# WENRA
# WORKING GROUP ON WASTE AND DECOMMISSIONING (WGWD)

# WASTE AND SPENT FUEL STORAGE SAFETY REFERENCE LEVELS REPORT

***version 1.0***

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# Contents

# Executive Summary

The Western European Nuclear Regulator's 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 Harmonisation 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 were based on RHWG report and 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 the chairman of the working group, Mr. Peter Lietava, based on support by the task manager, Mr. Philippe Bodenez and on the input provided by the members of WGWD 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 reference safety 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

Refers to properties of the unpackaged spent fuel or the waste and spent fuel package (i.e. the container and its contents).

### 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 acceptance criteria.

#### Ageing management

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

### 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 organisation may change as the facility passes to the decommissioning phase according to national strategies

### 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).

### 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

The new term reflects the evolution in the approach from the initial concept of 'Quality Control' (controlling the quality of products) through 'Quality Assurance' (the system to assure the quality of products) and 'Quality Management' (the system to manage quality). The 'Quality Management System' is a set of interrelated or interacting elements (system) to establish policy and objectives and to achieve those objectives.

### 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 organisation 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, poison buildup 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.

[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').

- 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 for storage. Waste acceptance requirements might include, for example, restrictions on the activity concentration or the total activity of particular radionuclides (or types of radionuclide) in the waste or the spent fuel or requirements concerning the form or the package of the waste or the spent 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 programme |
| 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 Harmonisation Working Group |
| SSCs | structures, systems and components |
| SRLs | safety reference levels |
| WANO | World Association of Nuclear Operators |
| WENRA | Western European Nuclear Regulators |
| WGWD | (WENRA) Working Group on Waste and Decommissioning |

# *Part I.*

# Introduction and Methodology

# 1. Introduction

This report is the result of an effort by the Working Group on Waste and Decommissioning (WGWD) of WENRA, from 2002 to 2006. 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 harmonisation 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.

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 1 May 2004, when most of these candidate countries became a 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 harmonisation of practices.

To perform these tasks two working groups within the WENRA have been established - Reactor Harmonisation 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 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.

The harmonisation process has the goal to produce harmonised safety reference levels by 2006 in most areas and to implement these levels by 2010 in each country.

### *1.3. Scope*

The SRLs are 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. SRLs very 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 and/or disposal without prior conditioning. The SRLs of this document shall be applied as appropriate to such material as well.

Spent fuel and waste stores build 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 Environment Impact Assessment regulation (required by EU directives), discharge authorisation, 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 organisations.

RHWG of WENRA developed SRLs for nuclear reactors. The principles underlying these levels will apply to any type of nuclear facility including waste and spent fuel storage facilities, taking into account the magnitude of the hazard in a graded approach.

### *1.4. Structure*

The report consists of three 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.

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 of the magnitude of the hazard.

# 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.

By the drafting of report versions developed in 2002-2006 the importance of the IAEA documents developed till then has been recognised. Therefore the starting point for the definition of facility specific SRLs, which have been later included into the former Subpart B, were the topics addressed by corresponding IAEA documents (requirements, guidances, etc). This list has been carefully reviewed and validated by the WGWD. In the case of storage, the available IAEA references were especially:

- Design of Spent Fuel Storage Facilities, Safety Series No. 116, IAEA, Vienna (1994),
- Operation of Spent Fuel Storage Facilities, Safety Series No. 117, IAEA, Vienna (1994),
- Safety Assessment for Spent Fuel Storage Facilities, Safety Series No. 118, IAEA, Vienna (1994),
- Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, Vienna (2000)
- Predisposal Management of Radioactive Waste Including Decommissioning, WS-R-2, IAEA, Vienna (2000),
- Periodic safety review of nuclear power plants, NS-G-2.10, Vienna (2003),
- A System for Feedback of Experience from Events in Nuclear Installations, Safety Guide, DS 288, Vienna (2005),
- Storage of Radioactive Waste, WS-G-6.1, Vienna (2006),
- Safety of Fuel Cycle Facilities, DS 316, Vienna (2006),
- Management Systems for Facilities and Activities, Safety Requirements, GS-R-3, Vienna (2006).

A first set of SRLs, based on RHWG report on harmonisation of reactor safety, has been established in 2002-2005. SRLs were posted on the website of the WENRA organisation at the beginning of 2006 and presented to stakeholders in the view to receive their comments before the 1st of June 2006. The WGWD has extensively modified the SRLs on the basis of comments provided by WENRA members. In this process comments received from stakeholders as result of the consultation process have been considered. Most of the comments recommended the group 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.

A new set of SRLs was established in 2006 in response to comments, as to facilitate a global benchmarking of the SRLs in the WENRA members country.

An evaluation of the implementation of the SRLs in the regulations and in the facilities shall be performed till mid-2007 in each WENRA members state. After this evaluation, the WENRA members shall develop a plan in order to implement the SRLs in their national regulations till the end of the decade.

# *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-62).

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.

As this document is intended to cover a wide range of different types of storage facilities, the reference levels will need to be implemented in different ways to be appropriate for the particular facility.

# 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 programmes 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 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 in line with national and international standards and ensure that these matters are given the highest priority.

*Related **IAEA** safety standards:*
*To fulfil its prime responsibility for safety during the lifetime of the facility, the operating organization shall:*

- *establish and implement safety, health and environmental policies in line with national and international standards and ensure that these matters are given the highest priority ;(...) (DS 316, para 4.1).*

**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.

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

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

*Related **IAEA** safety standards:*
*Interdependences among all steps in the generation and management of radioactive waste shall be appropriately taken into account. Owing to the existing interdependences among the various steps in radioactive waste management, all activities form the generation of the waste to its disposal shall be seen as parts of a larger entity, and each component shall be selected so as to be compatible with the others. (WS-R-2; para 4.1)*

**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.

**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:*
*Government shall ensure that adequate arrangements are made for the safe storage and disposal of radioactive waste. Responsibilities shall be delineated and assigned to ensure that any transfer of responsibility for waste is adequately managed. (GS-R-1; para 6.10)*

### *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:*
*The operating organization shall establish an organizational structure to enable these policies to be delivered with a clear definition of responsibilities and accountabilities, lines of authority and communication. (DS 316; para 4.1).*

**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 organisation the capability to assess the adequacy of the external organisations' capabilities of ensuring safety.

*Related **IAEA** safety standards:*
*The operating organization 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 operating organization shall nevertheless retain within its organisation the capability to assess the adequacy of the external organisations' capabilities of ensuring safety. (DS 316; para 4.9).*

**S-10:** The licensee shall define the necessary qualification and experience that affect safety.

*Related **IAEA** safety standards:*
*The operating organization shall define the necessary qualification and experience that affect safety. (DS 316; para 4.10).*

### *1.3. Safety issue: Quality management*

**S-11:** The establishment, management, implementation and evaluation of a Quality management system are important for ensuring facility safety by providing necessary assurance that the siting, design, construction, commissioning, operational and decommissioning requirements are defined and executed in accordance with the necessary standards and degree of rigor. The licensee shall establish and implement adequate Quality management system requirements for all stages of the facility's life cycle. These quality assurance arrangements shall be aligned with internationally recognized standards. Where the facility generates products, including waste products, these shall also be covered by the quality assurance regime.

*Related **IAEA** safety standards:*
*The establishment, management, implementation and evaluation of a QA programme are important for ensuring facility safety by providing necessary assurance that the siting, design, construction, commissioning, operational and decommissioning requirements are defined and executed in accordance with the necessary standards and degree of rigor. The operating organization shall establish and implement adequate QA requirements for all stages of the facility's life cycle. These quality assurance arrangements shall be aligned with internationally recognized standards. Where the facility generates products, including waste products, these shall also be covered by the quality assurance regime (DS 316; para 4.11)*

**S-12:** At the start of the design phase, a QA programme that outlines the requirements for the design of the facility shall be prepared and implemented by the licensee. This programme shall evolve, as necessary, into more detailed plans for each SSC so that the quality of the facility design is ensured at all times.

*Related **IAEA** safety standards:*
*At the start of the design phase, a QA programme that outlines the requirements for the design of the facility shall be prepared and implemented by the operating organization. This programme shall evolve, as necessary, into more detailed plans for each SSC so that the quality of the facility design is ensured at all times (DS 316; para4.12)*

**S-13:** During all stages in the lifetime of the storage facility, safety related work (including that of contractors) shall be planned and performed in accordance with established codes, standards, specifications, practices and administrative controls. Items and services important to safety shall be identified and controlled to ensure their proper use.

*Related **IAEA** safety standards:*
*During all stages in the lifetime of the fuel cycle facility, safety related work (including that of contractors) shall be planned and performed in accordance with established codes, standards, specifications, practices and administrative controls. Items and services important to safety shall be identified and controlled to ensure their proper use (DS 316; para 4.13)*

**S-14:** To ensure that all items and services important to safety under procurement meet established requirements and perform as specified, such items and services shall be subject to appropriate QA and quality control. Suppliers shall be evaluated and selected by the licensee on the basis of specified criteria. Requirements for reporting deviations from procurements specification and corrective actions shall be specified in the procurement documents. Evidence that purchased items and services meet procurement specifications shall be available before they are used.

*Related **IAEA** safety standards:*
*To ensure that all items and services important to safety under procurement meet established requirements and perform as specified, such items and services shall be subject to appropriate QA and quality control. Suppliers shall be evaluated and selected by the operating organization on the basis of specified criteria. Requirements for reporting deviations form procurements specification and corrective actions shall be specified in the procurement documents. Evidence that purchased items and services meet procurement specifications shall be available before they are used. (DS 316; para 4.14)*

### *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.

**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.

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

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

# 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 safety functions:
- control of subcriticality, if necessary,
- control of the exposure of operating personal, general public and environment,
- removal of heat, if necessary,
- confinement of radioactive material,

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

*Related **IAEA** safety standards:*
*The operating organisation shall identify all Postulated Initiating Events (PIEs) that could lead to a release of significant quantities of radiation and/or radiological materials and associated chemicals. The design Basis Event (DBEs) shall be identified as realistic envelopes for significant accident sequences. All safety functions shall be identified for the prevention and/or mitigation of the accident sequences. The appropriate barriers for preventing PIEs and/or mitigating accidents sequences shall be identified. These barriers, which implement the safety functions, can be SCCs or administrative safety requirements. (DS 316; para 6)*

*A design basis accident (DBA) approach, or an equivalent methodology, shall be used to identify significant accident sequences. For each identified accident sequence, the safety functions, the corresponding SSCs and the administrative safety requirements shall be identified as an implementation of the defence in depth concept. (DS 316; para 6.9)*

**S-20:** The design shall take into account the expected 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:*
*The radioactive waste storage facility shall be designed on the basis of the assumed conditions for its normal operation and assumed incidents or accidents. It shall be designed and constructed for the likely period of storage, (...), with the potential for degradation taken into account. (WS-R-2; para 5.23)*

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

*Related **IAEA** safety standards:*
*... it shall be designed and constructed (...) preferably with passive safety features. (WS-R-2; para 5.23)*

**S-22:** The licensee shall demonstrate that the construction standards used are applicable and the chosen materials appropriate, in particular taking into account the length of the storage period.

**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 current design basis shall be clearly and systematically defined and documented.

*Related **IAEA** safety standards:*
*The radioactive waste storage facility shall be designed on the basis of the assumed conditions for its normal operation and assumed incidents or accidents. It shall be designed and constructed for the likely period of storage, preferably with passive features, with the potential for degradation taken into account. Provisions shall be made for regular monitoring, inspection and maintenance of the waste and the storage facility to ensure continued integrity. The adequacy of the storage capacity should be periodically reviewed with account taken of the predicted waste arising and the expected life of the storage facility. (WS-R-2; para 5.23)*

**S-24:** The licensee shall identify structures, systems and components important to safety to the extent appropriate to a graded approach. The SSCs provide barriers for the prevention of the consequences of postulated initiating events (PIEs) and for the mitigation of accident sequences.

*Related **IAEA** safety standards:*
*The safety functions, and structures, systems and components important to safety (SSCs) shall be identified to the extent appropriate to a graded approach. The SSCs provide barriers for the prevention of the occurrences of postulated initiating events (PIEs) and for the mitigation of accident sequences (DS 316; para 2.13)*

**S-25:** The licensee shall address the ageing of SSCs and safety features 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 to accommodate the anticipated properties of materials at the end of their useful life. This is particularly important for facilities because of the range and characteristics of chemical and radiation conditions experienced during operational states and accident conditions. Where materials characteristics are unavailable, a suitable material surveillance programme shall be implemented by the operating organisation. Results derived from this programme shall be used to reviex the adequacy of the design at appropriate intervals. 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. (DS 316; para 6.17)*

**S-26**: The licensee shall establish 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:*
*The OLCs are the set of rules setting parameter limits, the functional capability and the performance levels of equipment and personnel for safe operation of a facility.(DS 316 para 2.14)*

**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…) ;
- the effects of heat generation from waste or spent fuel, covering both each individual waste and spent fuel packages or unpackaged spent fuel element 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 package or unpackaged spent fuel element as well as the whole store (including operational occurrences and accidental conditions).

[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.)*

*Related **IAEA** safety standards:*
*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 licensee shall, in particular justify storage limits for the properties of waste and spent fuel packages or unpackaged fuel elements during storage which may deviate from the original acceptance criteria, taking into account at least suitability for handling and retrieval. In particular, changes of the spent fuel, the waste products and the packages have to be considered.

**S-29:** The licensee shall take into account a list of PIE relevant to the extent appropriate to a graded approach, depending on the characterisation of the storage.

**S-30:** The licensee shall design the facility to prevent a criticality accident considering the criticality relevant parameters of the facility during normal operation, anticipated operational occurrences and design basis accidents.

*Related **IAEA** safety standards:*
*All operations with fissile materials shall be performed in such a way as to prevent a criticality accident (DS 316 para 6.43)*

**S-31:** The criticality safety shall be achieved by design rather than by the administrative safety means as far as practicable.

*Related **IAEA** safety standards:*
*As far as reasonably practicable, criticality hazard shall be controlled by design. (DS 316; para 6.)*

**S-32:** The licensee shall design and implement measures for protecting the workers, public and environment from the release of radioactive material and from ionising radiation in normal operation, anticipated operational occurrences and design basis accidents.

**S-33:** Means for removing residual heat during normal operation, anticipated operational occurrences and design basis accidents shall be provided, if necessary.

*Related **IAEA** safety standards:*
*Radioactive heat emission may result in the release of radioactive material if not adequately managed. Where appropriate this heat emission shall be accounted for in the facility design. (DS 316; para 6.)*

**S-34:** 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 arrangements for fire safety on the basis of a fire safety analysis and implementation of defence in depth (prevention, detection, control and mitigation) (DS 316; para 6.55).*

### *2.2. Safety issue: Handling and retrieval requirements*

**S-35:** 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.

**S-36:** The storage facility shall be designed in such a way that all waste or spent fuel packages 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:*
*The storage facility shall be designed in such a way that the waste can be retrieved whenever required (WS-R-2; para 5.27).*

**S-37:** The storage facility shall be designed so that individual waste and spent fuel packages or unpackaged spent fuel elements can be inspected.

*Related **IAEA** safety standards:*
*Provisions shall be made for regular monitoring, inspection and maintenance of the waste and the storage facility to ensure continued integrity. (WS-R-2; para 5.23)*

**S-38:** Appropriate equipment (e.g. packaging) shall be available in due time to deal with waste and spent fuel packages or unpackaged spent fuel elements that show signs of degradation.

*Related **IAEA** safety standards:*
*The storage facility shall be designed in such a way that the waste can be retrieved whenever required. (WS-R-2; para 5.27)*

### *2.3. Safety issue: Storage capacity*

**S-39:** The licensee shall ensure that reserve storage capacity is included in the design or is otherwise available, e.g. to allow reshuffling of waste and spent fuel packages or unpackaged spent fuel elements for inspection, retrieval or maintenance work.

# 3. Safety Area: Operation

**S-40:** The storage facility shall be operated so that individual of waste and spent fuel packages or unpackaged spent fuel elements, e. g. in case of pool type storage facilities, can be inspected.

**S-41:** The licensee shall ensure that the reserve storage capacity will always stay available for retrieved waste and spent fuel packages or unpackaged spent fuel elements.

## *3.1. Safety issue: Emergency Preparedness*

If as consequence from the safety case, for the set of design basis accidents events requiring protective measures cannot be excluded, emergency arrangements will be required. These 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 S-43, 44, 45 will not apply.

**S-42:** The licensee shall develop an emergency plan in co-ordination with other bodies having responsibilities in an emergency, including public authorities, establish the necessary organizational structure and assign responsibilities for managing emergencies.

*Related **IAEA** safety standards:*
*The operating organization shall develop an emergency plan in co-ordination with other bodies having responsibilities in an emergency, including public authorities, establish the necessary organizational structure and assign responsibilities for managing emergencies (DS 316; para 9.62).*

**S-43:** The emergency plan of the licensee shall provide for arrangements to address the following:

(1.) The designation of persons who will be responsible for directing on-site activities and for ensuring liaison with off-site organizations;
(2.) The requirements for personnel training;
(3.) The list of likely accidents, including combinations of nuclear and non-nuclear hazards as necessary. If relevant, the description of possible severe accidents and their consequences ;
(4.) The conditions and criteria under which an emergency shall be declared, a list of job titles and/or functions of persons empowered to declare it, and a description of suitable means for alerting response personnel and public authorities;
(5.) The arrangements for assessment of the radiological conditions on and off the site (water, vegetation, soil, air sampling);
(6.) Provisions for minimizing the exposure of persons to ionising radiation and for ensuring medical treatment of casualties;
(7.) Assessment of the state of the facility and the actions to be taken on the site to limit the extent of radioactive release and spread of contamination;
(8.) 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;
(9.) An inventory of the emergency equipment to be kept in readiness at specified locations;
(10.) The actions to be taken by persons and organizations involved in the implementation of the plan;
(11.) Provisions for declaring the termination of an emergency.

Related **IAEA** safety standards:
*The emergency plan of the operating organization shall provide for arrangements to address the following:*
- *The designation of persons who will be responsible for directing on-site activities and for ensuring liaison with off-site organizations;*
- *The requirements for personnel training;*
- *The list of likely accident. If relevant, the description of possible severe accidents and their consequences;*
- *The conditions and criteria under which an emergency shall be declared, a list of job titles and/or functions of persons empowered to declare it, and a description of suitable means for alerting response personnel and public authorities;*
- *The arrangements for assessment of the radiological conditions on and off thesite (water, vegetation, soil, air sampling);*
- *Provisions for minimizing the exposure of persons to ionising radiation and for ensuring medical treatment of casualties;*
- *Assessment of the state of the facility and the actions to be taken on the site to limit the extent of radioactive release and spread of contamination;*
- *The chain of command and communication, including a description of related facilities and procedures;*
- *An inventory of the emergency equipment to be kept in readiness at specified locations;*
- *The actions to be taken by persons and organizations involved in the implementation of the plan;*
- *Provisions for declaring the termination of an emergency (DS 316; para 9.63).*

**S-44:** The emergency plan shall be reviewed by the regulatory body and tested in an exercise before the commencement of operation. There shall thereafter at suitable intervals be exercises of the emergency plan and the emergency equipment, some of which shall be witnessed by the regulatory body. Some of these exercises shall be integrated and shall include the participation of as many as possible of the organizations concerned. The plans shall be subject to review and updating in light of the experience gained.

*Related **IAEA** safety standards:*
*The emergency plan shall be approved by the regulatory body and tested in an exercise before the commencement of operation. There shall thereafter at suitable intervals be exercises of the emergency plan and the emergency equipment, some of which shall be witnessed by the regulatory body. Some of these exercises shall be integrated and shall include the participation of as many as possible of the organizations concerned. The plans shall be subject to review and updating in light of the experience gained.(DS 316; para 9.66)*

### *3.2. Safety issue: Operational Experience Feedback*

**S-45:** The licensee shall establish and conduct an Operating Experience Feedback (OEF) programme to collect, screen, analyse 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:*
*When available, the information about incidents and events in other installations of the same type shall also be investigated and lessons learned shall be considered. (DS 316; para 4.25)*

*The operating organization must establish a programme for the collection and analysis of operating experience. (SS No. 110 ; para 513). Operating experience at the plant shall be evaluated in a systematic way. (NS-R-2; para. 2.21).*

*The operating organization and the regulatory body shall agree on and establish complementary programmes to analyse operating experience to determine whether equipment, procedures and/or training or related safety requirements need to be modified and to ensure that lessons are learned and acted upon (SS No. 110; para 513, NS-G-2.4; para 4.4).*

**S-46:** 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:*
*Overall responsibility for implementing the operating experience review programme can be placed in either the nuclear power plant or the operating organization. However, the involvement and support of senior management of the operating organization are key for an operating experience review programme to be effective (NS-G-2.4; para 6.63).*

*The investigation shall, where appropriate, result in clear recommendations to the plant management, which shall take appropriate corrective action without undue delay (NS-R-2; para 2.2.1).*

*Operating organisations should have the objective of improving safety, plant availability and commercial performance by identifying the causes of events and thereby avoiding their recurrence and by evaluating the applicability of good practices used by others (DS 288; para 4.3).*

### *3.3. Safety issue: Operation facility modification*

**S-47:** The licensee shall establish a process whereby its proposals for changes in design, equipment, storage conditions, waste or spent fuel characteristics, control or management are subject to a degree of assessment and scrutiny appropriate to the safety significance of the change, so that the specific and wider consequences of the modification including retrieval and disposal are adequately assessed. The process shall ensure that a review of possible consequences of a foreseen modification or change in one facility will not adversely impact on the operability or safety of associated or adjacent facilities.

*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 specific and wider consequences of the modification including retrieval and disposal are adequately assessed. The process shall ensure that a review of possible consequences of a foreseen modification or change in one facility will not adversely impact on the operability or safety of associated or adjacent facilities (DS 316; para 9.35)*

**S-48:** Modification of the storage conditions that may have impact on the safety of the storage facility should be subject to a specific planning and/or procedures and the appropriate authorizations.

*Related **IAEA** safety standards:*
*Modification of the storage conditions should be subject to specific plans and procedures and accompanied by appropriate authorizations from the regulatory body. The impact of any modifications on the safety of the stored waste should be considered in each case (WS-G-6.1; para 6.67).*

**S-49:** Before commissioning a modified facility, personnel shall have been trained, as appropriate, and all relevant documents necessary for facility operation shall have been updated. All temporary modifications shall be clearly identified at the point of application and at any relevant control position. Operating personnel shall be clearly informed of these modifications and of their consequences for the operation of the facility.

*Related **IAEA** safety standards:*
*Consideration should be given to the need to revise procedures, training and provisions for plant simulators as part of the implementation of the modification (NS-G-2.3, Para 4.28).*

*Prior to putting the plant back into operation after modifications, all relevant documents necessary for the operation of the plant after the modifications (in particular the documents for shift operators) shall be updated and personnel shall be trained as appropriate (NS-R-2, Para 7.7).*

*Temporary modifications (including defeat of interlocks, installation of jumpers and lifted leads) shall be clearly identified at the point of application and any relevant control position. Operating personnel shall be clearly*

*informed of these temporary modifications and of their consequences for the operation of the plant, under all operating conditions (NS-R-2, Para, 7.6).*

### *3.4. Safety issue: Maintenance, in-service inspection and functional testing*

**S-50**: Maintenance, periodic testing and inspection shall be conducted to ensure that SSCs are able to function in accordance with the design intents and safety requirements. In this context, the term maintenance refers both to preventive and corrective actions. Maintenance and periodic testing shall also cover the equipment necessary for onsite emergency plan implementation.

*Related **IAEA** safety standards:*
*Maintenance, periodic testing and inspection shall be conducted to ensure that SSCs are able to function in accordance with the design intents and safety requirements. In this context, the term maintenance refers both to preventive and corrective actions. Maintenance and periodic testing shall also cover the equipment necessary for onsite emergency plan implementation (DS 316; para 9.28).*

**S-51:** All maintenance, periodic testing and inspections shall be performed according to a programme based on approved, written procedures. Before the operation of the facility, the licensee shall prepare and assure the approval of programmes for maintenance, periodic testing and inspection of SSCs. These procedures shall delineate any changes form the normal operation status of the facility and have provisions for restoration of the normal configuration upon completion of the activity. A system of work permits in accordance with the QA programme shall be used for maintenance, periodic testing and inspection. Resumption of normal operation shall be permitted only after the person responsible for coordinating the maintenance work has approved the results of the maintenance assessment.

*Related **IAEA** safety standards:*
*All maintenance, periodic testing and inspections shall be performed according to a programme based on approved, written procedures. Before the operation of the facility, the operating organization shall prepare and assure the approval of programmes for maintenance, periodic testing and inspection of SSCs. These procedures shall delineate any changes form the normal operation status of the facility and have provisions for restoration of the normal configuration upon completion of the activity. A system of work permits in accordance with the QA programme shall be used for maintenance, periodic testing and inspection. Resumption of normal operation shall be permitted only after the person responsible for coordinating the maintenance work has approved the results of the maintenance assessment (DS 316; para 9.29).*

**S-52:** The frequency 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, periodic testing or inspection of SSCs shall be in accordance with the facility safety case. (DS 316; para 9.30).*

**S-53:** Equipment and items used for maintenance, periodic testing and inspection programmes shall be identified and controlled to ensure their proper use.

*Related **IAEA** safety standards:*
*Equipment and items used for maintenance, periodic testing and inspection programmes shall be identified and controlled to ensure their proper use (DS 316; para 9.31).*

**S-54:** The result of maintenance, testing and inspection shall be recorded and assessed.

*Related **IAEA** safety standards:*
*The result of maintenance, testing and inspection shall be recorded and assessed (DS 316; para 9.32).*

**S-55:** The maintenance, periodic testing and inspection programmes shall be reviewed at regular intervals to incorporate the lessons learned from experience.

*Related **IAEA** safety standards:*
*The maintenance, periodic testing and inspection programmes shall be reviewed at regular intervals to incorporate the lessons learned from experience (DS 316; para 9.33).*

**S-56:** As many facility occurrences happen during subordinate operations such as preparation for maintenance or testing, special attention shall be paid to these operations.

*Related **IAEA** safety standards:*
*As many facility occurrences happen during subordinate operations such as decontamination, washing and preparation for maintenance or testing, special attention shall be paid to these operations(DS 316; para 9.34).*

**S-57:** The licensee shall develop a programme 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.

**S-58:** For storage facilities, the program of inspection and maintenance shall include:
- the monitoring regime for the required environmental conditions within the storage facility,
- the appropriate program for monitoring the state of waste and spent fuel packages or unpackaged spent fuel elements, as deduced from the safety case, and the ageing of SSCs.

### *3.5. Safety issue: Specific contingency plans*

**S-59:** 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.

**S-60:** The licensee shall have plans to deal with deviations that may be linked to the loss of integrity or degradation of waste and spent fuel packages or unpackaged spent fuel elements beyond the storage limits.

**S-61:** The licensee shall consider appropriate contingency arrangements for waste and spent fuel packages or unpackaged spent fuel elements that are not retrievable by normal means.

### *3.6. Safety issue: Requirements for acceptance of waste and spent fuel packages and unpackaged spent fuel elements*

**S-62:** The owner is responsible for ensuring that the waste and spent fuel package fulfils all relevant design 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.

**S-63:** The licensee shall establish acceptance criteria for its storage facility.

**S-64:** These acceptance criteria shall take into account storage conditions and shall ensure compatibility with the safety case of the storage facility, including suitability for handling and retrieval.

**S-65:** 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 when they are received.

*Related **IAEA** safety standards:*
*Radioactive waste destined for disposal shall be processed to meet the acceptance criteria for disposal established with the approval of the regulatory body. These criteria define the radiological, mechanical, physical and biological properties of the waste and of any package (WS-R-2; para 5.31).*

*A comprehensive quality assurance programme ... shall be applied to all stages and elements of predisposal radioactive waste management having a bearing on safety. It may include the siting, design, construction, operation and maintenance of radioactive waste management facilities (WS-R-2; para 7.6).*

# 4. Safety area: Safety verification

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

**S-66:** The Licensee shall provide a safety case and use it as a basis for continuous support of safe operation.

*Related **IAEA** safety standards:*
*In compliance with Principle 9 on the safety of facilities, the safety of operations involving radioactive waste and the decommissioning of nuclear facilities shall be ensured by means of safety assessment and quality assurance. Safety and environmental impact assessments before commissioning shall be performed to demonstrate that the facilities and operation will be adequately safe. A quality assurance programme shall be conducted to provide the necessary confidence throughout all satges of design, construction and operation that all relevant requirements and criteria are met. (WS-R-2; para 7.1).*

*The operating organization shall establish and justify the safety of its facility through a set of documents named the 'safety case'. The safety case shall be the basis for the safe siting, construction, operation and decommissioning of the facility including the justification for changes. It shall be an important link between the operating organization and the regulatory body since it is the main body of documents for granting the authorizations necessary under national legislative requirements (DS 316; para 2.10).*

**S-67:** The safety case shall among others:
- describe the site, the facility layout and normal operation; and demonstrate how safety is achieved;
- contain detailed descriptions of the safety functions; all safety systems and SSC; their design basis and functioning in all operational states, including accident conditions;
- identify applicable regulations codes and standards;
- describe the relevant aspects of the facility organization and the management of safety;
- contain the evaluation of the safety aspects related to the site;
- outline the general design concept and the approach adopted to meet the fundamental safety objectives;
- contain evidence that the interdependencies among all steps in generation and management of radioactive waste management have been appropriately taken into account;
- describe the safety analyses performed to assess the safety of the facility in response to postulated initiating events against safety criteria and radiological release limits;
- describe the emergency operation procedures and accident management guidelines, the inspection and testing provisions, the qualification and training of personnel, the operational experience feedback programme, and the management of ageing;
- contain the technical bases for the operational limits and conditions;
- describe the policy, strategy, methods and provisions for radiation protection;
- describe the emergency preparedness arrangements;
- describe the on-site radioactive waste management provisions;
- describe how the relevant decommissioning and end-of-life aspects are taken into account during operation;
- demonstrate the long term compliances of waste and spent fuel packages or unpackaged spent fuel stored within the limits
- define a monitoring regime for the required environmental conditions within the storage facility;
- define an appropriate program for demonstrating the continuing compliance of waste and spent fuel packages or unpackaged spent fuel stored within the storage limits (see S-28).

*Related **IAEA** safety standards:*
*Facilities and activities for predisposal management of radioactive waste, including decommissioning activities, shall be subject to safety and environmental impact assessments in order to demonstrate that they are adequately safe and, more specifically, that they will be in compliance with safety requirements established by the regulatory body (WS-R-2; para 7.2).*

*These safety and environmental impact assessments shall address the facility's structures, systems and components, the waste to be processed and all associated operational work activities, and shall encompass both normal operation and anticipated incidents and accidents. In the latter case, the safety and environmental impact assessments shall demonstrate that appropriate measures have been taken to prevent incidents or accidents and that consequences would be mitigated should an incident or accident occur (WS-R-2; para 7.3).*

*The SAR should contain accurate and sufficiently precise information on the plant and its operating conditions and should typically include information on, for example, safety requirements, the design basis, site and plant characteristics, operational limits and conditions and safety analyses, in such a way that the regulatory body will be able to evaluate independently the safety of the plant (GS-G-4.1; para 2.1).*

**S-68:** The safety case for storage facilities shall cover both the facility itself and the waste and spent fuel packages or unpackaged spent fuel elements and their respective safety-relevant features.

**S-69:** The licensee shall update the safety case to reflect modifications and new regulatory requirements and relevant standards, as soon as practicable and in accordance with safety relevance of the modification after the new information is available and applicable. The licensee shall use the safety case as a basis for assessing the safety implications of changes to the facility or to operating practices.

*Related **IAEA** safety standards:*
*The safety case 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 facility modifications, (DS 316; para 2.16).*

*The plant management shall establish a procedure for updating documents as soon as possible after modification, installation and testing. Responsibilities for the revision of all documents such as …safety analysis report… shall be clearly assigned (NS-R-2; para 7.8).*

*Systematic updating of the SAR would then become a requirement for the operating organization during the remaining lifetime of the plant. This would usually be done periodically so as to reflect any feedback of operating experience, plant modifications and improvements, new regulatory requirements or changes to the licensing basis. (GS-G-4.1; para 2.6).Since the SAR is part of the overall justification of plant safety, it should reflect the current state and the licensing basis of the plant and should be kept up to date accordingly (GS-G-4.1; para 4.3).*

*The SAR is prepared by the operating organization for submission to the regulatory body to enable it to assess the suitability of the plant for licensing. The SAR should also serve as a basis for the operating organization to assess the safety implications of changes to the plant or to operating practices (GS-G-4.1; para 2.7).*

**S-70:** Independently of the periodic safety reviews (PSRs), the safety case shall be revised in particular if:
- there have been significant unexpected deviations in the environment conditions in the store;
- a significant change in the waste and spent fuel package and unpackaged spent fuel elements acceptance criteria is proposed, or, if safety-relevant waste and spent fuel properties change significantly from those that have been taken as a basis in the safety case;

- the properties of waste and spent fuel packages or unpackaged spent fuel elements stored have changed unexpectedly beyond the storage limits (see S-28), and it is not intended to take remedial action.

### *4.2. Safety issue: Periodic safety review*

**S-71:** The licensee shall carry out at regular intervals a review of the safety of the facility (PSR).

*Related **IAEA** safety standards:*
*The operating organization shall carry out at regular intervals a review of the facility safety case to ensure that it remains fully valid and that modifications made to the facility, as well as changes in its operating arrangements or utilization, are accurately reflected. In conducting these reviews, the operating organization shall explicitly consider the cumulative effects of modifications and ageing. These reviews shall also ensure that all changes in OLCs, maintenance programmes, drawings, operation, maintenance, and emergency procedures have been properly captured in the current arrangements and procedures (DS 316; para 2.17).*

*It shall be determined by means of the Periodic Safety Review to what extent the existing safety analysis report remains valid. The PSR shall take into account the actual status of the plant, operating experience, predicted end-of-life state, current analytical methods, applicable safety standards and the state of knowledge. (NS-R-2; para 10.3)*

*The primary responsibility for conducting a PSR and reporting its findings lies with the owner/operator of the plant... The regulatory body has the responsibility of specifying or approving the requirements for a PSR,... (NS-G-2.10; paras 5.1 and 5.2)*

**S-72:** The review shall confirm the compliance with its licensing requirements and any deviations shall be resolved. It shall also identify and evaluate the safety significance of differences from applicable current safety standards and best 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.

*Related **IAEA** safety standards:*
*It shall be determined by means of the PSR to what extent the existing safety analysis report remains valid. (NS-R-2; para 10.3)*

*The operating organization shall additionally carry out periodic safety reviews to confirm that the safety case remains valid. Such reviews need to consider the cumulative effect of changes to procedures, modifications to the facility and the operating organization, technical developments, operating experience and ageing. (DS 316 para 4.26)*

*The procedure… should be followed to identify any differences between the safety status of a nuclear power plant and current safety standards and practices... (NS-G-2.10; para 7.1).*

**S-73:** All reasonably practicable improvement measures shall be taken by the licensee as a result of the review.

*Related **IAEA** safety standards:*
*The procedure does not require that a nuclear power plant meet all current standards, however, reasonably practicable improvements should be made towards meeting them, (NS-G-2.10; para 7.1).*

**S-74:** The results of the PSR shall be reflected in the facility safety case update.

*Related **IAEA** safety standards:*
*The results of the periodic safety reviews shall be presented by the operating organization to the regulatory body and shall be reflected in the facility safety case up-date (DS 316; para 9.69)*

**S-75:** 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:*
*A PSR is a comprehensive safety review addressing all important aspects of safety, carried out at regular intervals, typically of ten years. The PSR should be conducted typically every ten years and its duration should not exceed 3 years. (NS-G-2.10; paras 1.4 and 3.5)*

**S-76:** The scope and methodology of the review shall be clearly defined and justified.

*Related **IAEA** safety standards:*
*The scope of a PSR includes all nuclear safety aspects of a nuclear power plant. (NS-G-2.10, para 3.1).*

*It is recommended that the scope should include, as a minimum, the safety factors given in section 4 (NS-G-2.10; para 6.2) [Plan - Plant design, Actual condition of SSCs, Equipment qualification, Ageing; Safety analysis - Deterministic safety analysis, Probabilistic safety analysis, Hazard analysis; Performance and feedback of experience - Safety performance, Use of experience from other plants and research findings; Management - Organization and administration, Procedures, The human factor, Emergency planning; Environment - Radiological impact on the environment; Global assessment]*

**S-77:** The PSR shall also include:
- consideration of the acceptance criteria and the limits for deviation from these criteria during storage of waste and spent fuel packages and unpackaged spent fuel elements,
- any changes in the basis for interdependencies between management steps for waste and spent fuel packages and unpackaged spent fuel.

## Appendix: 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), leaks (corrosion), plugging
- Instrumentation and control, human failures
- Internal fires and explosions (gas generation, process hazards)
- Flooding, vessel overflows

*Related **IAEA** safety standards:*
*Selected postulated initiating events (DS 316; Appendix 1)*

***External postulated initiating events***

*Natural phenomena*

- *Extreme weather conditions*
  *precipitation: rain, snow, ice, frazil, wind, tornadoes, hurricanes, cyclones, dust or sand storm, lightning, high or low temperature, humidity*
- *Flooding*
- *Earthquake and eruption of volcano*
- *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*
- *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 (terrorism, sabotage, infrastructure failure, strikes and blockages)*

***Internal postulated events***

- *Loss of energy and fluids : Electrical power supplies, air and pressurized air, vacuum, super heated water and steam, coolant, chemical reagents, and ventilation;*
- *Use of electricity and chemicals*
- *Mechanical failure including drop loads, rupture (pressure retaining vessels), leaks (corrosion), plugging*
- *Instrumentation and control, human failures*
- *Internal fires and explosions (gas generation, process hazards)*
- *Flooding, vessel overflows*