending, adding and/or deleting specific paragraphs. The paragraph numbering system used for the revision is as follows:

- (1) Amended paragraphs retain their original paragraph number. A list of amended paragraphs is given in the table below. As part of the revision process, some minor modifications of an editorial nature may have also been made. Editorial changes are not considered to be amendments to this publication and are not included in the table.
- (2) New paragraphs are indicated by using the number of the preceding paragraph with the addition of an uppercase letter. This numbering system is used only to indicate the location of new paragraphs within the text; it is not intended to imply a link between the paragraphs. A list of all new paragraphs in this publication is given in the table below.
- (3) Where a paragraph has been deleted, the paragraph number has been retained. A list of all deleted paragraphs in this publication is given in the table below.

Summary of changed paragraphs in this publication	
Amended paragraphs	1.3, 1.5, 1.7, 3.3, 3.9, 3.12, 3.19, 3.20, 3.24, 3.25, 3.26, 3.28, 3.29, 3.31, 4.2, 4.6, 4.11, 4.12, 5.1, 5.21, 5.23, 6.2, 6.4, 6.8–6.10, 6.29, 6.31–6.34, 6.37, 6.41, 6.42, 6.44, 6.46, 6.48, 6.49, 6.52, 6.57, 6.58, 6.60, 6.61, 6.67, 6.70–6.74, 6.81, 6.89, 6.90, 6.96–6.99, Table 2, 6.118, 6.125, 6.127, 6.136, 6.137, 6.138, 6.142, 6.151, I.4, I.11, I.12, I.16, I.21, I.22, I.25, I.26, I.29, I.33, I.35–I.37, I.46, II.3, VI–I
New paragraphs	1.7A, 3.31A, 3.31B, 5.21A, 6.37A
Deleted paragraphs	6.5, Annex IV

FOREWORD

The IAEA's Statute authorizes the Agency to “establish or adopt... standards of safety for protection of health and minimization of danger to life and property” — standards that the IAEA must use in its own operations, and which States can apply by means of their regulatory provisions for nuclear and radiation safety. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned. A comprehensive set of high quality standards under regular review is a key element of a stable and sustainable global safety regime, as is the IAEA's assistance in their application.

The IAEA commenced its safety standards programme in 1958. The emphasis placed on quality, fitness for purpose and continuous improvement has led to the widespread use of the IAEA standards throughout the world. The Safety Standards Series now includes unified Fundamental Safety Principles, which represent an international consensus on what must constitute a high level of protection and safety. With the strong support of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its standards.

Standards are only effective if they are properly applied in practice. The IAEA's safety services encompass design, siting and engineering safety, operational safety, radiation safety, safe transport of radioactive material and safe management of radioactive waste, as well as governmental organization, regulatory matters and safety culture in organizations. These safety services assist Member States in the application of the standards and enable valuable experience and insights to be shared.

Regulating safety is a national responsibility, and many States have decided to adopt the IAEA's standards for use in their national regulations. For parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by regulatory bodies and operators around the world to enhance safety in nuclear power generation and in nuclear applications in medicine, industry, agriculture and research.

Safety is not an end in itself but a prerequisite for the purpose of the protection of people in all States and of the environment — now and in the future. The risks associated with ionizing radiation must be assessed and controlled without unduly limiting the contribution of nuclear energy to equitable and sustainable development. Governments, regulatory bodies and operators everywhere must ensure that nuclear material and radiation sources are used beneficially, safely and ethically. The IAEA safety standards are designed to facilitate this, and I encourage all Member States to make use of them.

THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures¹ have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety, and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it

¹ See also publications issued in the IAEA Nuclear Security Series.

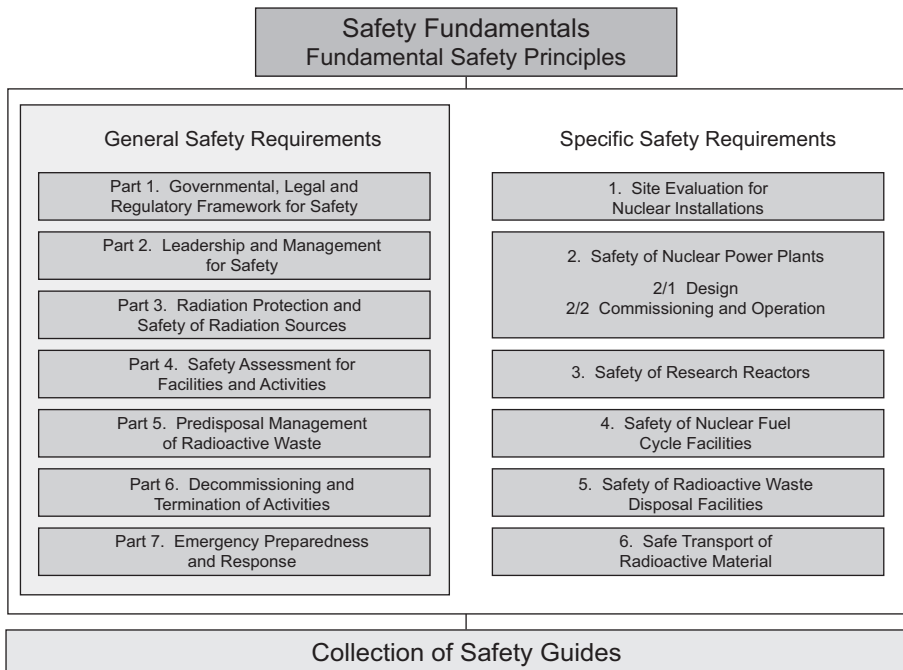


FIG. 1. The long term structure of the IAEA Safety Standards Series.

is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be

used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including the development of educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and five safety standards committees, for emergency preparedness and response (EPReSC) (as of 2016), nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards.

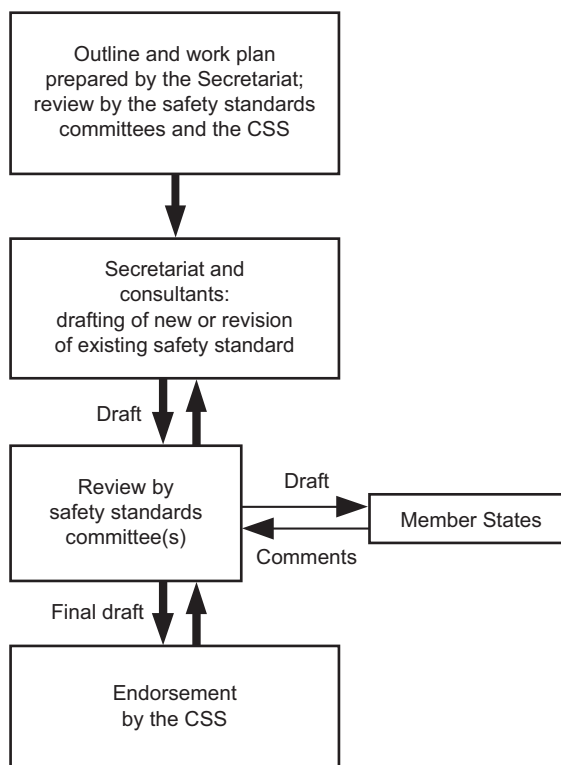


FIG. 2. The process for developing a new safety standard or revising an existing standard.

It articulates the mandate of the IAEA, the vision for the future application of the safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see <http://www-ns.iaea.org/standards/safety-glossary.htm>). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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1. INTRODUCTION

BACKGROUND

1.1. Spent nuclear fuel is generated from the operation of nuclear reactors of all types and needs to be safely and securely managed following its removal from the reactor core. Spent fuel¹ is considered waste in some circumstances or a potential future energy resource in others and, as such, management options might involve direct disposal (as part of what is generally known as the ‘once through fuel cycle’) or reprocessing (as part of what is generally known as the ‘closed fuel cycle’). Either management option will involve a number of steps, which will necessarily include storage of the spent fuel for some period of time. This time period for storage can differ, depending on the management strategy adopted, from a few months to several decades. The time period for storage will be a significant factor in determining the storage arrangements adopted. The final management option might not have been determined at the time of design of the storage facility, leading to some uncertainty in the storage period that will be necessary, a factor that needs to be considered in the adoption of a storage option and the design of the facility. Storage options include wet storage in some form of storage pool, or dry storage in a facility or in storage casks built for this purpose. Storage casks can be located in a designated area on a site or in a designated storage building. A number of different designs for both wet and dry storage have been developed and used in different States.

1.2. Irrespective of the consideration of spent fuel (either waste or an energy resource), the requirements for the storage of spent fuel are the same as those for the storage of radioactive waste, which are established in IAEA Safety Standards Series No. GSR Part 5, Predisposal Management of Radioactive Waste [1].

1.3. The safety of a spent fuel storage facility, and of the spent fuel stored within it, is ensured by appropriate confinement of the radionuclides involved, maintaining subcriticality, heat removal, radiation shielding and retrievability of the spent fuel or spent fuel packages. These functions are ensured by the proper siting, design, construction and commissioning of the storage facility, and its proper management and safe operation. At the design stage, due consideration also needs to be given to the future decommissioning of the facility.

¹ The terms ‘spent fuel’ and ‘spent nuclear fuel’ are used throughout this publication in the same meaning.

1.4. Spent fuel is generated continually by operating nuclear reactors. It is stored in the reactor fuel storage pool for a period of time for cooling and then may be transferred to a designated wet or dry storage facility, where it will await reprocessing or disposal (if it is considered to be radioactive waste). The spent fuel storage pools of some reactors have sufficient capacity to accommodate all the spent fuel that will be generated during the lifetime of the reactor.

1.5. The basic safety aspects for the storage of spent fuel are applicable to the storage of spent fuel from research reactors as well as from power reactors. For research reactors, an approach should be adopted that takes into account the differences between the fuel types (e.g. the lower heat generation of research reactor fuel, its higher enrichment level and cladding materials that are less corrosion resistant) when determining the measures to be taken to ensure confinement, heat removal, criticality control, radiation shielding and retrievability.

1.6. Many spent fuel storage facilities at reactors were intended to serve for a limited period of time (a few years) as a place to keep spent fuel between unloading from the reactor and its subsequent storage, reprocessing or disposal. In view of the time being taken to develop disposal facilities and the limited reprocessing programmes that have been developed, storage periods are being extended from years to decades. This change in approach to the management of spent fuel has been accompanied by other developments, for example increases in enrichment, increases of burnup, use of advanced fuel design and mixed oxide fuel, re-racking, use of burnup credit and, in some cases, extension of storage periods beyond the original design lifetime of the storage facility. Nevertheless, storage cannot be considered the ultimate solution for the management of spent fuel, which requires a defined end point such as reprocessing or disposal in order to ensure safety. The design lifetime of a nuclear installation is generally of the order of decades, and experience with the storage of spent fuel of up to around 50 years has accrued. While design lifetimes of up to 100 years have been considered and adopted for certain spent fuel storage facilities, in view of the rate of industrial and institutional change, periods beyond around 50 years are deemed to be 'long term' in the context of this Safety Guide (see also Annex I).

1.7. The present publication supersedes the 2012 edition of SSG-15². This Safety Guide complements IAEA Safety Standards Series No. WS-G-6.1, Storage of Radioactive Waste [2], and can be read in conjunction with it.

² INTERNATIONAL ATOMIC ENERGY AGENCY, Storage of Spent Nuclear Fuel, IAEA Safety Standards Series No. SSG-15, IAEA, Vienna (2012).

1.7A. The terms used in this Safety Guide are to be understood as defined and explained in the IAEA Safety Glossary [3].

OBJECTIVE

1.8. The objective of this Safety Guide is to provide guidance and recommendations on the design, commissioning, operation and assessment of safety for the different types of spent nuclear fuel storage facility (wet and dry), by considering different types of spent nuclear fuel from nuclear reactors, including research reactors, and different storage periods, including storage beyond the original design lifetime of the storage facility. This Safety Guide presents guidance and recommendations on how to meet the requirements established in GSR Part 5 [1] and IAEA Safety Standards Series Nos SSR-4, Safety of Nuclear Fuel Cycle Facilities [4], GSR Part 2, Leadership and Management for Safety [5], GSR Part 4 (Rev. 1), Safety Assessment for Facilities and Activities [6], and SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design [7].

SCOPE

1.9. This Safety Guide covers spent nuclear fuel storage facilities that are either collocated with other nuclear facilities (e.g. nuclear power plant, research reactor, reprocessing plant) or located on their own site. However, it is not specifically intended to cover the storage of spent nuclear fuel as long as it remains a part of the operational activities of a nuclear reactor or a spent fuel reprocessing facility, which are addressed in IAEA Safety Standards Series Nos SSG-40, Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors [8], and SSG-41, Predisposal Management of Radioactive Waste from Nuclear Fuel Cycle Facilities [9], respectively.

1.10. The scope of this Safety Guide includes the storage of spent nuclear fuel from water moderated reactors and can, with due consideration, also be applied to the storage of other types of nuclear fuel, such as spent nuclear fuel from gas cooled reactors and research reactors, and to the storage of spent fuel assembly components and degraded or failed nuclear fuel³ that might be placed in canisters.

1.11. This Safety Guide does not provide recommendations on the physical protection of nuclear material and nuclear facilities. Recommendations and

³ The terms ‘degraded fuel’ or ‘failed fuel’ can cover a broad range of conditions, from minor pinholes to cracked cladding to broken fuel pins.

guidelines on physical protection arrangements at nuclear facilities, including risk assessment, threat definition, design, maintenance and implementation of physical protection systems, evaluation of effectiveness and inspection of physical protection systems, are provided in Ref. [10] and in supporting publications in the IAEA Nuclear Security Series. This Safety Guide considers physical protection and accounting for and control of nuclear material only to highlight potential implications for safety.

STRUCTURE

1.12. Section 2 of this Safety Guide addresses the application of the fundamental safety objective and the fundamental safety principles to the storage of spent nuclear fuel. The roles and responsibilities of those involved in the storage of spent nuclear fuel are set out in Section 3. Section 4 provides recommendations on the management system necessary for safety. Section 5 provides recommendations on safety assessment and Section 6 provides recommendations on safety considerations in respect of design, construction, operation and decommissioning of spent fuel storage facilities, including considerations for long term storage. Appendix I addresses considerations specific to wet and dry storage of spent nuclear fuel and Appendix II addresses considerations in respect of spent fuel with particular characteristics. Annex I provides explanations of the concepts of short term and long term storage. Annex II summarizes operational and safety considerations for wet and dry storage facilities. Annex III provides an example of the sections that could be included in the operating procedures for a spent fuel storage facility. Annexes IV–VI provide listings of events for consideration in a safety assessment for a spent fuel storage facility.

1.13. For convenience, the text of each safety requirement that is applicable to the storage of spent nuclear fuel is reproduced in this Safety Guide, followed by the related recommendations.

2. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

2.1. National requirements for radiation protection are required to be established, in accordance with the fundamental safety objective and fundamental safety principles set out in IAEA Safety Standards Series No. SF-1, Fundamental

Safety Principles [11], and in compliance with IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [12]. In particular, doses to people as a consequence of the storage of spent fuel are required to be kept within specified dose limits and radiation protection is required to be optimized within dose constraints.

2.2. If several nuclear installations (e.g. nuclear power plants, spent fuel storage facilities, reprocessing facilities) are located at the same site, the dose constraints for public exposure should take into account all sources of exposure that could be associated with activities at the site. Particularly in such cases, the regulatory body should require the operating organization(s) of the nuclear installation(s) on the site to develop constraints, subject to regulatory approval. Alternatively, the regulatory body may establish the dose constraints. Requirements on dose constraints are established in GSR Part 3 [12] and recommendations are provided in IAEA Safety Standards Series No. GSG-8, Radiation Protection of the Public and the Environment [13].

2.3. The design of a spent fuel storage facility and the storage of spent fuel must be such that the workers, the public and the environment, present and future, will be protected from harmful effects of radiation exposure from all sources of ionizing radiation associated with current activities with spent fuel at the site [11], with sufficient margins for foreseeable future activities at the site that might also give rise to exposure.

2.4. Discharges to the environment from spent fuel storage facilities should be controlled in accordance with the conditions imposed by the regulatory body and should be included when estimating doses to workers and to the public. Recommendations on discharge limits are provided in IAEA Safety Standards Series No. GSG-9, Regulatory Control of Radioactive Discharges to the Environment [14].

2.5. The adequacy of control measures taken to limit the radiation exposure of workers and the public should be verified by monitoring and surveillance, both inside and outside the facility.

2.6. At each step in the management of spent fuel, a safety culture that encourages a questioning and learning attitude towards protection and safety and that discourages complacency should be fostered and maintained [5, 15, 16].

3. ROLES AND RESPONSIBILITIES

GENERAL

Requirement 1 of GSR Part 5 [1]: Legal and regulatory framework

“The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions. Protection shall also be provided beyond national borders as appropriate and necessary for neighbouring States that may be affected.”

Requirement 6 of GSR Part 5 [1]: 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.”

3.1. Storage of spent fuel should be undertaken within an appropriate national legal and regulatory framework that provides for a clear allocation of responsibilities [17], including responsibilities for meeting international obligations and for verifying compliance with these obligations, and which ensures the effective regulatory control of the facilities and activities concerned. The national legal framework should also ensure compliance with other relevant national and international legal instruments, such as the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [18].

3.2. The management of spent fuel may entail the transfer of spent fuel from one operating organization to another and various interdependences exist between the various steps in the management of spent fuel. The legal framework should include provision to ensure a clear allocation of responsibility for safety throughout the entire process, in particular with regard to the storage of spent fuel and its transfer between operating organizations. Continuity of responsibility for safety should be ensured by means of a system of authorization by the regulatory body. For transfers between States, authorizations from the respective national regulatory bodies are required [18, 19].

3.3. The responsibilities of the regulatory body⁴, the operating organization and, where appropriate, the spent fuel owner in respect of spent fuel management should be clearly specified in the legal and regulatory framework and should be functionally separate.

3.4. A mechanism for providing adequate financial resources should be established to cover any future costs, in particular the costs associated with spent fuel storage and decommissioning of the storage facility as well as the costs of managing radioactive waste. The financial mechanism should be established before licensing of the storage facility and its operation and should be updated as necessary. Consideration should also be given to provision of the necessary financial resources in the event of a premature shutdown of the spent fuel storage facility.

RESPONSIBILITIES OF THE GOVERNMENT

Requirement 2 of GSR Part 5 [1]: National policy and strategy on radioactive waste management

“To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors. The policy and strategy shall be compatible with the fundamental safety principles [11] and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste.”

3.5. The government is responsible for establishing a national policy and corresponding strategy for the management of spent fuel and for providing the legal and regulatory framework necessary to implement the policy and strategy. The national policy and strategy should cover all types of spent fuel and spent fuel storage facility in the State, with account taken of the interdependences between the various stages of spent fuel management, the time periods involved and the options available [17].

⁴ There might be one or a number of regulatory authorities with responsibility for facilities or activities in the State (see para. 3.15).

3.6. The government is responsible for establishing a regulatory body independent of the owners of the spent fuel or the operating organizations managing the spent fuel, with adequate authority, power, staffing and financial resources to discharge its assigned responsibilities [17].

3.7. The government should consult interested parties (i.e. those who are involved in or are affected by spent fuel management activities) on matters relating to the development of the national policy and strategy for the management of spent fuel.

3.8. In the event that circumstances change and storage is required beyond the period originally envisaged in the national strategy for the management of spent fuel, a re-evaluation of the national strategy should be carried out.

RESPONSIBILITIES OF THE REGULATORY BODY

Requirement 3 of GSR Part 5 [1]: Responsibilities of the regulatory body

“The regulatory body shall establish the requirements for the development of radioactive waste management facilities and activities and shall set out procedures for meeting the requirements for the various stages of the licensing process. The regulatory body shall review and assess the safety case...and the environmental impact assessment for radioactive waste management facilities and activities, as prepared by the operator both prior to authorization and periodically during operation. The regulatory body shall provide for the issuing, amending, suspension or revoking of licences, subject to any necessary conditions. The regulatory body shall carry out activities to verify that the operator meets these conditions. Enforcement actions shall be taken as necessary by the regulatory body in the event of deviations from, or non-compliance with, requirements and conditions.”

3.9. The regulatory body should provide guidance to operating organizations on how to meet requirements relating to the safe storage of spent fuel, which should include, but is not limited to: the application of a management system for the handling and storage of spent fuel; development of operational limits

and conditions; performance of the safety assessment; development and use of quantifiable performance indicators; and documentation and use of the safety case⁵.

3.10. Since spent fuel might be stored for long periods of time prior to its retrieval for reprocessing or disposal, the regulatory body should verify that the operating organization is providing the necessary personnel and the technical and financial resources for the lifetime of the spent fuel storage facility, to the extent that such confirmation is within the statutory obligations of the regulatory body.

3.11. The regulatory review of the decommissioning plans for spent fuel storage facilities should follow a graded approach, particularly considering the current stage in the lifetime of the storage facility. The initial decommissioning plan should be conceptual and should be reviewed by the regulatory body for its overall completeness rather than for specific decommissioning arrangements, but it should include specifically how financial and human resources and the availability of the necessary information from the design, construction and operational stages will be ensured when decommissioning takes place. The decommissioning plan should be updated regularly by the licensee and updates should be reviewed by the regulatory body. If a facility is to be shut down and no longer to be used for its intended purpose, a final decommissioning plan is required to be submitted to the regulatory body for review and approval [20].

3.12. General recommendations for regulatory inspection and enforcement actions relating to spent fuel storage facilities are provided in IAEA Safety Standards Series No. GSG-13, Functions and Processes of the Regulatory Body for Safety [21]. The regulatory body should periodically verify that the key aspects of the operation of the storage facility meet the requirements of the national legal system and facility licence conditions, such as those relating to keeping records on inventories and material transfers, compliance with acceptance criteria for storage, maintenance, inspection, testing and surveillance, operational limits and conditions, physical protection of nuclear material and arrangements for on-site emergency preparedness and response. Such verification might be carried out, for example, by routine inspections of the spent fuel storage facility and the operating organization, and by review and assessment of the safety case. In addition, verification should include observing and evaluating some exercises of the operating organization, in accordance with para. 6.30 of IAEA Safety Standards

⁵ The safety case is a collection of arguments and evidence in support of the safety of a facility or activity. This collection of arguments and evidence may be known by different names (e.g. safety report, safety dossier, safety file) in different States and might be presented in a single document or a series of documents (see Section 5).

Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency [22]. The regulatory body should verify that the necessary records are prepared and that they are maintained for an appropriate period of time. Recommendations on the records to be retained are provided in GSG-13 [21].

3.13. The regulatory body should set up appropriate means of informing interested parties, such as people living in the vicinity, the general public, the media and others, about the safety aspects (including health and environmental aspects) of the spent fuel storage facility and about regulatory processes, and should consult these parties, as appropriate, in an open and inclusive manner. The need for confidentiality (e.g. for security reasons) should be respected. Further recommendations are provided in IAEA Safety Standards Series No. GSG-6, Communication and Consultation with Interested Parties by the Regulatory Body [23].

3.14. The regulatory body should consider the licensing strategy to be adopted, for example:

- (a) A licence issued for the entire lifetime of the storage system and/or the facility, which encompasses the whole anticipated operating period, including periodic review of safety assessments, as elaborated in Section 5; or
- (b) A licence issued for a specified time period with the possibility for renewal after expiry.

3.15. If the regulatory body comprises more than one authority, effective arrangements should be made to ensure that regulatory responsibilities and functions are clearly defined and coordinated in order to avoid any omissions or unnecessary duplication and to prevent conflicting requirements being placed on the operating organization. The main regulatory functions of review and assessment and inspection and enforcement should be organized in such a manner as to achieve consistency and to enable the necessary feedback and exchange of information.

RESPONSIBILITIES OF THE OPERATING ORGANIZATION⁶

Requirement 4 of GSR Part 5 [1]: Responsibilities of the operator

“Operators shall be responsible for the safety of predisposal radioactive waste management facilities or activities.... The operator shall carry out safety assessments and shall develop a safety case, and shall ensure that the necessary activities for siting, design, construction, commissioning, operation, shutdown and decommissioning are carried out in compliance with legal and regulatory requirements.”

3.16. The operating organization is responsible for the safety of all activities associated with the storage of spent fuel (including activities undertaken by contractors) and for the specification and implementation of the programmes and procedures necessary to ensure safety. The operating organization should maintain a high level of safety culture and should demonstrate safety. In some instances, the operating organization might be the owner of the spent fuel and in other cases the owner might be a separate organization. In the latter instance, particular consideration should be given to interdependences among the spent fuel management steps, including for any activity carried out prior to receipt of the spent fuel at a storage facility, such as its characterization or packaging, or the subsequent transport of the spent fuel from the facility, to ensure that conditions for safety will be met.

3.17. The responsibilities of the operating organization of a spent fuel storage facility typically include the following:

- (a) Application to the regulatory body for permission to site, design, construct, commission, operate, modify or decommission a spent fuel storage facility;
- (b) Conduct of appropriate safety assessment and environmental assessment in support of the application for a licence;
- (c) Operation of the spent fuel storage facility in accordance with the requirements of the safety case, the licence conditions and the applicable regulations;
- (d) Development and application of acceptance criteria for the storage of spent fuel, as approved by the regulatory body;

⁶ The operating organization is assumed to be the licensee. If the facility is operated under contract, the interface between the responsibilities of the licensee and those of the contracted operational management need to be clearly defined, agreed upon and documented.

- (e) Provision of periodic reports as required by the regulatory body (e.g. information on the actual inventory of spent fuel, any transfers of spent fuel into and out of the facility, any events that have occurred at the facility and which have to be reported to the regulatory body) and communication with interested parties and the general public.

3.18. Prior to authorization of a spent fuel storage facility, the operating organization should provide the regulatory body with a safety case that demonstrates the safety of the proposed activities and also demonstrates that the proposed activities at the facility will be in compliance with the safety requirements and criteria set out in national laws and regulations. As part of the safety case, the operating organization should use the safety assessment to establish specific operational limits and conditions for approval by the regulatory body. The operating organization may wish to set an operational target level within these specified limits to assist in avoiding any breach of approved limits and conditions (see para. 6.106).

3.19. At an early stage in the lifetime of a spent fuel storage facility, the operating organization should prepare the initial plan for its eventual decommissioning. For new facilities, features that will facilitate decommissioning should be taken into consideration at the design stage. Such features should be included in the decommissioning plan, together with information on arrangements regarding how the availability of the necessary human and financial resources and information will be ensured, for presentation in the safety case. The operating organization should regularly update the decommissioning plan and submit updates to the regulatory body for review and approval. If a facility is to be shut down and is no longer to be used for its intended purpose, the operating organization is required to submit a final decommissioning plan to the regulatory body for review and approval within a period agreed with the regulatory body [20].

3.20. For existing facilities without a decommissioning plan, the licensee should prepare such a plan as soon as possible and submit it to the regulatory body for review and approval. Subsequent updates are to be made in accordance with the requirements on decommissioning established in IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities [20], and recommendations provided in IAEA Safety Standards Series No. SSG-47, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities [24].

3.21. The operating organization should establish the requirements for training and qualification of its staff and contractors, including for initial training and periodic refresher training [4]. The operating organization should ensure that all concerned

staff members understand the nature of the spent fuel, its potential hazards and the relevant operating and safety procedures pertaining to it. Supervisory staff should be competent to perform their activities and should therefore be selected, trained, qualified and authorized for that purpose. A radiation protection officer should be appointed to oversee the application of radiation protection requirements.

3.22. The operating organization should carry out pre-operational tests and commissioning tests to demonstrate compliance of the storage facility and storage activities with the requirements of the safety assessment and with the requirements established by the regulatory body.

3.23. The operating organization should ensure that discharges of radioactive material and other potentially hazardous material to the environment are in accordance with the conditions of the licence. Discharges should be documented.

3.24. The operating organization should prepare plans and implement programmes for personnel monitoring, area monitoring and environmental monitoring.

3.25. The operating organization should establish procedures on how to analyse the need for and how to implement modifications to the spent fuel storage facility, storage conditions and the spent fuel to be stored. As part of the procedures, the potential consequences of such modifications and of the works performed to implement them should be evaluated, including consequences for the safety of other facilities and also for the retrieval, transport, reprocessing and disposal of spent fuel. The procedures should be commensurate with the significance of the proposed modifications for safety.

3.26. The operating organization is required to allocate and maintain appropriate financial resources to undertake all necessary tasks throughout the lifetime of the facility, including its decommissioning [17].

3.27. The operating organization should develop and maintain a record keeping system on data relating to the spent fuel and the storage system, which should include the radioactive inventory, location and characteristics of the spent fuel, information on the ownership and origin of the spent fuel, and information about its characterization. An unequivocal identification system should be established, with markings that will last for the duration of the storage period. Such records should be preserved and updated to enable the implementation of the spent fuel management strategy, whether disposal or reprocessing.

3.28. The operating organization is required to prepare an emergency plan and the necessary procedures and analytical tools for on-site emergency preparedness and effective response [22]. The operating organization is required to coordinate this emergency plan with those of all other bodies that have responsibilities in a nuclear or radiological emergency, including public authorities, and submit it to the regulatory body for approval [22]. Account is required to be taken, in the content, features and extent of the emergency plan, of the results of the hazard assessment and any lessons identified from operating experience and from past emergencies, including conventional emergencies [22, 25]. The operating organization should demonstrate to the regulatory body, as part of the safety case, that the emergency arrangements provide for sufficient assurance of an effective on-site emergency response and that they are in place [26].

RESPONSIBILITIES OF THE SPENT FUEL OWNER

Requirement 6 of GSR Part 5 [1]: 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.”

3.29. There should be clear and unequivocal ownership of the spent fuel stored in the facility. The responsibilities of the spent fuel owner and the responsibilities of the operating organization, if they differ, should be clearly defined and documented. The spent fuel owner (namely, a body having legal title to the spent fuel, including financial liabilities) should be responsible for the overall strategy for the management of its spent fuel. In determining the overall strategy, the spent fuel owner should take into account interdependences between all stages of spent fuel management, the options available and the overall national spent fuel management strategy.

3.30. Information about any changes in ownership of the spent fuel or changes in the relationship between the owner and the operating organization of a spent fuel storage facility should be provided to the regulatory body.

ACCOUNTING FOR AND CONTROL OF NUCLEAR MATERIAL AND PHYSICAL PROTECTION SYSTEMS

Requirement 21 of GSR Part 5 [1]: 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 implemented in such a way as not to compromise the safety of the facility....”

Requirement 5 of GSR Part 5 [1]: Requirements in respect of security measures

“Measures shall be implemented to ensure an integrated approach to safety and security in the predisposal management of radioactive waste.”

3.31. The operating organization will be required to establish, maintain and implement a system for nuclear material accounting and control as an integrated part of the State system of accounting for and control of nuclear material⁷ [10].

3.31A. In addition, physical protection systems for deterrence and detection of the intrusion of unauthorized persons and for protection against sabotage from within and outside the facility are required to be designed and installed during the construction and operation of the spent fuel storage facility.

3.31B. Paragraph 1.10 of SF-1 [11] requires that safety measures and security measures “be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.” The operating organization should demonstrate to the regulatory body that security provisions, including physical protection systems, and safety measures at the facility are managed in such a way as to achieve this.

⁷ Safeguards agreements between the IAEA and non-nuclear-weapon States party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) contain the obligation of the State to establish and maintain a national system of accountancy for and control of nuclear material. The IAEA document describing the structure and content of such NPT safeguards agreements, INFCIRC/153(Corrected) [27], also known as the ‘Blue Book’, sets out the basic requirement for a State’s system of accounting for and control of nuclear material.

4. MANAGEMENT SYSTEM

GENERAL

Requirement 7 of GSR Part 5 [1]: Management systems

“Management systems shall be applied for all steps and elements of the predisposal management of radioactive waste.”

4.1. The requirements on the management system for all stages in the lifetime of a spent fuel storage facility are established in GSR Part 2 [5]. Recommendations on the management system for the storage of spent fuel are provided in IAEA Safety Standards Series No. GS-G-3.3, The Management System for the Processing, Handling and Storage of Radioactive Waste [28].

4.2. An integrated management system is required to be established, implemented, assessed and continually improved by the operating organization [5] and applied to all stages of the storage of spent fuel. The management system is required to be aligned with the goals of the operating organization and to contribute to their achievement [5]. The management system should address the siting, design, commissioning, operation, maintenance and decommissioning of the spent fuel storage facility. The management system is required to be designed to ensure that the safety of the spent fuel and of the spent fuel storage facility is maintained, and that the quality of the records and of subsidiary information of spent fuel inventories is preserved, with account taken of the length of the storage period and the consecutive management steps, for example reprocessing or disposal [5]. The management system should also contain provisions to ensure that the fulfilment of its goals can be demonstrated.

4.3. The long term nature of spent fuel management operations means that particular consideration should be given to establishing and maintaining confidence that the performance of the spent fuel storage facilities and activities will meet the safety requirements throughout the lifetime of the facility to the end of its decommissioning (e.g. by creation of the funding arrangements that will be necessary to manage the spent fuel in the long term).

SPENT FUEL MANAGEMENT

4.4. National and international policies and principles for spent fuel management that currently constitute an accepted management arrangement can evolve over the lifetime of the facility. Policy decisions (e.g. regarding spent fuel reprocessing) and technological innovations and advances (e.g. in partitioning and transmutation) can lead to fundamental changes in the overall spent fuel management strategy. However, the operating organization retains its responsibility for safety at all times, and continuous commitment by the organization remains a prerequisite of ensuring safety and the protection of human health and the environment.

4.5. For the plans, goals and objectives associated with the strategy for achieving an integrated approach to safety, interaction with all interested parties should be considered, as well as long term aspects such as:

- (a) Provision of adequate resources (the adequacy of resources for maintenance of facilities and equipment may need to be periodically reviewed over operational periods that may extend over decades);
- (b) Preservation of technology and knowledge and transfer of such knowledge to people or organizations joining the spent fuel management programme in the future;
- (c) Retention or transfer of ownership of spent fuel and spent fuel management facilities;
- (d) Succession planning for the technical and managerial human resources of the spent fuel management programme or the operating organization;
- (e) Continuation of arrangements for interacting with interested parties.

RESOURCE MANAGEMENT

4.6. Spent fuel management activities will require financial and human resources and the necessary infrastructure at the site where the spent fuel storage facility is located. Senior management is required to make arrangements to provide adequate resources for spent fuel management activities, to satisfy the demands imposed by safety, health, environmental, security, quality, human and organizational factors, and societal and economic aspects of the full range of activities involved in the management of spent fuel and the potentially long duration of such activities [5].

4.7. Arrangements for the funding of future spent fuel management activities should be specified, and responsibilities, mechanisms and schedules for providing

the funds should be established in due time. The generator of the spent fuel should establish an appropriate funding mechanism.

4.8. The management system for spent fuel management should include provisions to deal with funding related challenges, such as the following:

- (a) For various reasons (e.g. bankruptcy, cessation of business), it might not be feasible to obtain the necessary funds from the spent fuel generator, especially if funds were not set aside at the time the benefits were received from the activity, or if ownership of the spent fuel has been transferred to another party.
- (b) If funds are to come from public sources, their allocation will compete with other demands for public funding, and it may be difficult to gain access to adequate funds on a timely basis.
- (c) It might be difficult to make realistic estimates of costs for spent fuel management activities that are still in the planning stage and for which no experience has been accumulated.
- (d) It might be difficult to estimate anticipated costs for activities that will only begin in the long term, because they will depend strongly on assumptions made about future inflation rates, interest rates and technological developments.
- (e) It might be difficult to determine appropriate risk and contingency factors to be built into estimates of future costs, owing to the uncertainties associated with future changes in societal demands, political imperatives, public opinion and the nature of unplanned events that may need resources for dealing with them.
- (f) If several organizations are involved in spent fuel management activities, the necessary financial arrangements might be complex and might vary over the lifetime of the facility. It might be problematic to establish an adequate degree of confidence in all the arrangements so that the necessary continuity of funding throughout the entire series of activities is ensured.

4.9. Accumulated experience, including lessons identified from incidents and events, should be reviewed periodically and should be used in revising training programmes and in reaching future decisions.

4.10. In the design of facilities for long term spent fuel management, consideration should be given to the incorporation of measures that will facilitate operation, maintenance of equipment and eventual decommissioning of the facility. For long term spent fuel management activities, future infrastructural requirements should be specified and plans should be made to ensure that these will be met. In such

planning, consideration should be given to the continuing need for support services, spare parts for equipment that might eventually cease to be manufactured, and equipment upgrades to meet new regulations and operational improvements, and to the evolution and inevitable obsolescence of software. Consideration should also be given to the need to develop monitoring programmes and inspection techniques for use during extended periods of storage.

PROCESS IMPLEMENTATION

4.11. Consideration should be given to the possible need to relocate spent fuel casks if problems arise after they have been placed in storage. The availability of any specialized equipment that may be necessary over a long time period while spent fuel is in storage or that may be necessary in the future should be assessed.

4.12. Records concerning spent fuel and its storage that need to be retained for an extended period should be stored in a manner that minimizes the likelihood and consequences of loss, damage or deterioration due to unpredictable events such as fire, flooding or other natural or human induced events (both internal and external to the facility). Storage arrangements for records should meet the requirements prescribed by the national authorities or the regulatory body, and the status of the records should be periodically assessed. If records are inadvertently destroyed, the status of surviving records should be examined and the importance of their retention and their necessary retention periods should be re-evaluated.

4.13. The management system should be reassessed whenever the relationship between the owner of the spent fuel and the operating organization of the facility changes (e.g. public organizations are privatized, new organizations are created, existing organizations are combined or restructured, responsibilities are transferred between organizations, operating organizations undergo internal reorganization of the management structure, or resources are reallocated).

5. SAFETY CASE AND SAFETY ASSESSMENT

GENERAL

Requirement 13 of GSR Part 5 [1]: 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.”

Requirement 14 of GSR Part 5 [1]: 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 shall provide assurance to the regulatory body that safety requirements will be met.”

Requirement 22 of GSR Part 5 [1]: 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.”

5.1. In demonstrating the safety of the spent fuel storage facility and related activities, a safety case should be developed as development of the facility progresses and the supporting safety assessment should be carried out in a structured and systematic manner. Proposed facilities, processes, operations and activities should be examined to determine whether they can be implemented safely and whether they meet all requirements with regard to safety. If storage casks are to be used, one or separate safety cases and/or safety assessments might be prepared for the storage casks, for the storage building or facility and for the subsequent transport arrangements if the cask will be used eventually for transport as well as for storage. This will depend on the national regulatory approach. However, irrespective of the approach taken, the interdependences between spent

nuclear fuel management operations, activities and collocated facilities should be taken into consideration to ensure that an integrated approach to safety is adopted and that safety is optimized. The safety case and supporting safety assessment should provide the primary input to the licensing documentation that is used to demonstrate compliance with regulatory requirements [6].

5.2. The various stages in the lifetime of the spent fuel storage facility (i.e. siting, design, construction, commissioning, operation, decommissioning) should be taken into account in the safety case. The safety case should be periodically reviewed in accordance with regulatory requirements and should be revised as necessary.

5.3. The prime responsibility for safety throughout the lifetime of a facility lies with the operating organization [11]. This includes responsibility for both ensuring the safety of the facility and demonstrating its safety in the safety case.

5.4. Long term storage (see para. 1.6 and Annex I) might involve a period of time that exceeds the normal design lifetime of civil structures, including short term storage facilities, and this will have implications for the selection of construction materials, operating methods, and quality assurance and quality control requirements. Specific issues that should be given particular consideration in the safety case for a facility for long term storage of spent fuel include the anticipated lifetime of the facility, the importance of passive safety features, retrievability and the management system. Consideration should also be given to the provision of support services when the spent fuel storage facility remains in operation after other facilities at the site have been closed, in particular for storage facilities at reactor sites.

5.5. The rationale for the selection of the assessment time frame should be explained and justified. Depending on the purpose of the assessment and other components of assessment context [26], for ease of modelling or presentation it might be convenient to divide the overall time frame of the safety assessment into shorter ‘time windows’ with various end points.

5.6. In determining the assessment time frame, account should be taken of the characteristics of the particular storage facility or activity, the site and the spent fuel to be stored. Other factors that should be considered include the following:

- (a) For most long term storage systems (including storage casks, engineered constructions and the surrounding environment), potential health and environmental impacts might increase for a period of time after commissioning of the facility. In the long term, and depending on the