WENRA
WORKING GROUP ON WASTE AND DECOMMISSIONING (WGWD)

WASTE AND SPENT FUEL STORAGE SAFETY REFERENCE LEVELS REPORT

version 2.0

March 2010

Contents

Executive Summary

The Western European Nuclear Regulators' Association (WENRA) is an international body made up of the Heads and senior staff members of nuclear regulatory authorities of European countries with nuclear power plants. The main objectives of WENRA is to develop a common approach to nuclear safety, to provide an independent capability to examine nuclear safety in applicant countries and to be a network of chief nuclear safety regulators in Europe exchanging experience and discussing significant safety issues.

To accomplish these tasks two working groups within the WENRA have been established - Reactor Harmonization Working Group (RHWG) and Working Group on Waste and Decommissioning (WGWD).

This document contains the results of the work of WGWD in the area of the safety for spent fuel and radioactive waste storage facilities. The objective of this report is to provide safety reference levels for these facilities, which are based on corresponding IAEA documents (requirements, guidances, etc). Although the IAEA safety standards establish an essential basis for safety of all nuclear installations covering also the spent fuel and radioactive waste stores, the WENRA safety reference levels incorporate more facility specific requirements.

The document was prepared by reviewing the Storage Report Version 1.0 by the working group based on support by the German task manager, Mr. Bernhard Gmal. WGWD members during the review period are listed below.

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WENRA Policy Statement

We, the heads of the national nuclear safety authorities, members of WENRA, commit ourselves to a continuous improvement of nuclear safety in our respective countries.

Nuclear safety and radiation protection are based on the principle of the prime responsibility of the operators. Our role is to ensure that this responsibility is fully secured, in compliance with the regulatory requirements.

In order to work together, we created the Western European Nuclear Regulators' Association (WENRA) with the following main objectives to:

- build and maintain a network of chief nuclear safety regulators in Europe;
- promote exchange of experience and learning from each other´s best practices;
- develop a harmonized approach to selected nuclear safety and radiation protection issues and their regulation, in particular within the European Union;
- provide the European Union Institutions with an independent capability to examine nuclear safety and its regulation in applicant countries.

In order to develop a harmonized approach, we are making efforts to:

- share our experience feedback and our vision;
- exchange personnel, allowing an in-depth knowledge of working methods of each other;
- develop common safety reference levels in the fields of reactor safety, decommissioning safety, radioactive waste and spent fuel management facilities in order to benchmark our national practices.

We recognise the IAEA standards to form a good base for developing national regulations. The developed reference levels represent good practices in our counties and we are committed

- by the year of 2010 to adapt at a minimum our national legislation and implementation to the reference levels;
- to influence the revision of the IAEA standards when appropriate;
- to continuously revise the reference levels when new knowledge and experience are available.

We strive for openness and improvement of our work. For that purpose we are making efforts to

- keep the European nuclear safety and radiation protection bodies not belonging to WENRA and the EU Institutions informed of the progress made in our work;
- make the WENRA reports available on the Internet (www.wenra.org);
- invite stakeholders to make comments and suggestions on our reports and the proposed reference levels.

Signed in Stockholm December 2005

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Glossary

Acceptance criteria for storage

see: waste or spent fuel acceptance criteria

Ageing

General process in which characteristics of a structure, system or component gradually change with time or use.

Ageing degradation

Ageing effects that could impair the ability of a structure, system or component to function within its design limits .

Ageing management

Engineering, operations and maintenance actions to control within acceptable limits the ageing degradation of structures, systems or components.

Burnup credit

Credit in the safety assessment of a structure, component, system or facility that is given for the reduction in spent fuel nuclear reactivity as a result of fission

Conditioning

Those operations that produce a waste or spent fuel package suitable for handling, transport, 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.

Design basis accident

Accident conditions against which a facility is designed according to established design criteria, and for which the damage to the fuel and the release of radioactive material are kept within authorized limits.

Discharge, authorized

Planned and controlled release of (usually gaseous or liquid) radioactive material into the environment in accordance with an authorization.

Licensee

The licensee is the organization having overall responsibility for a facility or activity (the responsible organization)
Remark: WGWD recognizes that this organization may change as the facility passes to the decommissioning phase according to national strategies.

Management system

A set of interrelated or interacting elements (system) for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective way. The management system integrates all elements of an organization into one coherent system. These elements include the structure, resources and processes. Personnel, equipment and organizational culture as well as the documented policies and processes are parts of the management system.

The organization's processes have to address the totality of the requirements on the organization as established in, for example, IAEA safety standards and other international codes and standards.

The term management system reflects and includes the evolution in the approach from the initial concept of 'quality control' (controlling the quality of products) through 'quality assurance' (the system to ensure the quality of products) to 'quality management' (the system to manage quality).

Monitoring

1. The measurement of dose or contamination for reasons related to the assessment or control of exposure
2. Continuous or periodic measurement of radiological or other parameters or determination of the status of a system, structure or component. Sampling may be involved as a preliminary step to measurement.

Nuclear facility

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

Nuclear safety

see *Protection and Safety*

Operation

All activities performed to achieve the purpose for which an authorized facility was constructed.

Operational limits and conditions

A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility.

Owner

Owner means a body having legal title to waste or spent fuel including financial liabilities (it is usually the waste and spent fuel producer).

Passive Safety Feature

A safety feature which does not depend on an external input and/or continuous supply of media.

Protection and Safety

The protection of people against exposure to ionizing radiation or radioactive materials and the safety of radiation sources, including the means for achieving this, and the means for preventing accidents and for mitigating the consequences of accidents should they occur.

Safety is primarily concerned with maintaining control over sources, whereas radiation protection is primarily concerned with controlling exposure to radiation and its effects. Clearly the two are closely connected: radiation protection is very much simpler if the source in question is under control, so safety necessarily contributes towards protection. Sources come in many different types, and hence safety may be termed nuclear safety, radiation safety, radioactive waste safety or transport safety, but protection (in this sense) is primarily concerned with protecting humans against exposure, whatever the source, and so is always radiation protection.

> **Radiation protection**: The protection of people from the effects of exposure to ionizing radiation, and the means for achieving this.
> **Nuclear safety**: The achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards.

Quality management system

see *management system*

Radiation protection

see *protection and safety*

Regulatory body

An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

Safety analysis

Evaluation of the potential hazards associated with the conduct of an activity.

Safety assessment

1. Assessment of all aspects of the siting, design and operation of an authorized facility that are relevant to protection and safety.
2. The systematic process that is carried out throughout the design process to ensure that all the relevant safety requirements are met by the proposed (or actual) design. Safety assessment includes, but is not limited to, the formal safety analysis.

Safety case

A collection of arguments and evidence in support of the safety of a facility or activity. This will normally include the findings of a safety assessment.

Safety policy

A documented commitment by the licensee to a high nuclear safety performance supported by clear safety objectives and targets and a commitment of necessary resources to achieve these targets. The safety policy is issued as separate safety management document or as visible part of an integrated organization policy.

Spent fuel

1. Nuclear fuel removed from a reactor following irradiation, which is no longer usable in its present form because of depletion of fissile material, neutron poison build-up or radiation damage.[1]
2. Nuclear fuel that has been irradiated in and permanently removed from a reactor core.

Storage

The holding of spent fuel or of radioactive waste in a facility that provides for their/its containment, with the intention of retrieval.

Structures, systems and components (SSCs)

A general term encompassing all of the elements (items) of a facility or activity which contribute to protection and safety, except human factors.

- **Structures** are the passive elements: buildings, vessels, shielding, etc.
- A **system** comprises several **components**, assembled in such a way as to perform a specific (active) function.
- A **component** is a discrete element of a system.

Waste treatment

Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are:

- volume reduction,
- removal of radionuclides from the waste, and
- change of composition.

Treatment may result in an appropriate waste form.

Waste

Material for which no further use is foreseen.

Waste, radioactive

For legal and regulatory purposes, waste that contains or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body.

Waste or spent fuel acceptance requirements

Quantitative or qualitative criteria specified by the regulatory body, or specified by an operator and approved by the regulatory body, for radioactive waste or spent fuel to be accepted by the operator of a repository for disposal or by the operator of a storage facility. Waste acceptance requirements might include, for example, restrictions on the activity concentration or the total activity of particular radionuclides (or types of radionuclides) in the waste or the spent fuel or requirements concerning the form or the package of the waste or the spent fuel.

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[1] The adjective 'spent' suggests that *spent fuel* cannot be used as fuel in its present form (as, for example, in *spent source*). In practice, however (as in (2) above), *spent fuel* is commonly used to refer to fuel which has been used as fuel but will no longer be used, whether or not it could be (which might more accurately be termed 'disused fuel').

Waste characterization

Determination of the physical, chemical and radiological properties of the waste to establish the need for further adjustment, treatment or conditioning, or its suitability for further handling, processing, storage or disposal.

Waste or spent fuel package

The product of conditioning that includes the waste or spent fuel form and any container(s) and internal barriers (e. g. absorbing materials and liner), as prepared in accordance with requirements for handling, transport, storage and/or disposal.

List of Abbreviations

AMP	ageing management program
EIA	environmental impact assessment
EU	European Union
IAEA	International Atomic Energy Agency
NEA	Nuclear Energy Agency (OECD)
NPP	nuclear power plant
OEF	operational experience feedback
OLC	operational limits and conditions
PIE	postulated initiating event
PSR	periodic safety review
QM	quality management
R&D	research and development
RHWG	(WENRA) Reactor Harmonization Working Group
SSCs	structures, systems and components
SRL	safety reference level
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators' Association
WGWD	(WENRA) Working Group on Waste and Decommissioning

Part I.

Introduction and Methodology

1. Introduction

This report in Version 2.0 is the result of an effort by the Working Group on Waste and Decommissioning (WGWD) of WENRA, from 2002 to 2009. It presents the safety reference levels (SRLs) for radioactive waste and spent fuel management facilities and practices that are thought to be a good basis for future harmonization on a European level.

The SRLs can not be considered as independent European safety requirements because current legislation in WENRA member states would not allow that due to fundamental differences reflecting the historical development in European countries. The SRLs are a set of requirements against which the situation of each country is assessed and it is each country's responsibility to implement actions to ensure that these levels are reached.

1.1. Background

WENRA, which has been established in February 1999, is the association of the Heads of nuclear regulatory authorities of European countries with at least one nuclear power plant in construction, operation or decommissioning phase. WENRA has been formally extended in 2003 to include future new European Union (EU) member states. Currently following countries are members of WENRA: Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland and the United Kingdom. Recently various other states have been appointed to WENRA meetings with the status of "observers". However such states have not yet been participating in the work of WGWD and have not taken part in the preparation of this report.

The original objectives of the Association were:

- to provide the EU institutions with an independent capability to examine nuclear safety and its regulation in applicant countries,
- to provide the EU with an independent capability to examine nuclear safety and regulation in candidate countries,
- to evaluate and achieve a common approach to nuclear safety and regulatory issues which arise.

The second objective of WENRA has been fulfilled by the preparation of a report on nuclear safety in candidate countries having at least one nuclear power plant. After May 1st, 2004, when most of these candidate countries became regular EU member states, the new WENRA tasks, based on first and third original Association's objectives, became:

- provide the European Union institutions with an independent capability to examine nuclear safety and its regulation in applicant countries and
- to develop common approaches to nuclear safety and regulations and to encourage the harmonization of practices.

To perform these tasks two working groups within the WENRA have been established - Reactor Harmonization Working Group (RHWG) and Working Group on Waste and Decommissioning (WGWD). The work of WGWD has started in 2002.

1.2. Objective

The objective of this report is to provide SRLs for spent fuel and radioactive waste storage facilities. The design storage period involved will typically be several decades, depending on the national waste and spent fuel management strategy.

Although the SRLs in this report are oriented toward the licensees of the above-mentioned facilities, who are usually responsible for the safety of the facilities throughout their lifetime, they can also be used by the regulatory body for the review and evaluation of storage facilities' safety.

According to the WENRA policy statement the harmonization process of the national legal systems in member states should be finished by the year 2010. In 2009 WENRA decided to prolong the deadline in case of the storage SRLs until end of 2012.

1.3. Scope

The SRLs are primarily focussed on separate, purpose built or adapted storage facilities used to store spent fuel or radioactive waste in solid form. As this document is intended to cover a wide range of storage facilities, the reference levels will need to be implemented in different ways to be appropriate for the particular facility. The SRLs were also primarily developed for licensed *nuclear* facilities for storage, but can be used also for other facilities accommodating radioactive waste from industry, hospitals, research centres etc.

Under certain circumstances (steam generator exchange, decommissioning) large, bulky waste items are subject to storage. The SRLs of this document shall be applied as appropriate to such material as well.

These SRLs may also be applied to stores as integrated parts of other facilities, e.g. NPPs, facilities for waste conditioning or for disposal. In such cases it should be recognized that many of the SRLs of a general nature, e.g. on quality management and facility operation, may have to be applied together with SRLs developed for the other parts of the facility. A similar situation occurs if the storage facility is operated in combination with other facilities, or incorporates other nuclear activities than storage.

Spent fuel stores built for the normal operation of the reactors are not covered by this report. Because of the national policies on spent fuel, operators can consider the need to extend the use of the stores or adapting the existing ones, beyond the operational period of the reactor. Those facilities shall be covered by this report.

Because WGWD members do not all regulate the following matters, WGWD has concentrated on relevant nuclear and waste safety requirements and, in particular, it has not taken into account in detail other regulatory requirements such as Environmental Impact

Assessment regulation (required by EU directives), discharge authorization, waste disposal, conventional occupational health and safety, physical protection including safeguards, and funding issues. In some countries, these matters are addressed by other national regulatory organizations.

1.4. Structure

The report consists of two main parts.

Following this introduction, Section I.-2. presents the general methodology that was followed to develop the SRLs and to analyse their application in participating countries.

Part II of the report presents the actual waste and spent fuel storage reference levels.

2. Methodology

The working methodology of WGWD has gone through several steps and changes since 2002, when the working group was established. A list of topics to be covered by WGWD was defined taking into account the common field of responsibility of WENRA members. Generally for the development of storage SRLs relevant IAEA documents were consulted, the latest list of which is as follows:

- Fundamental Safety Principles, Safety Fundamentals SF-1, Vienna (2006)
- Storage of Spent Fuel, DS 371, Vienna (January 2010)
- Predisposal Management of Radioactive Waste, GSR Part 5, Vienna (2009),
- Periodic safety review of nuclear power plants, NS-G-2.10, Vienna (2003),
- A System for Feedback of Experience from Events in Nuclear Installations, NS-G-2.11, Vienna (2006),
- Storage of Radioactive Waste, WS-G-6.1, Vienna (2006),
- Safety of Nuclear Fuel Cycle Facilities, NS-R-5, Vienna (2009),
- Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, Safety Requirements, GS-R-1, Vienna (2000).
- Management Systems for Facilities and Activities, Safety Requirements, GS-R-3, Vienna (2006).
- The Management System for the Processing, Handling and Storage of Radioactive Waste, GS-G-3.3, Vienna (2008)
- The Management System for Nuclear Installations GS-G-3.5, Vienna (2009)
- Preparedness and Response for a Nuclear or Radiological Emergency, GS-R-2, Vienna, 2002
- Periodic Safety Review of Nuclear Power Plants, DS 426, Vienna (2009)
- Safety Case and Safety Assessment for Predisposal Management of Radioactive Waste, DS 284, Vienna (August 2008)

A first set of SRLs was posted on the website of the WENRA organization at the beginning of 2006 and presented to stakeholders in order to receive their comments before June 1st, 2006. Most of the comments recommended to address more specifically the issues raised by the

storage of spent fuel and radioactive waste in order to prevent the specific hazards they pose. WGWD reflected a considerable number of comments and established in December 2006 Version 1.0 of the waste and spent fuel storage report on which basis the following benchmarking exercise of the storage-SRLs in WENRA member countries was conducted.

An evaluation of the implementation of the SRLs in the regulations (national legal systems) and in the facilities has been performed till mid-2009 in each WENRA member state. In a benchmarking exercise the justification and evidence for implementation of each SRL was discussed country by country and agreed within WGWD in subgroups. After this evaluation, all member states developed national action plans in order to address identified discrepancies and to update their national regulations till the end of 2012. Progress of the national action plans is under continuous review of the working group.

Reflecting the results of the national assessments, the set of SRLs was subject to further improvement, which together with updated references of IAEA documents, led to this most recent version 2.0 of the ”Waste and Spent Fuel Storage Safety Reference Levels”. For accomplishing this, two review readings of the SRLs were carried out in the plenary sessions of the 21st and 22nd meeting of the WGWD. Before the 23rd meeting an update of the references and quotations of relevant IAEA documents had been performed. After the 23rd meeting of WGWD with a final reading WENRA approved the report in spring 2010 for official release as draft on the WENRA homepage. Stakeholders are invited to respond with comments until June 30th 2010 using the standard WENRA procedure as described on the homepage (“submit comments”-button on the menue).

Part II.

Waste and Spent Fuel Storage Safety Reference Levels

These reference levels are intended for separate, purpose built or adapted storage facilities which should incorporate passive safety features as far as reasonably practical and which will be used to store spent fuel or waste in solid form. The design base storage period involved will typically be several decades, depending on the national waste and spent fuel management strategy. In the future WGWD may consider other aspects of radioactive waste and spent fuel management.

Some reference levels apply to the owner of the waste or spent fuel (S-04, S-05, S-06, S-07, S-18, S-51).

WGWD is conscious that some of the reference levels, in particular those related to the design of facilities, may not be fulfilled by existing facilities. Implementation of these levels for existing facilities will have to be examined within the national regulatory framework.

The term nuclear safety covers in this document also the measures for radiation protection.

The reference levels apply to wide range of facilities for the storage of spent fuel and radioactive waste, for which the hazard potential may vary significantly. On the one hand, the reference levels apply to fuel stores which may require active protection systems of high reliability. On the other hand, the reference levels apply to the storage of wastes where the design of both the waste package and the store are based on the concept of passive safety.

Consideration therefore needs to be given as to whether individual reference levels are relevant in specific circumstances, and when they are relevant they need to be applied in a proportionate manner, taking account the magnitude of the hazard.

1. Safety area: Safety management

1.1. Safety issue: Responsibility

S-01: The licensee of the radioactive waste and spent fuel store is responsible for the safety of all activities in the facility, and for the implementation of programs and procedures necessary to ensure safety, including the waste or spent fuel stored. In accordance with the graded approach, the programs and procedures necessary to ensure safety shall be commensurate with the scale of the facility and the type of the inventory.

*Related **IAEA** safety standards:*

The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks. (SF-1; principle 1)

The person or organization responsible for any facility or activity that gives rise to radiation risks or for carrying out a programme of actions to reduce radiation exposure has the prime responsibility for safety.(SF-1; para 3.3)

The operator is responsible for the safety of all activities in the storage of radioactive waste and for the implementation of the programmes and procedures necessary to ensure safety. In accordance with the graded approach, the programmes and procedures necessary to ensure safety will generally be less extensive for the operator of a small facility. (WS-G-6.1, para 3.11).

S-02: To fulfil its prime responsibility for safety during the lifetime of the facility, the licensee shall establish and implement safety policies and ensure that safety issues are given the highest priority.

*Related **IAEA** safety standards:*

To fulfil its prime responsibility for safety throughout the lifetime of a fuel cycle facility, the operating organization shall establish, implement, assess and continually improve a management system that integrates safety, health, environmental, security, quality and economic elements to ensure that safety is properly taken into account in all the activities of an organization. (NS-R-5, para 4.1)

The operating organization shall establish and implement safety, health and environmental policies in accordance with national and international standards and shall ensure that these matters are given the highest priority (NS-R-5, para 4.2)

S-03: The licensee shall commit itself to maintain the safety of the facility and, as far as reasonably practicable, improve it on the basis of operating experience.

*Related **IAEA** safety standards:*

Operators shall be responsible for the safety of predisposal radioactive waste management facilities or activities.4 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.(GSR Part 5, Requirement 4)

S-04: There shall be clear and unequivocal ownership of the waste and spent fuel stored in the facility.

*Related **IAEA** safety standards:*

There should be clear and unequivocal ownership of the spent fuel stored in the facility. […] (DS 371; para 3.29)

[…] The legal framework should include provisions to ensure a clear allocation of responsibility for safety throughout the entire process of predisposal management, in particular with respect to storage, and including

any transfer between operators. The continuity of responsibility for safety should be ensured by means of authorization by the regulatory body.[…] (WS-G-6.1, para 3.2).

S-05: The waste or spent fuel owner shall be responsible for the overall strategy for the management of its waste and spent fuel, taking into account interdependencies between all stages of waste and spent fuel management and options available, from generation to disposal. The strategy shall be consistent with the overall national radioactive waste and spent fuel management strategy.

*Related **IAEA** safety standards:*

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. (GSR Part 5, Requirement 6)

Owing to the interdependences among the various steps in the predisposal management of radioactive waste, all activities from the generation of radioactive waste up to its disposal, including its processing, are to be seen as parts of a larger entity, and the management elements of each step have to be selected so as to be compatible with those of the other steps. This has to be achieved principally through governmental and regulatory requirements and approaches. It is particularly important to consider the established acceptance criteria for disposal of the waste or the criteria that are anticipated for the most probable disposal option. (GSR Part 5, para 3.21)

S-06: The interface between responsibilities of the licensee of the storage facility and the waste or spent fuel owner shall be clearly defined, agreed and documented.

*Related **IAEA** safety standards:*

The interface between the responsibilities of the operator and the spent fuel owner, if they differ, should be clearly defined, agreed and documented. (DS 371; para 3.29)

S-07: Information about changes of waste and spent fuel ownership, or about changes to the relationship between owner and licensee, shall be provided to the regulatory authority.

*Related **IAEA** safety standards:*

Information about changes of ownership of waste or about changes in the relationship between owner and licensee has to be provided to the regulatory body. (GSR Part 5, para 3.18)

1.2. Safety issue: Organizational structure

S-08: The licensee shall establish an organizational structure to enable its safety policy to be delivered with a clear definition of responsibilities and accountabilities, lines of authority and communication.

*Related **IAEA** safety standards:*

Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks. (SF-1; principle 3)

The operating organization shall establish an organizational structure to enable these policies to be carried out with a clear definition of responsibilities and accountabilities, lines of authority and communication. (NS-R-5; para 4.2).

S-09: The licensee shall maintain the capability in terms of staffing, skills, experience and knowledge to enable it to competently undertake the activities during the lifetime of the facility from siting to decommissioning. Where the resources and skills necessary to deliver any part of theses undertakings are provided by an external organization, the licensee shall

nevertheless retain within its organization the capability to assess the adequacy of the external organizations' capabilities of ensuring safety.

*Related **IAEA** safety standards:*

The operating organization shall maintain the capability in terms of staffing, skills, experience and knowledge to undertake competently all activities during the lifetime of the facility from siting to decommissioning. Where the resources and skills necessary to deliver any part of these undertakings are provided by an external organization, the operating organization shall nevertheless retain within its organization the capability to assess the adequacy of the external organizations' capabilities for ensuring safety. (NS-R-5; para 4.9).

S-10: The licensee shall specify the necessary qualifications and experiences for all staff involved in activities that may affect safety and establish training programs for developing and maintaining the professional skills of the staff.

*Related **IAEA** safety standards:*

The operating organization shall specify the necessary qualifications and experience for all staff involved in activities that may affect safety. It shall also specify appropriate requirements on training and its assessment and approval. (NS-R-5; para 4.10).

1.3. Safety issue: Management system

S-11: A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by:

- bringing together in a coherent manner all the requirements for managing the organization
- describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied
- ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible negative impact on safety.

*Related **IAEA** safety standards:*

A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by:

- *Bringing together in a coherent manner all the requirements for managing the organization;*
- *Describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied;*
- *Ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible negative impact on safety. (GS-R-3; para 2.1, also cited in GS-G-3.3, para 2.1)*

Leadership in safety matters has to be demonstrated at the highest levels in an organization. Safety has to be achieved and maintained by means of an effective management system. This system has to integrate all elements of management so that requirements for safety are established and applied coherently with other requirements, including those for human performance, quality and security, and so that safety is not compromised by other requirements or demands. The management system also has to ensure the promotion of a safety culture, the regular assessment of safety performance and the application of lessons learned from experience. (SF-1, principle 3, para 3.12)

S-12: The management system shall cover the full lifetime of a facility and the entire duration of activities in normal, transient and emergency situations. For a storage facility, these phases usually include planning, siting, design, construction, commissioning, operation and decommissioning.

*Related **IAEA** safety standards:*

This Safety Requirements publication is applicable throughout the lifetime of facilities and for the entire duration of activities in normal, transient and emergency situations. .... For a facility, these phases usually include siting, design, construction, commissioning, operation and decommissioning (or close-out or closure). (GS-R-3; para 1.11)

S-13: The processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organization shall be identified, and their development shall be planned, implemented, assessed and continually improved. The work performed in each process shall be carried out under controlled conditions, by using approved current procedures, instructions, drawings or other appropriate means that are periodically reviewed to ensure their adequacy and effectiveness.

Related IAEA safety standards:

The processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organization shall be identified, and their development shall be planned, implemented, assessed and continually improved. (GS-R-3; para. 5.1)

The work performed in each process shall be carried out under controlled conditions, by using approved current procedures, instructions, drawings or other appropriate means that are periodically reviewed to ensure their adequacy and effectiveness. (GS-R-3; para. 5.9)

S-14: The documentation of the management system shall include the following:

- the policy statements of the licensee;
- a description of the management system;
- a description of the functional responsibilities, accountabilities, levels of authority and interactions of those managing, performing and assessing work;
- a description of the interactions with relevant external organizations;
- a description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved.

*Related **IAEA** safety standards:*

The documentation of the management system shall include the following:
- The policy statements of the organization;
- A description of the management system;
- A description of the structure of the organization;
- A description of the functional responsibilities, accountabilities, levels of authority and interactions of those managing, performing and assessing work;
- A description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved. (GS-R-3; para. 2.8)

1.4. Safety issue: Record keeping

S-15: The licensee shall develop and maintain a record system on the location and characteristics of every waste and spent fuel package or unpackaged spent fuel element in storage, including information on its ownership and origin.

*Related **IAEA** safety standards:*

The operating organization should develop and maintain a records system on spent fuel data and on the storage system, which includes the radioactive inventory, location and characteristics of the spent fuel, information on ownership, origin and information about its characterization. […] (DS 371, para 3.27)

For the storage of radioactive waste, a variety of records should be compiled, managed and maintained in accordance with a management system. The scope and detail of the records will depend on the hazard associated with the facility and on the complexity of the operations and activities. (WS-G-6.1, para 4.3)

S-16: The licensee shall ensure that each waste and spent fuel package or unpackaged spent fuel element can be uniquely identified with a marking system that will last for the storage period.

*Related **IAEA** safety standards:*

[…] There should be an unequivocal identification with a marking system that will last for the storage period. These records should be preserved and updated, to enable the implementation of the spent fuel management strategy whether disposal or reprocessing. (DS 371, para 3.27)

A tracking system for waste packages should be developed and implemented. The system should provide for the identification of waste packages and their locations and an inventory of waste stored. The sophistication of the waste tracking system required (e.g. including labelling and bar coding) will depend on the number of waste packages, the anticipated duration of storage of the waste and the hazard associated with it. (WS-G-6.1, para 4.11)

S-17: The licensee shall implement an adequate system to provide up-to-date information on the radioactive inventory within the storage facility.

*Related **IAEA** safety standards:*

The operating organization should develop and maintain a records system […].These records should be preserved and updated, to enable the implementation of the spent fuel management strategy whether disposal or reprocessing. (DS 371, para 3.27)

The stored radioactive waste should be characterized (e.g. by radionuclide type, inventory, activity concentration, half-life and the physical, chemical and pathogenic properties of the waste) and the results should be documented in an inventory log. (WS-G-6.1, para 5.5)

S-18: The owner shall ensure that sufficient records are preserved and updated (taking into account in particular the condition of waste and spent fuel package or unpackaged spent fuel element during storage), to enable implementation of its strategy for the management of waste or spent fuel, including disposal.

*Related **IAEA** safety standards:*

The operating organization of a spent fuel storage facility should receive detailed information concerning the characteristics of the spent fuel received for storage. This information should be supplied by the nuclear facility (i.e. power plant or research reactor) generating spent fuel (DS 371, para 6.123)

[…] The management system should be designed to ensure […] that the quality of the records and of subsidiary information such as the marking and labelling of waste packages is preserved. […] (WS-G-6.1, para 3.21)

2. Safety area: Design

The design of the storage facility should incorporate passive safety features as far as reasonably practicable, thereby minimising the reliance on active safety system, monitoring and human intervention to ensure safety. Where it is not reasonably practicable to incorporate passive safety features in the design, then the safety function will need to be fulfilled with active safety features. The SRLs in this subsection are connected with relevant design aspects.

2.1. Safety issue: Storage facility design requirements

S-19: The storage facility shall be designed to fulfil the fundamental applicable safety functions:

- control of subcriticality,
- control of the exposure of operating personal, general public and environment,
- removal of heat,
- confinement of radioactive material,
- feasibility of handling and retrieval

during normal operation, anticipated operational occurrences and design basis accident conditions.

*Related **IAEA** safety standards:*

6.4. In general the storage facility should be designed to fulfil the main safety functions, i.e. maintaining subcriticality, removal of heat, containment of radioactive material and shielding from radiation, and in addition retrievability of the fuel […] […] (DS 371, para 6.4)

The following should be provided for in the design of storage facilities for radioactive waste for normal operations:
(a) Containment of the stored materials;
(b) Prevention of criticality (when storing fissile materials);
(c) Radiation protection (shielding and contamination control);
(d) Removal of heat (if applicable);
(e) Ventilation, as necessary;
(f) Inspection and/or monitoring of the waste packages, as necessary;
(g) Maintenance and repair of waste packages;
(h) Retrieval of the waste, whether for processing, repackaging or disposal;
(i) Inspection of waste packages and of the storage facility;
(j) Future expansion of the storage capacity, as appropriate;
(k) Transport of waste inside the storage facility to improve the flexibility of operations;
(l) Decommissioning. (WS-G-6.1, para 6.23)

The operating organization shall identify postulated initiating events that could lead to a release of radiation and/or significant amounts of radioactive material and associated chemical substances [...] (NS-R-5, para 6.8)

A design basis accident approach, or an equivalent methodology, shall be used to identify significant accident sequences. For each accident sequence identified, the safety functions, the corresponding SSCs important to safety and the administrative safety requirements that are used to implement the defence in depth concept shall be identified. (NS-R-5, para 6.9)

S-20: The design of the storage facility shall take into account the expected operational lifetime of the facility to ensure that the safety conditions, the operational limits and conditions identified in the safety case will be met.

*Related **IAEA** safety standards:*

Predisposal radioactive waste management facilities shall be located and designed so as to ensure safety for the expected operating lifetime under both normal and possible accident conditions, and for their decommissioning. (GSR Part 5, Requirement 17)

S-21: The design of the storage facility shall incorporate passive safety features as far as reasonably practicable.

*Related **IAEA** safety standards:*

[…]Due account shall be taken of the expected period of storage, and, to the extent possible, passive safety features shall be applied. For long term storage in particular, measures shall be taken to prevent degradation of the waste containment. (GSR Part 5, Requirement 11)

S-22: The licensee shall demonstrate that design and construction of the facility are based on applicable standards and appropriate materials especially taking into account the expected lifetime of the facility.

*Related **IAEA** safety standards:*

The storage system, particularly the storage cask, should be constructed of suitable materials, using appropriate design codes and standards and construction methods, to maintain shielding and containment functions under the storage and loading/unloading conditions expected during its design lifetime unless adequate maintenance and/or replacement methods during operation can be demonstrated. […] (DS 371, Appendix I.54)

The need for and the extent of commissioning activities and tests will vary depending on the size, complexity and contents of the storage facility. Commissioning involves a logical progression of tasks and tests to demonstrate the correct functioning of specific equipment and features incorporated into the design of the storage facility to provide for safe storage. The adequacy of the facility's design […] should be demonstrated and confirmed. (WS-G-6.1, para 4.17)

S-23: The radioactive waste and spent fuel storage facility shall be designed on the basis of assumed conditions for its normal operations and assumed incidents or accidents. The design basis shall be clearly and systematically defined and documented.

*Related **IAEA** safety standards:*

Predisposal radioactive waste management facilities shall be located and designed so as to ensure safety for the expected operating lifetime under both normal and possible accident conditions, and for their decommissioning. (GSR Part 5, Requirement 17)

S-24: The licensee shall identify and classify structures, systems and components important to safety (SSCs), applying a graded approach.

*Related **IAEA** safety standards:*

The safety functions, and structures, systems and components important to safety (SSCs) shall be identified in the safety analysis report to the extent appropriate and in accordance with a graded approach. The SSCs provide barriers for the prevention of the occurrences of postulated initiating events (PIEs), the control and limitation of accident sequences and mitigation of the consequences (NS-R-5; para 2.12).

S-25: The licensee shall address the ageing of SSCs and safety features of facilities for the storage of spent fuel and waste by establishing, if necessary, provisions for their maintenance,

testing and inspection. Results derived from this program shall be used to review the adequacy of the design at appropriate intervals.[2]

*Related **IAEA** safety standards:*

In the design stage, design safety margins shall be adopted so as to accommodate the anticipated properties of materials at the end of their useful life. This is particularly important for fuel cycle facilities because of the range and characteristics of chemical and radiation conditions experienced in operational states and in accident conditions. Where details of the characteristics of materials are unavailable, a suitable material surveillance programme shall be implemented by the operating organization. Results derived from this programme shall be used to review the adequacy of the design at appropriate intervals. This may require provisions in the design for the monitoring of materials whose mechanical properties may change in service owing to factors such as fatigue (e.g. from cyclic mechanical or thermal loadings), stress corrosion, erosion, chemical corrosion or the induction of changes by irradiation. (NS-R-5, para 6.17)

Before the start of operations, the operator should prepare a programme of periodic maintenance, testing and inspection of systems that are essential to safe operation. The need for maintenance, testing and inspection should be addressed from the design stage. […] Systems and components that should be considered for periodic maintenance, testing and inspection may include:
(a) Waste containment systems, including tanks and other containers;
(b) Waste handling systems, including pumps and valves;
(c) Heating and/or cooling systems;
(d) Radiation monitoring systems;
(e) Calibration of instruments;
(f) Ventilation systems;
(g) Normal and standby systems for electrical power supply;
(h) Utilities and auxiliary systems such as systems for water, gas and compressed air;
(i) The system for physical protection;
(j) Building structures and radiation shielding;
(k) Fire protection systems. (WS-G-6.1, para 6.79)

The operation of a spent fuel storage facility should include an appropriate programme of maintenance, inspection and testing of items important to safety, i.e. structures, systems and components. Safe access to all structures, systems, areas and components requiring periodic maintenance, inspection and testing should be provided. Such access should be sufficient for the safe operation of all required tools and equipment and for the installation of spares. (DS 371, para 6.108)

S-26: The licensee shall establish operational limits and conditions (OLCs) in order to maintain the storage facility and waste and spent fuel packages or unpackaged spent fuel elements in a safe state during facility operation.

*Related **IAEA** safety standards:*

[…] All operations and activities important to safety have to be subject to documented limits, conditions and controls, and have to be carried out by trained, qualified and competent personnel. (GSR Part 5, para 5.19)

The OLCs are the set of rules that establish parameter limits, the functional capability and the performance levels of equipment and personnel for the safe operation of a facility. (NS-R-5, para 2.13)

Operational limits and conditions shall be prepared before operation of the facility commences. (NS-R-5, para 9.21)

S-27: The defined OLCs (see S-26) shall consider, in particular, and as appropriate:
- environmental conditions within the store (e. g. temperature, humidity, contaminants…);

[2] This may require design provisions to monitor materials whose mechanical properties may change in service owing to such factors as fatigue (cyclic mechanical or thermal loadings), stress corrosion, erosion, chemical corrosion or radiation induced changes.)

- the effects of heat generation from waste or spent fuel, covering both each individual waste and spent fuel packages or unpackaged spent fuel elements as well as the whole store;
- potential aspects of gas generation from waste or spent fuel, in particular the hazards of fire ignition, explosion, waste and spent fuel package or unpackaged spent fuel element deformations and radiation protection aspects;
- criticality prevention, covering both each individual waste and spent fuel packages or unpackaged spent fuel elements as well as the whole store (including operational occurrences and accidental conditions);
- suitability for handling and retrieval.

*Related **IAEA** safety standards:*
Operational limits and conditions for a spent fuel storage facility should be developed on the basis of the following:

a. Design specifications and operating parameters and the results of commissioning tests;
b. The sensitivity of items important to safety and the consequences of events following the failure of items, the occurrence of specific events or variations in operating parameters;
c. *The accuracy and calibration of instrumentation equipment for measuring safety related operating parameters;[…](DS 371, para 6.102)*

Operational limits and conditions form an important part of the basis on which operation is authorized and as such should be incorporated into the technical and administrative arrangements that are binding on the operating organization and operating personnel. Operational limits and conditions for spent fuel storage facilities, which result from the need to meet legal and regulatory requirements, should be developed by the operating organization and subject to approval by the regulatory body as part of the licence conditions.[….] (DS 371, para 6.103)

While all operations can be directly or indirectly related to some aspect of safety, the aim of operational limits and conditions should be to manage and control the basic safety hazard in the facility and they should be directed toward:
(a) Preventing situations which might lead to unplanned exposure of people (workers and the public) to radiation; and
(b) Mitigating the consequences of such events should they occur. (DS 371, para 6.104)

Gas generation by radiolysis or chemical reaction may be associated with the storage of radioactive waste. The concentration of gases in air shall be kept below hazardous levels to avoid, for example, explosive gas/air mixtures. (WS-R-2 5.26)

If necessitated by the nature of the radioactive waste, dissipation of heat from the waste shall be ensured and criticality shall be prevented. (WS-R-2; para 5.28)

S-28: The design of the facility shall take into account all relevant postulated initiating events (PIEs), depending on the storage characteristics. A list of potential PIE is provided in the appendix.

*Related **IAEA** safety standards:*

The operating organization shall identify postulated initiating events that could lead to a release of radiation and/or significant amounts of radioactive material and associated chemical substances. [...] The set of postulated initiating events shall include both internally and externally initiated events (NS-R-5, para 6.8).

The postulated initiating events that may influence the design of the spent fuel storage facility and the integrity and safety of the spent fuel should be identified […]. (DS 371, para 5.19)

In addition to radiological hazards, external hazards (e.g. fire or explosion), which may contribute to radiologically significant consequences, should also be considered in the design of storage facilities for radioactive waste. (WS-G-6.1, para 6.25)

S-29: The criticality safety shall be achieved by design as far as practicable. If burnup credit is adopted, compliance with the limiting burnup level shall be verified by administrative and operational controls.

*Related **IAEA** safety standards:*

As far as reasonably practicable, criticality hazard shall be controlled by means of design. (NS-R-5, para 6.43)

Approval to consider burnup credit in the safety assessment should be granted only if based on design engineered safety features and operational controls. Operational controls provide defence in depth and contribute to maintaining subcritical conditions. The minimum required burnup value should be verified by independent measurement. (DS 371, Appendix II, para II.8)

S-30: The licensee shall make design arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation of a fire).

*Related **IAEA** safety standards:*

The operating organization shall make design provisions for fire safety on the basis of a fire safety analysis and the implementation of the concept of defence in depth (i.e. for prevention, detection, control and mitigation). (NS-R-5, para 6.55).

2.2. Safety issue: Handling and retrieval requirements

S-31: The handling equipment shall be designed particularly to take account of radiation protection aspects, ease of maintenance and minimization of the probability and consequences of associated incidents and accidents.

*Related **IAEA** safety standards:*

Handling equipment should be designed to minimize the probability and consequence of incidents and accidents, and to minimize the potential for damaging spent fuel, spent fuel assemblies, and storage or transport casks. […] (DS 371, para 6.49)

Waste handling equipment should be designed to include provision for the following:
(a) Safe operation under all anticipated conditions;
(b) Avoiding damage to the waste package;
(c) Safe handling of defective or damaged waste packages;
(d) Minimizing contamination of the equipment itself;
(e) Avoiding the spread of contamination. (WS-G-6.1, para 6.32)

S-32: The storage facility shall be designed in such a way that any waste or spent fuel package or unpackaged spent fuel can be retrieved within an appropriate time, at the end of the facility operation or in order to intervene in the event of unexpected faults.

*Related **IAEA** safety standards:*

Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management. […] (GSR Part 5, Requirement 11)

S-33: The storage facility shall be designed so that waste and spent fuel packages or unpackaged spent fuel elements can be inspected to verify their continued integrity.

*Related **IAEA** safety standards:*

Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management. […] (GSR Part 5, Requirement 11)

Provision has to be made for the regular monitoring, inspection and maintenance of the waste and of the storage facility to ensure their continued integrity. […](GSR Part 5 para 4.22)

2.3. Safety issue: Storage capacity

S-34: The licensee shall ensure that reserve storage capacity is included in the design or is otherwise available to allow for inspection, retrieval, maintenance or remedial work.

*Related **IAEA** safety standards:*

Design aspects associated with the layout of a spent fuel storage facility are set out in the following:: [...]
(g) Space should be provided to permit the inspection of spent fuel and inspection and maintenance of components, including spent fuel handling equipment; [...] (DS 371, para 6.47)

The facility should have a reserve storage capacity, which should be included in the design or should be otherwise available, e.g. to allow for reshuffling of spent fuel casks or unpackaged spent fuel elements for inspection, retrieval or maintenance work. The reserve capacity should be such that the largest type of storage cask can be unloaded or, in the case of a modular storage facility, that at least one module can be unloaded. (DS 371, para 6.15)

There should be reserve storage capacity available to accommodate waste arising in various situations. Such situations may include abnormal conditions (e.g. the need to empty a leaking tank) or periods when modifications or refurbishments are being undertaken. (WS-G-6.1, para 6.58)

3. Safety Area: Operation

3.1. Safety issue: Conduct of Operation

S-35: The storage facility shall be operated so that in accordance with the inspection program as defined in S-48 waste and spent fuel packages or unpackaged spent fuel elements can be inspected.

*Related **IAEA** safety standards:*

Waste shall be stored in such a manner that it can be inspected, monitored, retrieved and preserved in a condition suitable for its subsequent management. […] (GSR Part 5, Requirement 11)

S-36: The licensee shall ensure that the reserve storage capacity will stay available for retrieved waste and spent fuel packages or unpackaged spent fuel elements.

*Related **IAEA** safety standards:*

The facility should have a reserve storage capacity, which should be included in the design or should be otherwise available, e.g. to allow for reshuffling of spent fuel casks or unpackaged spent fuel elements for inspection, retrieval or maintenance work. The reserve capacity should be such that the largest type of storage cask can be unloaded or, in the case of a modular storage facility, that at least one module can be unloaded. (DS 371, para 6.15)

There should be reserve storage capacity available to accommodate waste arising in various situations. Such situations may include abnormal conditions (e.g. the need to empty a leaking tank) or periods when modifications or refurbishments are being undertaken. (WS-G-6.1, para 6.58)

3.2. Safety issue: Emergency Preparedness

If for the set of design basis accidents as consequence from the safety case events requiring protective measures cannot be excluded, planned emergency arrangements will be required. These emergency plans should be proportionate taking account of the magnitude of the accident consequence. For some facilities (such as with low radioactive inventory) an off-site emergency plan may not be required, which must be justified and the off-site aspects of this safety issue will not apply.

S-37: Based upon an assessment of reasonably foreseeable events and situations that may require protective measures the licensee shall provide arrangements for responding effectively to events requiring protective measures at the scene for:

(a) regaining control of any emergency arising at the site, including events related to combinations of non-nuclear and nuclear hazards;

(b) preventing or mitigating the consequences at the scene of any such emergency and

(c) co-operating with external emergency response organizations in preventing adverse health effects in workers and the public.

*Related **IAEA** safety standards:*

Arrangements must be made for emergency preparedness and response for nuclear or radiation incidents. (SF-1, Principle 9)

The primary goals of preparedness and response for a nuclear or radiation emergency are:

- *To ensure that arrangements are in place for an effective response at the scene and, as appropriate, at the local, regional, national and international levels, to a nuclear or radiation emergency;*

- *To ensure that, for reasonably foreseeable incidents, radiation risks would be minor;*
- *For any incidents that do occur, to take practical measures to mitigate any consequences for human life and health and the environment. (SF-1; para 3.34)*

Emergency preparedness and response arrangements commensurate with the threat category of the facility, […], should be developed and implemented. (WS-G-6.1, para 5.14)

The operator should draw up emergency plans based on the potential radiological impacts or accidents and be prepared to respond to accidents at all times as indicated in the emergency plans. (DS 371, para 3.28)

The potential radiological impacts of accidents should be assessed by the operating organization and reviewed by the regulatory body [21]. Provision should be made to ensure that there is an effective capability to respond to accidents. Considerations should include the development of scenarios of anticipated sequences of events (see Section 5) and the establishment of emergency procedures and emergency plan to deal with each of the scenarios, including checklists and lists of persons and organizations to be alerted. (DS 371, para 6.73)

S-38: The licensee shall

- prepare an on-site emergency plan as basis for preparation and conduct of emergency measures (An example for the contents of such emergency plan is given in app. 2),
- establish the necessary organizational structure for clear allocation of responsibilities, authorities and arrangements for coordinating facility activities and cooperating with external response agencies throughout all phases of an emergency and
- ensure, that based on the on-site emergency plan trained and qualified personnel, facilities and equipment need to control an emergency are appropriate, reliable and available at the time.

*Related **IAEA** safety standards:*

The operating organization, taking into account the potential hazards of the facility, shall develop an emergency plan in coordination with other bodies having responsibilities in an emergency, including public authorities; shall establish the necessary organizational structure; and shall assign responsibilities for managing emergency response. (NS-R-5; para 9.62).

Emergency response procedures should be documented, made available to the personnel concerned and kept up to date. Exercises should be held periodically to test the emergency response plan and the degree of preparedness of the personnel. Inspections should be performed regularly to ascertain whether the equipment and other resources needed in the event of an emergency are available and in working order. (DS 371, para 6.74)

In addition to providing operating procedures and contingency procedures as described above, the operating organization should also develop an emergency plan […] (DS 371, para 6.99)

The appropriate responsible authorities shall ensure that:
(a) emergency plans [are] prepared and approved for any practice or source which could give rise to a need for emergency intervention;
(b) [response organizations are] involved in the preparation of emergency plans, as appropriate;
(c) the content, features and extent of emergency plans take into account the results of any [threat assessment] and any lessons learned from operating experience and from [emergencies] that have occurred with sources of a similar type […];
(d) emergency plans [are] periodically reviewed and updated." […] (GS-R-2, para 5.17)

Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation (such as procedures, checklists, telephone numbers and manuals) shall be provided for performing the functions specified in Section 478. These items and facilities shall be selected or designed to be operational under the postulated conditions (such as the radiological, working and environmental conditions) that may be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (such as the communication frequencies of other response organizations), as appropriate. These support items shall be located or provided in a manner that allows their effective use under postulated emergency conditions.
(GS-R-2, para 5.25)

The operator and the response organizations shall identify the knowledge, skills and abilities necessary to be able to perform the functions specified [...]. The operator and the response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel have the requisite knowledge, skills, abilities, equipment, and procedures and other arrangements to perform their assigned response functions. The arrangements shall include ongoing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities for emergency response undergo the specified training. (GS-R-2, para 5.31)

S-39: The emergency plan shall be submitted to the regulatory body. At regular intervals there shall be emergency exercises, some of which shall be witnessed by the regulatory body. Some of these exercises shall be integrated and shall include the participation of all organizations concerned. The plan shall be subject to review and updating in light of the experience gained.

*Related **IAEA** safety standards:*

In developing the emergency response arrangements, consideration has to be given to all reasonably foreseeable events. Emergency plans have to be exercised periodically to ensure the preparedness of the organizations having responsibilities in emergency response. (SF-1; para 3.37)

The emergency plan shall be approved by the regulatory body as appropriate and shall be tested in an exercise before radioactive material is introduced into the facility. There shall thereafter be exercises of the emergency plan at suitable intervals, some of which shall be observed by the regulatory body. Some of these exercises shall be integrated with local, regional and national response organizations, as appropriate, and shall involve the participation of as many as possible of the organizations concerned. The plans shall be subject to review and to updating in the light of the experience gained. (NS-R-5; para 9.66)

3.3. Safety issue: Operational Experience Feedback

S-40: The licensee shall establish and conduct an Operating Experience Feedback (OEF) program to collect, screen, analyze and document operating experience and events at the facility in a systematic way. Relevant operational experience and events reported by other facilities shall also be considered as appropriate.

*Related **IAEA** safety standards:*

Despite all measures taken, accidents may occur. The precursors to accidents have to be identified and analysed, and measures have to be taken to prevent the recurrence of accidents. The feedback of operating experience from facilities and activities - and, where relevant, from elsewhere - is a key means of enhancing safety. Processes must be put in place for the feedback and analysis of operating experience, including initiating events, accident precursors, near misses, accidents and unauthorized acts, so that lessons may be learned, shared and acted upon. (SF-1; para 3.17)

Adequate arrangements should be made for the review and approval of operating procedures, the systematic evaluation of operating experience, including that of other facilities, and the taking of corrective actions in a timely and appropriate manner to prevent and counteract developments adverse to safety. Provision should be made for controlling the distribution of operating procedures, in order to guarantee that operating personnel have access to only the latest approved edition. (DS 371, para 6.91)

In the generation and storage of waste, as well as subsequent management steps, a safety culture should be fostered and maintained to encourage a questioning and learning attitude to protection and safety and to discourage complacency. (WS-G-6.1, para 2.6)

S-41: The licensee shall ensure that results are obtained, that conclusions are drawn, measures are taken, good practices are considered and that timely and appropriate corrective actions are implemented to prevent recurrence and to counteract developments adverse to safety.

*Related **IAEA** safety standards:*

All organizations involved in the process of operational experience feedback should screen information on events, taking into account their own needs. Operating organizations should have the objective of enhancing safety, plant availability and commercial performance by identifying the causes of events so as to be able to avoid their recurrence, and by evaluating the applicability of good practices used by others. [...]
(NS-G-2.11, para 3.3)

Operating experience and events at the facility and reported by similar facilities should be collected, screened and analysed in a systematic way. Conclusions should be drawn and implemented by means of an appropriate feedback procedure [….]. (DS 371, para 6.100, see also para 6.91)

3.4. Safety issue: Operation facility modification

S-42: Modifications of design, equipment, storage conditions, waste or spent fuel characteristics, control or management, especially changes of SSCs, OLCs or operational procedures in a spent fuel or radioactive storage shall be subject to planning, assessment, review and authorization processes commensurate to the importance to safety of the modification. These processes shall ensure that the modifications will not impact adversely the safety of the facility or associated facilities or the further management of spent fuel or waste.

*Related **IAEA** safety standards:*

The operating organization shall establish a process whereby its proposals for changes in design, equipment, feed material characteristics, control or management are subject to a degree of assessment and scrutiny appropriate to the safety significance of the change, so that the direct and wider consequences of the modification are adequately assessed. The process shall include a review of possible consequences to ensure that a foreseen modification or change in one facility will not adversely affect the operability or safety of associated or adjacent facilities (NS-R-5; para 9.35)

S-43: Before introducing a modification according to S-42, personnel shall, as approporiate, have been trained according to the new operating procedures and all relevant documents necessary for facility operation shall have been updated.

*Related **IAEA** safety standards:*

[…] Provisions should be made for implementing a controlled distribution of operational procedures, in order to guarantee that operating personnel have only the last approved edition. (DS 371, para 6.91)

In accordance with the management system, arrangements should be in place for the review and approval of operating procedures and for the communication to operating personnel of any revisions. Periodic reviews should be undertaken to take account of operational experience. Any revisions should be adopted only after they have been reviewed to ensure compliance with operational limits and conditions, approved by authorized persons and documented. (WS-G-6.1, Para 6.75)

The operating organization should ensure that the appropriate revisions to plant procedures, personnel training and plant simulators necessitated by the modifications are implemented in a complete, correct and timely manner as part of the implementation process.(NS-G-2.3 para 3.9)

3.5. Safety issue: Maintenance, periodic testing and inspection

S-44: A maintenance, periodic testing and inspection program shall be conducted according to written procedures in order to ensure that SSCs are able to function in accordance with the design intents and safety requirements.

*Related **IAEA** safety standards:*

Maintenance, calibration, periodic testing and inspection shall be performed to ensure that SSCs are able to function in accordance with the design intent and with safety requirements. In this context, the term maintenance

includes both preventive and corrective actions. Maintenance, calibration and periodic testing shall also be carried out on the equipment necessary for implementation of the on-site emergency plan (NS-R-5; para 9.28).

S-45: The extent of the program for maintenance, periodic testing or inspection of SSCs shall be in accordance with the facility safety case.

*Related **IAEA** safety standards:*

The frequency for maintenance, calibration, periodic testing and inspection of SSCs shall be in accordance with the facility licensing documentation. (NS-R-5; para 9.30).

S-46: The result of maintenance, periodic testing and inspection shall be recorded and assessed.

*Related **IAEA** safety standards:*

The results of maintenance, testing and inspection shall be recorded and assessed (NS-R-5; para 9.32).

S-47: The maintenance, periodic testing and inspection programs shall be reviewed at regular intervals to incorporate the lessons learned from experience.

*Related **IAEA** safety standards:*

The maintenance, calibration, periodic testing and inspection programmes shall be reviewed at regular intervals to incorporate the lessons learned from experience (NS-R-5; para 9.33).

S-48: The licensee shall develop an inspection program for the verification of the continuing compliance of waste and spent fuel packages or unpackaged spent fuel stored with the limits specified in the safety case to ensure continued functionality of safety features on which safety case is based. This program shall address:
- the required environmental conditions within the storage facility,
- the state of waste and spent fuel packages or unpackaged spent fuel elements.

*Related **IAEA** safety standards:*

[…] Safety related operating instructions shall be prepared before operations commence. Operating instructions shall clearly describe the methods of operating, including all checks, tests, calibrations and inspections necessary to ensure compliance with the operational limits and conditions […]. (NS-R-5, para 9.22)

The integrity of stored spent fuel should be monitored in the operation of a spent fuel storage facility. [….] (DS 371, para 6.101)

3.6. Safety issue: Specific contingency plans

S-49: The licensee's procedures for the receipt of waste and spent fuel packages or unpackaged spent fuel elements shall contain provisions to deal safely with those that fail to meet the acceptance criteria, e. g. returning to the owner, taking remedial actions.

*Related **IAEA** safety standards:*

Acceptance criteria should be developed for the spent fuel storage facility and the spent fuel, taking into account all relevant operational limits and conditions and the future reprocessing or disposal requirements, including retrieval. Before spent fuel is transferred to the storage facility, acceptance must be given by the operator and the respective legal authority. Contingency plans should be available on how to deal safely with spent fuel that does not comply with acceptance criteria. (DS 371, para 6.118)

The operators' procedures for the reception of waste have to contain provisions for safely managing waste that fails to meet the acceptance criteria; for example, by taking remedial actions or by returning the waste. (GSR Part 5, para 4.26)

S-50: The licensee shall have plans and establish appropriate contingency arrangements for waste and spent fuel packages or unpackaged spent fuel elements that are not retrievable by normal means or show signs of degradation.

*Related **IAEA** safety standards:*

Spent fuel assemblies that have become damaged as a result of mechanical events, should be kept separate from intact fuel and provided with appropriate monitoring to detect any outer containment failure. Consideration should be given to contingency arrangements on how to deal with spent fuel that is not retrievable by normal means or that cannot be transported easily. (DS 371, para 6.131)

Procedures should be developed for the safe operation of a large waste storage facility. The extent and the degree of detail of specific procedures should be commensurate with the safety significance of the particular subject of the procedures and should cover, where applicable: [...]

(i) Contingency and emergency arrangements; [...] (WS-G-6.1, para 6.3)

3.7. Safety issue: Requirements for acceptance of waste and spent fuel packages and unpackaged spent fuel elements

S-51: The owner is responsible for ensuring that the waste and spent fuel packages and unpackaged spent fuel elements fulfil all relevant requirements such as:

- compatibility with handling, transport and storage requirements, including suitability for retrieval and transport after the anticipated storage period;
- known or likely requirements for subsequent disposal or other management aspects included in the owner's waste and spent fuel management strategy, such as the need for further treatment or conditioning of the waste or spent fuel.

*Related **IAEA** safety standards:*

[…]It is necessary that those persons responsible for a particular step in the predisposal management of radioactive waste, or for an operation in which waste is generated, adequately recognize these interactions and relationships so that the safety and the effectiveness of the predisposal management of radioactive waste may be considered in an integrated manner. This includes taking into account the identification of waste streams, the characterization of waste, and the implications of transporting and disposing of waste. There are two issues in particular to be addressed: compatibility (i.e. taking actions that facilitate other steps and avoiding taking decisions in one step that detrimentally affect the options available in another step) and optimization (i.e. assessing the overall options for waste management with all the interdependences taken into account). […] (GSR Part 5, para 3.22)

S-52: The licensee shall establish acceptance criteria for its storage facility.

*Related **IAEA** safety standards:*

Waste packages and unpackaged waste that are accepted for processing, storage and/or disposal shall conform to criteria that are consistent with the safety case. (GSR Part 5, Requirement 12)

The responsibilities of the operator of a large storage facility for radioactive waste would typically include: [...] (d) Developing and applying acceptance criteria for the storage of radioactive waste; [...] (WS-G-6.1, para 3.12)

The responsibilities of the operating organization of a spent fuel storage facility would typically include: [...] (d) Developing and applying acceptance criteria for the storage of spent fuel as approved by the regulatory body; [...] (DS 371, para 3.17)

S-53: These acceptance criteria shall take into account storage conditions and shall ensure compatibility with the safety case of the storage facility, and shall ensure suitability for handling and retrieval.

*Related **IAEA** safety standards:*

Waste acceptance criteria have to be developed that specify the radiological, mechanical, physical, chemical and biological characteristics of waste packages and unpackaged waste that are to be processed, stored or disposed of; for example, their radionuclide content or activity limits, their heat output and the properties of the waste form and packaging. (GSR Part 5, para 4.24)

Waste acceptance criteria should be developed for the storage facility, with account taken of all relevant operational limits and future requirements for disposal, if the latter are known. (WS-G-6.1, para 6.6)

Acceptance criteria should be developed for the spent fuel storage facility and the spent fuel, with account taken of all relevant operational limits and conditions and future demands for reprocessing or disposal, including retrieval of the spent fuel. (DS 371, para 6.1118)

S-54: The licensee shall make sure that appropriate processes are set up and implemented, involving auditing, inspection and testing, to ensure that waste and spent fuel packages or unpackaged spent fuel elements meet the acceptance criteria for storage.

*Related **IAEA** safety standards:*

Upon receipt, waste packages should be checked for leakage and surface contamination and to ensure that they are consistent with the documentation. Waste characterization, process control and process monitoring should be applied within a formal management system. (WS-G-6.1 para 6.9)

Upon receipt, spent fuel casks should be checked for gamma and neutron radiation levels, leakage, surface contamination and to ensure that they are consistent with the documentation. Characterization of the spent fuel including process control and process monitoring, should be applied within a formal management system. (DS 371, para 6.120)

4. Safety area: Safety verification

4.1. Safety issue: Contents and updating of the safety case

S-55: The licensee shall provide a safety case and use it as a basis for continuous support of safe operation throughout the lifetime of a facility.

*Related **IAEA** safety standards:*

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. (GSR Part 5, Requirement 13)

S-56: The licensee shall use the safety case also as a basis for assessing the safety implications of changes to the facility or to operating practices.

*Related **IAEA** safety standards:*

[…] 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. (GSR Part 5, Requirement 13)

S-57: The safety case shall cover both the facility itself and the waste and spent fuel packages or unpackaged spent fuel elements and their respective safety-relevant features. The safety case shall include a description of how all the safety aspects of the site, the design, construction and operation, as well as provisions for decommissioning of the facility, and the managerial controls satisfy the regulatory requirements (for a typical list of contents see Annex 3).

*Related **IAEA** safety standards:*

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. (GSR Part 5, Requirement 14)

S-58: The licensee shall update the safety case to reflect
- modifications and new regulatory requirements and relevant standards;
- results of the periodic safety review;
- results from analyzis of incidents

as soon as practicable and in accordance with safety relevance of the modification after the new information is available and applicable.

*Related **IAEA** safety standards:*

The operator shall carry out periodic safety reviews and shall implement any safety upgrades required by the regulatory body following this review. The results of the periodic safety review shall be reflected in the updated version of the safety case for the facility. (GSR part 5 Requirement 16, also Requirement 13, see S-55)

The licensing documentation shall be maintained and updated during the operational lifetime of the facility on the basis of the experience and knowledge gained and in accordance with the regulatory requirements, with account taken of modifications to the facility (NS-R-5; para 2.15).

The safety case and supporting safety assessments including their implementing management systems should be periodically reviewed in accordance with regulatory requirements. The review of management systems should include aspects of safety culture. In addition, they should be reviewed and updated:

(a) When there is any significant change to the installation or radionuclide inventory that affects safety;
(b) When changes occur in the site characteristics that may impact on the storage facility, e.g. industrial development, nearby population;
(c) When significant changes in knowledge and understanding occur (such as from research data or operational experience feedback);
(d) When there is an emerging safety issue due to a regulatory concern or an incident; and
(e) Periodically at predefined periods as specified by the regulatory body. Some Member States specify not less than once in ten years.

Safety should be reassessed in the case of significant, unexpected deviations in the storage conditions, e.g. if safety relevant spent fuel properties change and begin to deviate from those taken as a basis in the safety assessment. (DS 371, para 5.27)

4.2. Safety issue: Periodic safety review

S-59: The licensee shall carry out at regular intervals a review of the safety of the facility (PSR). The review shall be made periodically, at a frequency which shall be established by the national regulatory framework (e. g. every ten years).

*Related **IAEA** safety standards:*

The process of safety assessment for facilities and activities is repeated in whole or in part as necessary later in the conduct of operations in order to take into account changed circumstances (such as the application of new standards or scientific and technological developments), the feedback of operating experience, modifications and the effects of ageing. For operations that continue over long periods of time, assessments are reviewed and repeated as necessary. Continuation of such operations is subject to these reassessments demonstrating to the satisfaction of the regulatory body that the safety measures remain adequate. (SF-1; para 3.16)

The safety assessment and the management systems within which it is conducted have to be periodically reviewed at predefined intervals in accordance with regulatory requirements.[…] (GSR Part 5 para5.12)

S-60: The scope and methodology of the PSR shall be clearly defined and justified. The PSR shall confirm the compliance with the licensing requirements. It shall also identify and evaluate the safety significance of differences from applicable current safety standards and good practices and take into account the cumulative effects of changes to procedures, modifications to the facility and the operating organization, technical developments, operational experience accumulated and ageing of SSCs. It shall include consideration of the acceptance criteria for waste and spent fuel packages and unpackaged spent fuel elements and any deviation from these criteria during storage.

*Related **IAEA** safety standards:*

See also S-59

In accordance with the national regulatory requirements, the operating organization shall carry out periodic safety reviews to confirm that the licensing documentation remains valid and that modifications made to the facility, as well as changes in its operating arrangements or utilization have been accurately reflected in the licensing documentation. In conducting these reviews, the operating organization shall expressly consider the cumulative effects of changes to procedures, modifications to the facility and the operating organization, technical developments, operating experience and ageing. (NS-R-5; para 4.26)

S-61: The results of the PSR shall be documented. All reasonably practicable improvement measures shall be subject to an action plan.

Related IAEA safety standards:

Protection must be optimized to provide the highest level of safety that can reasonably be achieved. (SF-1; Principle 5)

Central to the management and verification of safety is the ability of an organization to establish effective review and improvement as an ongoing process. To establish this process, the operating organization shall periodically conduct a review of the facility's operational and safety performance to identify, investigate and correct adverse trends that may have an impact on safety. Such a process shall also cover safety culture, and the improvement of attitudes and the operating environment for safe operation. (NS-R-5 para 9.70)

The results of the reviews and the PSR reports should be recorded in a systematic and auditable manner. (DS 426, para 8.10)

Appendix 1: Postulated initiating events

External postulated events

Natural phenomena

- Extreme weather conditions (precipitation: rain, snow, ice, hail, wind, lightning, high or low temperature, humidity);
- flooding
- earthquake
- natural fires
- effect of terrestrial and aquatic flora and fauna (blockage of inlet and outlets, damages on structure)

Human induced phenomena

- fire, explosion or release of corrosive/hazardous substance (from surrounding industrial and military installations or transport infrastructure);
- aircraft crash (accidents);
- missiles due to structural/mechanical failure in surrounding installations;
- flooding (failure of a dam, blockage of a river);
- power supply and potential loss of power;
- civil strife (infrastructure failure, strikes and blockages);

Internal postulated events

- loss of energy and fluids: electrical power supplies, air and pressurised air, vacuum, super heated water and steam, coolant, chemical reagents and ventilation;
- improper use of electricity and chemicals;
- mechanical failure including drop loads, rupture (pressure retaining vessels or pipes), leaks (corrosion), plugging;
- instrumentation and control, human failures;
- internal fires and explosions (gas generation, process hazards);
- flooding, vessel overflows;

*Related **IAEA** safety standards:*

External postulated initiating events

Natural phenomena

- *Extreme weather conditions:*

Precipitation including rain, hail snow, ice, frazil ice, wind including tornadoes, hurricanes, cyclones, dust or sand storms, lightning, extreme high or low temperature, extreme humidity;

- *Flooding,*
- *Earthquakes and eruption of volcanoes*
- *Natural fires*

- *Effects of terrestrial and aquatic flora and fauna (leading to blockages of inlets and outlets, anddamage to structures)*

Human induced phenomena

- *Fires, explosions or releases of corrosive/hazardous substances*
- *(from surrounding industrial and military installations or transport infrastructure)*
- *Aircraft crashes*
- *Missile strikes(arising from structural/mechanical failure in surrounding installations);*
- *Flooding (e. g. failure of a dam, blockage of a river);*
- *Los of power supply*
- *Civil strife (leading to infrastructure failure, strikes and blockages).*

Internal postulated events

- *Loss of energy and fluids (loss of electrical power supplies, air and compressed air, vacuum, super heated water and steam, coolant, chemical reagents, and ventilation;*
- *Failures in use of electricity or chemicals;*
- *Mechanical failure including drop loads, rupture (pressure retaining vessels or pipes), leaks (due to corrosion), plugging;*
- *Failure of and human error with instrumentation and control systems;*
- *Internal fires and explosions (due to gas generation and, process hazards);*
- *Flooding(e. g. vessel overflows).*

(selected from NS-R-5, Annex 1)

Appendix 2: Contents of the On-Site Emergency Plan

The emergency plan of the licensee shall provide for arrangements to address the following:

Emergency preparedness

(1.) The requirements for personnel training;
(2.) the list of potential accidents, including combinations of nuclear and non-nuclear hazards as necessary. If relevant, the description of possible severe accidents and their consequences;
(3.) the conditions and criteria under which an emergency shall be declared, and a description of suitable means for alerting response personnel and the public authorities;
(4.) an inventory of the emergency equipment to be kept in readiness at specified locations;

Personal and organizational responsibilities and provisions

(1.) The designation of persons who will be responsible for directing on-site activities and for ensuring liaison with off-site organizations;
(2.) a list of job titles and/or functions of persons empowered to declare it;
(3.) the chain of command and communication, including a description of related facilities and procedures; there shall be a means of informing all persons on the site of the actions to be taken in the event of an emergency;
(4.) the actions to be taken by persons and organizations involved in the implementation of the plan;
(5.) provisions for declaring the termination of an emergency.;

Assessment of impacts of incidents

(1.) The arrangements for assessment of the radiological conditions on and off the site (water, vegetation, soil, air sampling);
(2.) assessment of the state of the facility;

Mitigation of adverse consequences

(1.) Provisions for minimizing the exposure of persons to ionising radiation and for ensuring medical treatment of casualties;
(2.) the actions to be taken on the site to limit the extent of radioactive release and spread of contamination;

*Related **IAEA** safety standards:*

The emergency plan of the operating organization shall include:
(a) The designation of persons who will be responsible for directing on-site activities and for ensuring liaison with off-site organizations;
(b) The requirements for personnel training;
(c) A listing of possible accidents and, if relevant, descriptions of the accidents and their foreseeable consequences;
(d) The conditions under which, and criteria according to which an emergency shall be declared, a list of job titles and/or functions of the persons empowered to declare an emergency, and a description of suitable means for alerting response personnel and public authorities;
(e) The arrangements for assessment of radiological conditions on and off the site (for water, vegetation and soil and by air sampling);
(f) Provisions for minimizing the exposure of persons to radiation and for ensuring the medical treatment of casualties;
(g) Assessment of the state of the facility and the actions to be taken on the site to limit the extent of radioactive releases and the spread of contamination;

(h) The chain of command and communication, including a description of related facilities and procedures;
(i) An inventory of the emergency equipment to be kept in readiness at specified locations;
(j) The actions to be taken by persons and organizations involved in the implementation of the emergency plan;
(k) Provisions for declaring the termination of an emergency. (NS-R-5; para 9.63).

Appendix 3: Typical Contents of a Safety Case

The preparation of a safety case including the supporting safety assessment is a step by step development. The safety case is progressively developed and refined as the storage facility project proceeds. The proposed content of the safety case takes into account the scope of this document (see chapter 1.3) and therefore does not specifically address items such as EIA, physical protection incl. safeguards, etc.
The detailed structure and format of the safety case depends on the requirements of national regulatory systems and may be different country by country.
The safety case shall as appropriate among others:

describe the site characteristics, storage facility layout, design basis and safety functions of the facility and contain a list of safety relevant SSCs to demonstrate how safety is achieved throughout the anticipated storage period;

Related IAEA safety standards:

A facility specific safety case and supporting assessment should generally include aspects such as:
(a) A description of the site and facility (including the maximum expected inventory of spent fuel and its acceptance criteria, the storage facility and its characteristics, structures, systems and components, including the characteristics of items important to the safety of the spent fuel storage facility, in accordance with the requirements of its licence) and a specification of applicable regulations and guidance;
…. (DS 371, para. 5.22)

The content of a safety case for a facility may vary between Member States but the components of the safety case for a predisposal waste management facility or activity should include:
…
Descriptions of the facilities and the site. These descriptions should be based on traceable information and should identify the features of the facilities and the site. They should be at a level of detail that is sufficient to inform an assessment of the processes and events that might affect the performance of the facilities.
… (DS 284, para. 4.4)

describe handling and storage activities and any other type of operations to be performed in the storage facility;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
…
(b) A description of spent fuel handling and storage activities and any other operations at the facility; (DS 371, para. 5.22)

describe the expected amount and characteristics of waste or spent fuel packages or unpackaged spent fuel elements to be stored;

*Related **IAEA** safety standards:*

(DS 371, para. 5.22)

The content of a safety case for a facility may vary between Member States but the components of the safety case for a predisposal waste management facility or activity should include:
• A description of the waste, a discussion of possible the options for management of the waste, and the rationale for the chosen / proposed waste management options....(DS 284, para. 4.4)

contain information on and justify the predicted lifetime of the storage facility;

*Related **IAEA** safety standards:*

... Due account shall be taken of the expected period of storage, ... (GSR Part 5, Requirement 11)

The safety case will have to justify the expected lifetime of the facility. The expected lifetime of the facility needs to be sufficient for the activity being undertaken. (DS 284, para. 6.43)

- include assessment of the safety of normal operation and during possible accident conditions in response to postulated initiating events and provide clear evidence of compliance with safety criteria and radiological limits (safety assessment);

*Related **IAEA** safety standards:*

facility specific safety case and supporting assessment should generally include aspects such as:
....
(g) Documentation of safety analyses and the safety assessment for inclusion in the documentation supporting the licensing of the facility;
....
The expected values for subcriticality, heat removal capacity and calculated radiation doses inside and at the boundary of the spent fuel storage facility;(DS 371, para. 5.22)

The content of a safety case for a facility may vary between Member States but the components of the safety case for a predisposal waste management facility or activity should include:
...
A safety assessment that provides assurance to the regulatory body and other interested parties that operations will be conducted safely and that safety requirements will be met. (DS 284, para. 4.4)

- describe the management system;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
....
The management system;
.... (DS 371, para. 5.22)

To ensure the safety of predisposal radioactive waste management facilities and the fulfilment of waste acceptance criteria, management systems are to be applied to the siting, design, construction, operation, maintenance, shutdown and decommissioning of such facilities and to all aspects of processing, handling and storage of waste. Features that are important to safe operation, and that are considered in the management system, are to be identified on the basis of the safety case and the assessment of environmental impacts [2, 8, 14]. These activities are required to be supported by means of an effective management system that establishes and maintains a strong safety culture [8, 14]. (GSR Part 5 para. 3.24)

The content of a safety case for a facility may vary between Member States but the components of the safety case for a predisposal waste management facility or activity should include:
...
Descriptions of the managerial ... controls over the facilities.
... (DS 284, para. 4.4)

- desribe the provisions for the management and minimization of waste produced during operation of the facility;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
....
(u) Provisions for the management of radioactive waste and for decommissioning. ....(DS 371, para. 5.22)

- contain descriptions of commissioning programme and assessment of its results including justification of any non-compliances;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as: ….
(g) The commissioning programme;
….(DS 371, para. 5.22)

- define an appropriate program for demonstrating the continuing long term compliance of waste and spent fuel packages or unpackaged spent fuel stored within the acceptance criteria including the environmental conditions within the storage facility;

*Related **IAEA** safety standards:*

... For long term storage in particular, measures shall be taken to prevent the degradation of the waste containment. (GSR Part 5, Requirement 11)

A facility specific safety case and supporting assessment should generally include aspects such as:
….
(k) Monitoring programmes, including a programme for shielding verification, a programme for surveillance of the condition of stored spent fuel and a programme for surveillance of stored spent fuel assemblies, if appropriate;
…. (DS 371, para. 5.22)

Because long-term storage is an interim measure, the safety case should describe the provisions for the regular monitoring ... of the waste and the storage facility to ensure their continued integrity over the anticipated lifetime of the facility. (DS 284, para. 6.56)

- contain operational documentation such as:

  - operational limits and conditions for safe operation of the storage facility and their technical bases, and waste and spent fuel packages or unpackaged spent fuel acceptance criteria;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as: ….
(f) Establishment of operational limits, conditions and administrative controls based on the safety assessment. If necessary, the design of the spent fuel storage facility should be modified and the safety assessment should be updated. Such controls should include acceptance criteria for spent fuel casks, including canisters containing failed fuel;
….. (DS 371, para. 5.22)

Waste packages and unpackaged waste that are accepted for processing, storage and/or disposal shall conform to criteria that are consistent with the safety case. (GSR Part 5, Requirement 12).

Predisposal radioactive waste management facilities shall be operated in accordance with ... the conditions imposed by the regulatory body. ...(GSR Part 5, Requirement 19).

  - procedures and operational manuals for activities with significant safety implications

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
…
(j) Procedures and operational manuals for activities with significant safety implications;
….. (DS 371, para. 5.22)

... Operations shall be based on documented procedures. ...(GSR Part 5, Requirement 19).

- the operational inspection, maintenance and testing provisions,

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
….
(g) Organizational control of operations;
……
(k) A programme for periodic maintenance, inspection and testing; (DS 371, para. 5.22)

Waste shall be stored in such a manner that it can be inspected ... (GSR Part 5, Requirement 11)

... Due consideration shall be given to the maintenance of the facility to ensure its safe performance. ... (GSR Part 5, Requirement 19).

Because long-term storage is an interim measure, the safety case should describe the provisions for the regular ... inspection and maintenance of the waste and the storage facility to ensure their continued integrity over the anticipated lifetime of the facility. (DS 284, para. 6.56)

- the operational experience feedback programme,

*Related **IAEA** safety standards*

A facility specific safety case and supporting assessment should generally include aspects such as:
….
(n) A programme for feedback of operational experience;
…. (DS 371, para. 5.22)

- the programme for management of ageing;

Related IAEA safety standards

For storage beyond the original design lifetime, a re-evaluation of the initial design (and of the current design if it is significantly different), operations, maintenance, ageing management, safety assessment and any other aspect of the spent fuel storage facility relating to safety should be performed.[…]
(DS 371, para.5.29)

- describe the arrangements for qualification and training of personnel;

Related IAEA safety standards:

A facility specific safety case and supporting assessment should generally include aspects such as:
….
(o) The training programme for staff;
…. (DS 371, para. 5.22)

- describe the emergency preparedness arrangements at least at the level of on-site emergency plan;

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
The emergency preparedness and response plan;
…. (DS 371, para. 5.22)

... Emergency preparedness and response plans, if developed by the operator, are subject to the approval of the regulatory body (GSR Part 5, Requirement 19)

- include the site strategy for decommissioning and the (initial) decommissioning plan[3];

*Related **IAEA** safety standards:*

A facility specific safety case and supporting assessment should generally include aspects such as:
....
(u) *Provisions for the management of radioactive waste and for decommissioning.*
.... (DS 371, para. 5.22)

The operator shall develop, in the design stage, an initial plan for the shutdown and decommissioning of predisposal radioactive waste management facilities and shall periodically update it throughout the operational period. (GSR Part 5, Requirement 20).

The content of a safety case for a facility may vary between Member States but the components of the safety case for a predisposal waste management facility or activity should include:

- *...*
- *Plans regarding the ... decommissioning of the facilities. ...*
- *... (DS 284, para. 4.4)*

[3] Further details on the structure and content of decommissioning plan are covered by WGWD document "Decommissioning Safety Reference Levels Report"