Western European
WENRA WGWD
Nuclear Regulators Association

Report

Waste and Spent Fuel Storage Safety Reference Levels

–

Report of Working Group of Waste and Decommissioning (WGWD)
Version 2.3, January 2024

Table of 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 in operation or decommissioning. The main objectives of WENRA are to develop a common approach to nuclear safety, to provide an independent capability to examine nuclear safety and to provide a network for chief nuclear safety regulators in Europe to exchange experience and discuss significant safety issues.

To accomplish these tasks three working groups within the WENRA have been established – the Reactor Harmonisation Working Group (RHWG), the Working Group on Waste and Decommissioning (WGWD) and the Working Group on Research Reactors (WGRR).

This document contains the results of the work of WGWD in the area of 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, guides, etc). Although the IAEA safety standards establish an essential basis for the 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 previous Storage Report Version 2.2 by the working group based on support by the task manager, Mr Sven Keßen. WGWD members and other participants who contributed during the review period are listed below:

Belgium	Lionel BASTIAENS Frederic BERNIER Fabienne DE SMET Radouane SGHIR Maryna SURKOVA
Bulgaria	Alexei ALEXIEV Nikolay GROZEV Lidiya KATZARSKA Valentin STANCHEV Radosveta MARKOVA-MIHAYLOVA
Czech Republic	Peter LIETAVA (former chairperson of WGWD)
Finland	Jarkko KYLLÖNEN
France	Olivier LAREYNIE Guilhem LEPOULTIER Viviane NGUYEN
Germany	Kerstin STAHL Sven KESSEN
Hungary	István LÁZÁR Gábor NAGY
Italy	Nadia CIPRIANI Mario DIONISI Barbara GIANNONE Fabrizio TRENTA

Lithuania	Sigizmundas STYRO
The Netherlands	Peter GORTS Saskia VAN HENSBERGEN Machiel KLEEMANS
Romania	Daniela DOGARU Cornelia VIRTOPEANU
Slovakia	Alena ZAVAZANOVA
Slovenia	Polona TAVČAR
Spain	Marcos DE TORO FERNANDEZ José-Luis REVILLA María Aránzazu SOGO ALDAMENDI
Sweden	Bengt HEDBERG Åsa ZAZZI
Switzerland	Isabel SIERRA Stefan THEIS (former chairperson of WGWD)
Ukraine	Olha HORODNICHA Tamara SUSHKO Oleksii TOKAREVSKI
United Kingdom	Chris GLAISTER Simon MORGAN (chairperson of WGWD) Kamaljit SIHRA

Western European
WENRA WGWD
Nuclear Regulators Association

Terms of Reference

of the WESTERN EUROPEAN NUCLEAR REGULATORS´ ASSOCIATION

(WENRA)

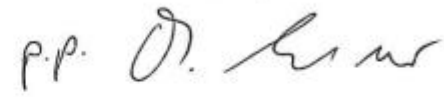
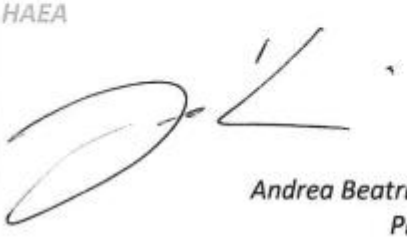
14 November 2023

1. We, the Heads of Nuclear Regulatory Authorities (signatories[1]) of European countries with nuclear power plants, gathered within WENRA, the independent association of European national nuclear regulators, commit to work together to continuously improve and harmonise nuclear safety to as high as reasonably practicable levels.
2. We commit, in particular, to maintain and further develop a common set of up to date safety reference levels (SRLs) aiming at a high safety level, strive for their implementation in our national regulatory frameworks and benchmark their implementation.
3. WENRA's vision is to have consistent high levels of nuclear safety in Europe, protecting people and the environment now and in the future.
4. Besides WENRA full members, other heads of national regulatory authorities may participate in WENRA under the status of associated member or observer member. The application process is defined in a separate document, approved by WENRA, defines the application process, the main criteria considered by WENRA, as well as the rights and duties of associated members and observer members. In any case admission of a new member remains a sovereign decision by WENRA full members.
5. WENRA, as an independent association, does not receive any instructions from national governments nor from EU or other international institutions.
6. Decisions in the name of WENRA are taken by consensus among full members and are expected to be applied by each of members.
7. Taking into account the European and international environment in the nuclear field, WENRA defines and updates regularly strategic objectives that streamline its actions.
8. Final documents reflecting WENRA's activities or positions on safety related matters are made public.
9. Working groups are established and shutdown through WENRA decisions during plenary meetings dependent on agreed priorities.
10. WENRA members provide adequate resources to ensure effective working of WENRA and its working groups.

---

[1] *WENRA full members are the signatories of the Terms of Reference*

11. WENRA keeps regular relationships with the European Union institutions, in particular ENSREG, to discuss any significant safety-related topic of interest, identify emerging safety issues that can challenge its members, address interface and avoid duplication in respective activities and provide advice on nuclear safety and regulatory matters.
12. WENRA develops and maintains suitable relations with regulatory authorities from other countries as well as with international organisations.
13. WENRA ensures appropriate opportunities for stakeholders to be informed of or, when applicable, to contribute to its work.

Belgium *Federal Agency for Nuclear Control, FANC*  Frank Hardeman *Director General*	**Bulgaria** *Nuclear Regulatory Agency, BNRA*  Tsanko Bachiyski *Chairman*
Czech Republic *State Office for Nuclear Safety, SUJB*  Dana Drábová *Chairperson*	**Finland** *Radiation and Nuclear Safety Authority, STUK*  Petteri Tiippana *Director General*
France *Nuclear Safety Authority, ASN*  Olivier Gupta *Director General*	**Germany** *Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, BMUV*  Gerrit Niehaus *Director General*
Hungary *Hungarian Atomic Energy Authority, HAEA*  *Andrea Beatrix Kadar* *President*	**Italy** *National Nuclear Safety and Radiation Protection Inspectorate, ISIN*  Maurizio Pernice *Director*

Lithuania *State Nuclear Power Safety Inspectorate, VATESI*  Michail Demčenko *Head*	**Poland** *National Atomic Energy Agency, PAA*  Andrzej Glowacki *President*
Romania *National Commission for Nuclear Activities Control, CNCAN*  Cantemir Ciurea *President*	**Slovak Republic** *Nuclear Regulatory Authority of the Slovak Republic, UJD*  Marta Ziakova *Chair*
Slovenia *Slovenian Nuclear Safety Administration, SNSA*  Igor Sirc *Director*	**Spain** *Spanish Nuclear Safety Council, CSN*  Javier Dies *Commissioner*
Sweden *Swedish Radiation Safety Authority, SSM*  Michael Knochenhauer *Acting Director General*	**Switzerland** *Swiss Federal Nuclear Safety Inspectorate, ENSI*  Marc Kenzelmann *Director General*

The Netherlands *Authority for Nuclear Safety and Radiation Protection, ANVS*  Annemiek Van Bolhuis *Chair of the Board*	**Ukraine** *State Nuclear Regulatory Inspectorate of Ukraine, SNRIU*  Oleh Korikov *Acting Chairman*
United Kingdom *Office for Nuclear Regulation, ONR*  Mark Foy *Chief Nuclear Inspector*	

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 and 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 legal person or organization having overall responsibility for a facility or activity.
(Remark: WGWD recognises 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 manner. The management system integrates all elements of an organization into one coherent system to enable all of the organization's objectives to be achieved. These elements include the organizational 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 to radiation or radioactive substances, and the interpretation of the results,
2. Continuous or periodic measurement of radiological or other parameters or determination of the status of a structure, system 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 facility practice which are relevant to protection and safety; for a nuclear facility this includes the site, the design and the operation of the facility.
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, that is no longer usable in its present form.[2]
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.

[2] 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 No. 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 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 criteria
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 storage facility. Waste acceptance criteria 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 criteria concerning the waste form or the packaging 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

EIA	Environmental impact assessment
EU	European Union
IAEA	International Atomic Energy Agency
NAP	National Action Plan
NPP	Nuclear power plant
OEF	Operational experience feedback
OLCs	Operational limits and conditions
PIE	Postulated initiating event
PSR	Periodic safety review
RHWG	(WENRA) Reactor Harmonisation Working Group
SSCs	Structures, systems and components
SRL	Safety Reference Level
WENRA	Western European Nuclear Regulators Association
WGRR	(WENRA) Working Group on Research Reactors
WGWD	(WENRA) Working Group on Waste and Decommissioning

Part 1

Introduction and Methodology

1.1 Introduction

This report is the result of an effort by the Working Group on Waste and Decommissioning (WGWD) of WENRA, from 2002 to 2023, in particular focussing on the period since the publication of the previous version of this report, v2.2, in 2014. 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 cannot 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.

1.1.1 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 since 2003 to include future new European Union (EU) member states. Currently, regulatory authorities from the following 18 countries are members of WENRA: Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland, Ukraine and the United Kingdom. Recently, authorities from Canada and the Russian Federation have gained the status of "associated members" of WENRA, and authorities from various other states have been admitted to WENRA meetings as "observers", including Japan and the USA. However, while some observers have been present and active at WGWD meetings, the preparation of this report as well as the development of the SRLs and efforts to harmonise their national regulations have been undertaken by the members only.

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, and

- 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 regular EU member states, the new WENRA tasks, based on first and third original Association's objectives, became:

- to 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.

Each WENRA member commits to implementing SRLs in its regulatory framework and to tracking this implementation. WENRA associated members commit to considering implementing the SRLs.

The SRLs are administered by WGWD which gives a rating for each member state's performance against each SRL. Each country undertakes a national self-assessment against each SRL, which is then benchmarked or moderated by the members of WGWD, with a rating of A (fully conforming with SRL), B (not applicable, or SRL addressed satisfactorily in another way) or C (improvements needed). WENRA Members which identified areas for improvement then develop a National Action Plan to respond to the findings, usually within a period of 2 to 3 years, and undergo re-benchmarking.

To perform these tasks three standing working groups within the WENRA have been established – initially the Reactor Harmonisation Working Group (RHWG) and the Working Group on Waste and Decommissioning (WGWD), then in 2021 the Working Group on Research Reactors (WGRR). The work of WGWD has started in 2002.

1.1.2 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.

These SRLs constitute the basis for a common approach to nuclear safety for spent fuel and radioactive waste storage facilities in the WENRA member states and, based on national action plans, shall be implemented in the legal and regulatory framework system of each WENRA member state. Detailed country-specific progress on these activities is presented in part III of the report.

According to the WENRA policy statement the initial harmonisation 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 the end of 2012 with a subsequent further extension to 2013. These results were published in a preliminary final report in 2014. This new update of the Storage Report serves to highlight the regulatory changes and improvements effected in the member states since then.

1.1.3 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, applying a graded approach, but can be used also in that way 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 the storage of 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 recognised that many of the SRLs of a general nature 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 pools built within the reactor building for the 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.

1.1.4 Structure

The report consists of three main parts.

Following this introduction, Section 1.2 presents the general methodology that was followed to develop the SRLs and to analyse their application in participating countries.

Part 2 of the report presents the actual waste and spent fuel Storage Reference Levels.

Part 3 of the report describes the benchmarking process and its progress between 2014 and 2023 and the remaining National Action Plans (NAP).

1.2 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 the relevant IAEA documents at the time were consulted. As far as these have been revised or superseded, the references presented in Part 2 have been updated to reflect the developments in internationally accepted safety standards and their continuing relation to the storage SRLs. The list of IAEA documents referred to in this report is as follows:

- Fundamental Safety Principles, Safety Fundamentals SF-1, Vienna (2006)
- Leadership and Management for Safety, General Safety Requirements GSR Part 2, Vienna (2016)
- Predisposal Management of Radioactive Waste, General Safety Requirement GSR Part 5, Vienna (2009)
- Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Requirements GSR Part 7, Vienna (2015)
- Safety of Nuclear Fuel Cycle Facilities, Specific Safety Requirements SSR-4, Vienna (2017)
- Safety of Nuclear Fuel Cycle Facilities, Safety Requirements NS-R-5 Rev. 1, Vienna (2014), superseded by SSR-4
- The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste, General Safety Guide GSG-3, Vienna (2013)
- Leadership, Management and Culture for Safety in Radioactive Waste Management, General Safety Guide GSG-16, Vienna (2022)
- Storage of Radioactive Waste, Safety Guide WS-G-6.1, Vienna (2006)
- Storage of Spent Fuel, Specific Safety Guide SSG-15 Rev. 1, Vienna (2020)
- Periodic Safety Review of Nuclear Power Plants, Specific Safety Guide SSG-25, Vienna (2013),
- Operating Experience Feedback for Nuclear Installations, Specific Safety Guide SSG-50, Vienna (2018),
- Modifications to Nuclear Power Plants, Specific Safety Guide SSG-71, Vienna (2022)

A first set of SRLs was posted on the website of WENRA at the beginning of 2006 and presented to stakeholders in order to receive their comments before 1 June 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 of the Waste and Spent Fuel Storage Report on which basis the subsequent benchmarking exercises of the storage SRLs in WENRA member states was conducted.

An evaluation of the implementation of the SRLs in the regulations (national legal frameworks) 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 WENRA members developed National Action Plans in order to address identified discrepancies and to update their national regulations till the end of 2012.

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 version 2 of the "Waste and Spent Fuel Storage Safety Reference Levels" which are still in use today. 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 have been invited to respond with comments until 30 June 2010. In subsequent WGWD meetings

- all comments received were evaluated,
- SRL texts were modified accordingly where agreed, and
- any such decisions were discussed with representatives of relevant stakeholder organizations in a special working group session.

Finally, the resulting Storage Report, version 2.1, was approved by WENRA in autumn 2010 and published in February 2011. The existing National Action Plans and the underlying national regulatory frameworks were benchmarked against the new set of SRLs. These results were finally published in April 2014 as version 2.2 of the Storage Report, the forerunner to this present version.

Since 2014, WENRA members have continued to update their national regulatory frameworks and to implement the WENRA requirements defined by the set of Safety Reference Levels on spent fuel and radioactive waste storage in their regulations. This report highlights the progress that was achieved in the member states since 2014, including the first benchmarking results for the storage SRLs of Ukraine which joined WENRA as a full member state in 2015.

Part 2

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 radioactive 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. Since the last update of the Storage Report in 2014, WGWD has also begun to develop and benchmark a set of Safety Reference Levels on the treatment and conditioning of radioactive waste and spent fuel, which can be found in the Processing Report in its current version 1.1 of April 2018.[3]

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 a 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.

[3] The current version can always be found at https://wenra.eu/wgwd

2.1

Safety area: Safety management

-

2.1.1 Safety issue: Responsibility

S-01:

The licensee of the radioactive waste or spent fuel storage facility 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:*

The operating organization shall have the prime responsibility for the safety of a nuclear fuel cycle facility over its lifetime. This responsibility includes ensuring that the design meets all applicable safety requirements. (SSR-4; requirement 2)

The operating organization and all other organizations engaged in activities important to the safety of a nuclear fuel cycle facility shall be responsible for ensuring that safety matters are given the highest priority. The operating organization shall possess the necessary competence to ensure that the facility meets all applicable safety requirements and shall retain responsibility for safety when contracting out any processes, including the design or other analysis. (SSR-4; para 4.1)

The operating organization shall establish and implement safety, health and environmental policies that give protection and safety the overriding priority warranted by their significance.

(SSR-4; requirement 3)

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. 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. […]

(SSG-15 Rev. 1; para 3.29)

[…] There should be clarity at all times regarding both ownership of the waste and responsibility for safety. […] (GSG-16; para 2.5(b))

[…] 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 responsibilities of the spent fuel owner and the responsibilities of the operating organization, if they differ, should be clearly defined and documented. (SSG-15 Rev. 1; 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)

2.1.2 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)

In order to ensure rigour and thoroughness by individuals at all levels in the achievement and maintenance of safety in all activities, the operating organization:

(a) Shall clearly define responsibilities and accountabilities for safety with corresponding lines of authority and communication and shall ensure that individuals are not given other business roles that conflict with their responsibilities for safety (…) (SSR-4; 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 establish and apply a single coherent management system in which all the constituents of the organization, including its structure, resources and processes, are integrated to enable the organization's objectives to be achieved. (SSR-4; para 4.8)

The operating organization shall be responsible for ensuring that the necessary knowledge, skills, behaviours and attitudes supporting a strong safety culture and safety expertise are sustained at the nuclear fuel cycle facility,44 and that human resource policies are developed and long-term objectives for human resources are met. (SSR-4; para 9.12)

Resource management includes measures to ensure that the resources essential to the implementation of safety policy and the enhancement of safety and the achievement of the organization's objectives are identified and made available. The management system shall ensure that:

(a) The operating organization is resourced with sufficient qualified personnel for the safe operation of the facility.
(b) Suppliers, manufacturers and designers of items important to safety have an effective management system in place.
(c) External personnel (including suppliers of both materials and services) are adequately qualified and are performing their activities under the same controls and to the same standards as the facility personnel.

(d) Equipment, tools, materials, hardware and software necessary to operate the facility at all stages of its lifetime in a safe manner are specified, supplied, checked, verified and maintained in accordance with the management system. (SSR-4; para 4.16)

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 ensure that all activities that may affect safety are performed by suitably qualified and competent persons. (SSR-4; requirement 58)

Senior management shall clearly document the duties, the responsibilities, the necessary experience and the training requirements of operating personnel, and their lines of communication. (SSR-4; para 9.14)

The operating organization shall clearly define the requirements for qualification and competence to ensure that personnel performing safety related functions are capable of safely performing their duties. (SSR-4; para 9.38)

Suitably qualified personnel shall be selected and shall be given the necessary training and instruction to enable them to perform their duties correctly for all facility states, in accordance with the appropriate procedures. (SSR-4; para 9.39)

A suitable training and retraining programme shall be established and maintained for the operating personnel. (SSR-4; para 9.40)

2.1.3 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:*

The management system shall be applied to achieve goals safely, to enhance safety and to foster a strong safety culture by:

(a) Bringing together in a coherent manner all the necessary elements for safely managing the organization and its activities;
(b) Describing the arrangements made for management of the organization and its activities;
(c) Describing the planned and systematic actions necessary to provide confidence that all requirements are met;
(d) Ensuring that safety is taken into account in decision making and is not compromised by any decisions taken. (GSR Part 2; para 4.9. See also GSG-16; para 5.42)

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 applies to registrants and licensees throughout the lifetime of facilities and the duration of activities, for all operational states and for accident conditions, and in a nuclear or radiological emergency. The lifetime of a facility includes its siting and site evaluation, design, construction, commissioning, operation and decommissioning (or closure and the post-closure period, including any subsequent period of institutional control), until its release from regulatory control. (GSR Part 2; para 1.13)

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:*

Processes and activities shall be developed and shall be effectively managed to achieve the organization's goals without compromising safety. (GSR Part 2; requirement 10)

The effectiveness of the management system shall be monitored and measured to confirm the ability of the organization to achieve the results intended and to identify opportunities for improvement of the management system. (GSR Part 2; para 6.1)

All processes shall be regularly evaluated for their effectiveness and for their ability to ensure safety. (GSR Part 2; para 6.2)

New processes or modifications to existing processes shall be designed, verified, approved and applied so that safety is not compromised. Processes, including any subsequent modifications to them, shall be aligned with the goals, strategies, plans and objectives of the organization. (GSR Part 2; para 4.30)

Each process or activity that could have implications for safety shall be carried out under controlled conditions, by means of following readily understood, approved and current procedures, instructions and drawings. These procedures, instructions and drawings shall be validated before their first use and shall be periodically reviewed to ensure their adequacy and effectiveness. Individuals carrying out such activities shall be involved in the validation and the periodic review of such procedures, instructions and drawings. (GSR Part 2; para 4.32)

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 management system shall be documented. The documentation of the management system shall be controlled, usable, readable, clearly identified and readily available at the point of use.

(GSR Part 2; requirement 8)

The documentation of the management system shall include as a minimum: policy statements of the organization on values and behavioural expectations; the fundamental safety objective; a description of the organization and its structure; a description of the responsibilities and accountabilities; the levels of authority, including all interactions of those managing, performing and assessing work and including all processes; a description of how the management system complies with regulatory requirements that apply to the organization; and a description of the interactions with external organizations and with interested parties. (GSR Part 2; para 4.16)

2.1.4 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 record keeping system on data relating to the spent fuel and the storage system, which should include the radioactive inventory, location and characteristics of the spent fuel, information on the ownership and origin of the spent fuel, and information about its characterization. An unequivocal identification system should be established, with markings that will last for the duration of the storage period. Such records should be preserved and updated to enable the implementation of the spent fuel management strategy, whether disposal or reprocessing. (SSG-15 Rev. 1; 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:*

[…] An unequivocal identification system should be established, with markings that will last for the duration of the storage period. Such records should be preserved and updated to enable the implementation of the spent fuel management strategy, whether disposal or reprocessing.
(SSG-15 Rev. 1; 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 record keeping system on data relating to the spent fuel and the storage system, which should include the radioactive inventory, location and characteristics of the spent fuel, information on the ownership and origin of the spent fuel, and information about its characterization. An unequivocal identification system should be established, with markings that will last for the duration of the storage period. Such records should be preserved and updated to enable the implementation of the spent fuel management strategy, whether disposal or reprocessing. (SSG-15 Rev. 1; 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 and/or the licensee shall ensure that sufficient records are preserved and updated during the whole storage period (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 be given detailed information concerning the characteristics of the spent fuel received for storage. This information should be supplied by the nuclear facility that generated the spent fuel (i.e. nuclear power plant or research reactor). […]

(SSG-15 Rev. 1; para 6.119)

[…] 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)

2.2
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.

2.2.1 Safety issue: Storage facility design requirements

S-19:
The storage facility shall be designed to fulfil the fundamental applicable safety functions:
- control of sub-criticality,
- removal of heat,
- radiation shielding,
- confinement of radioactive material,
- retrievability

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

*Related **IAEA** safety standards:*

The storage facility should be designed to fulfil the main safety functions; that is, maintaining subcriticality, removal of heat, confinement of radioactive material and shielding from radiation and, in addition, retrievability of the fuel or spent fuel packages. […]

(SSG-15 Rev. 1; para 6.4. See also WS-G-6.1; para 6.23)

The design shall be such that the following main safety functions are met for all facility states of the nuclear fuel cycle facility:

(a) Confinement and cooling of radioactive material and associated harmful materials;
(b) Protection against radiation exposure;
(c) Maintaining subcriticality of fissile material. (SSR-4; requirement 7)

[…] A systematic approach shall be taken to identifying those items important to safety that are necessary to fulfil the main safety functions and to defining the conditions and inherent features that contribute to or affect fulfilling the main safety functions for all facility states. A hazards analysis (or equivalent) shall be conducted to identify all design basis accidents and their associated initiating

events that could challenge or cause the failure of the main safety functions and result in unacceptable consequences. […] (SSR-4; para 6.1)

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)

The operating organization should demonstrate in the safety case that, to the extent possible, passive safety features are applied. In the assessment of long term safety, the degradation of passive barriers over time should be taken into account. (SSG-15 Rev. 1; para 5.7)

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 confinement functions under the storage and loading and unloading conditions expected throughout its design lifetime, unless adequate maintenance and/or replacement methods during operation can be demonstrated. […] (SSG-15 Rev. 1; appendix I.53)

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, associated safety limits and items important to safety shall be identified in the safety analysis report, which shall also provide details about the operating organization, the conduct of operations and the management system throughout the lifetime of the nuclear fuel cycle facility. […] (SSR-4; para 3.7)

The level of detail in the information to be presented in the safety analysis report shall be determined using a graded approach. (SSR-4; para 3.8)

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.[4]

*Related **IAEA** safety standards:*

Design safety margins shall be adopted so as to accommodate the anticipated properties of items important to safety, to allow for the effects of materials ageing and degradation processes.
(SSR-4; requirement 32)

[4] 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 operating organization shall ensure that an effective ageing management programme is implemented to manage the ageing of items important to safety so that the required safety functions are fulfilled over the entire operating lifetime of the nuclear fuel cycle facility.

(SSR-4; requirement 60)

Items important to safety shall be designed to facilitate maintenance, inspection and testing for their functional capability over the lifetime of the facility. (SSR-4; requirement 26)

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)

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 should be provided to all structures, systems and components and areas requiring periodic maintenance, inspection and testing. Such access should be adequate for the safe operation of all necessary tools and equipment and for the installation of spare parts.

(SSG-15 Rev. 1; 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)

Operational limits and conditions are a set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel for the safe operation of a facility. Operational limits and conditions necessary for safe operation shall be developed in the design stage for a new facility and updated, if necessary, during commissioning to allow time for validation and approval. (SSR-4; para 6.58)

Operational limits and conditions shall be prepared in the design stage, confirmed in the commissioning stage and established before operations of the facility commence. (SSR-4; requirement 18)

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 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;
(d) Consideration of the technical specifications for each item important to safety and the need to ensure that such items continue to function in the event of any specified fault occurring or recurring;
(e) The need for items important to safety to be available to ensure safety in operational states including maintenance;
(f) Specification of the equipment that should be available to enable a full and proper response to postulated initiating events or design basis accidents;
(g) The minimum staffing levels that need to be available to operate the spent fuel storage facility safely. (SSG-15 Rev. 1; para 6.102 and table I)

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 should be subject to approval by the regulatory body as part of the licence conditions. (SSG-15 Rev. 1; para 6.103)

The aim of operational limits and conditions should be to manage and control the hazards associated with the facility. Operational limits and conditions should be directed towards:

(a) Preventing situations that might lead to the unplanned exposure of workers and the public to radiation;

(b) Mitigating the consequences of any such events, if they were to occur.

(SSG-15 Rev. 1; para 6.104)

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:*

Postulated initiating events, including human induced events, that could affect safety shall be identified and their effects, both individually and in credible combinations, shall be evaluated.

(SSR-4; requirement 19)

Postulated initiating events that might influence the design of the spent fuel storage facility and the integrity and safety of the spent fuel should be identified. (SSG-15 Rev. 1; para 5.18)

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:*

The design shall ensure an adequate margin of subcriticality, under operational states and conditions that are referred to as credible abnormal conditions, or conditions included in the design basis.

(SSR-4; requirement 38)

For the prevention of criticality by means of design, the double contingency principle shall be the preferred approach. […] (SSR-4; para 6.142)

Approval to consider burnup credit in the safety assessment should be granted only if based on 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. (SSG-15 Rev. 1, 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 arrangements for ensuring protection against fire and explosion.
(SSR-4; requirement 69)

The arrangements for ensuring fire safety made by the operating organization shall cover the following: adequate management for fire safety; preventing fires from starting; detecting and extinguishing quickly any fires that do start; preventing the spread of those fires that have not been extinguished (e.g. fire zoning of the facility, with adequate fire barriers between zones); and providing sufficient protection from fire to permit the facility to be brought to a safe and stable state. […]
(SSR-4; para 9.109)

2.2.2 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 accidents and other incidents, and to minimize the potential for damaging spent fuel, spent fuel assemblies and storage or transport casks. […] (SSG-15 Rev. 1; 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)

2.2.3 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) Sufficient space should be provided to permit inspection of spent fuel and inspection and maintenance of components, including spent fuel handling equipment. [...] (SSG-15 Rev. 1; para 6.47)

The facility should have a reserve storage capacity, which should be included in the design or should be otherwise available, for example in order 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. (SSG-15 Rev. 1; 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)

2.3
Safety area: Operation

–

2.3.1 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, for example in order 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. (SSG-15 Rev. 1; 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)

2.3.2 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 operating organization is required to prepare an emergency plan and the necessary procedures and analytical tools for on-site emergency preparedness and effective response. The operating organization is required to coordinate this emergency plan with those of all other bodies that have responsibilities in a nuclear or radiological emergency, including public authorities, and submit it to the regulatory body for approval. Account is required to be taken, in the content, features and extent of the emergency plan, of the results of the hazard assessment and any lessons identified from operating experience and from past emergencies, including conventional emergencies. The operating organization should demonstrate to the regulatory body, as part of the safety case, that the emergency arrangements provide for sufficient assurance of an effective on-site emergency response and that they are in place.
(SSG-15 Rev. 1; para 3.28)

Hazards should be identified and potential consequences of an emergency should be assessed to provide a basis for establishing on-site as well as off-site emergency arrangements associated with the storage of spent fuel. As such, the hazard assessment should be provided to off-site authorities to

inform their emergency planning, either by the operating organization or the regulatory body. A graded approach to emergency preparedness and response will need to be applied, in accordance with the results of the hazard assessment in line with GSR Part 7 and GS-G-2.1. (SSG-15 Rev. 1; 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 appendix 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:*

In addition to providing operating procedures for normal operation and emergency operating procedures as described above, the operating organization should also develop an on-site emergency plan in accordance with the requirements established in GSR Part 7. (SSG-15 Rev. 1; para 6.99)

The appropriate responsible authorities shall ensure that:

(a) A 'concept of operations' for emergency response is developed at the beginning of the preparedness stage.

(b) Emergency plans and procedures are prepared and, as appropriate, approved for any facility or activity, area or location that could give rise to an emergency warranting protective actions and other response actions.

(c) Response organizations and operating organizations, as appropriate, are involved in the preparation of emergency plans and procedures, as appropriate.

(d) Account is taken in the content, features and extent of emergency plans of the results of any hazard assessment and any lessons from operating experience and from past emergencies, including conventional emergencies.

(e) Emergency plans and procedures are periodically reviewed and updated.

(GSR Part 7; para 6.18)

The operating organization and response organizations shall identify the knowledge, skills and abilities necessary to perform the functions specified in Section 5. The operating organization and response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel selected have the requisite knowledge, skills and abilities to perform their assigned response functions. The arrangements shall include arrangements for continuing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities in an emergency response undergo the specified training. (GSR Part 7; para 6.28)

The operating organization shall establish and maintain arrangements for on-site preparedness and response for a nuclear or radiological emergency for facilities or activities under its responsibility, in accordance with the applicable requirements. These arrangements shall be commensurate with the

hazards identified and the potential consequences associated with the nuclear fuel cycle facility and shall take the associated non-radiological hazards into account, including chemical hazards.

(SSR-4; para 9.120)

The operating organization shall develop emergency arrangements in accordance with the applicable requirements and shall establish the necessary emergency plans and organizational structure, with assigned authority and responsibilities for managing an emergency response. When appropriate, the operating organization shall coordinate with off-site response organizations in the development of on-site and off-site emergency arrangements that are consistent with one another and that can be promptly executed and effectively managed. Emergencies that involve multiple locations shall be considered in the arrangements. (SSR-4; para 9.122)

S-39:

The on-site 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 subject to approval by the regulatory body, as appropriate, and shall be tested in an exercise before radioactive material is introduced into the facility. (SSR-4; para 9.123)

Exercise programmes shall be developed and implemented in accordance with GSR Part 7. Exercises shall be conducted at suitable intervals and shall involve, to the extent practicable, all those individuals with duties in responding to an emergency. Exercises shall be evaluated and lessons identified shall be used to revise, as necessary, the established emergency arrangements. (SSR-4; para 9.130)

2.3.3 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 safety relevant 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.

(SSG-15 Rev. 1; 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:*

The management system should include procedures for the provision of feedback on operating experience from activities undertaken at the installation, as part of the operating experience programme implemented to prevent recurrence of events and to enhance safety. (SSG-50; para 2.11)

Management should ensure that all personnel are informed about the objectives of the operating experience programme and their role in its implementation. Expectations for the identification and reporting of events, performance weaknesses and negative trends should be communicated effectively to ensure that those expectations are met by everyone at the installation, including contractors. Opportunities for improvement and good practices should also be clearly communicated. The expectations should be communicated through formal means, such as briefings and group meetings, written instructions and training; through informal means, such as newsletters and information systems; and by example, such as through supervision and coaching. (SSG-50; para 2.19)

Management should ensure that corrective actions resulting from the operating experience programme are given appropriate priority within budgetary and staffing plans to ensure that they are implemented, with follow-up to review their effectiveness. This should also include the implementation of corrective actions relating to radioactive waste minimization and the early allocation of adequate funds for decommissioning. (SSG-50; para 2.20)

Operating experience and events at the facility and reported by operating organizations of 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 [….]. (SSG-15 Rev. 1; para 6.100)

2.3.4 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:*

Operational control of modifications: The operating organization shall establish and implement a programme for the control of modifications to the facility. (SSR-4; requirement 61)

The operating organization should establish procedures on how to analyse the need for and how to implement modifications to the spent fuel storage facility, storage conditions and the spent fuel to be stored. As part of the procedures, the potential consequences of such modifications and of the works performed to implement them should be evaluated, including consequences for the safety of other facilities and also for the retrieval, transport, reprocessing and disposal of spent fuel. The procedures should be commensurate with the significance of the proposed modifications for safety.
(SSG-15 Rev. 1; para 3.25)

The maintenance and modification of any item of equipment, process or document of the spent fuel storage facility should be subject to specified procedures. These procedures should be subject to authorization before they are implemented. The procedures should describe the categorization of the modification in accordance with its safety significance. Depending on the safety categorization, each modification will be subject to varying levels of review and approval by management of the facility and the regulatory body. (SSG-15 Rev. 1; para 6.92)

S-43:

Before introducing a modification according to S-42, personnel shall, as appropriate, 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:*

[…] 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.

(SSG-15 Rev. 1; 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 any revisions to plant documentation, personnel training and plant simulators necessitated by the modifications are implemented in a complete, correct and timely manner as part of the modification programme. (SSG-71; para 3.10)

2.3.5 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, periodic testing and inspection shall be conducted to ensure that items important to safety are able to function in accordance with their design intent and safety requirements, in compliance with the operational limits and conditions, and shall support the long term safety of the facility. In this context, maintenance includes both preventive actions and corrective actions.

(SSR-4; para 9.74)

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 of maintenance, periodic testing and inspection of individual items important to safety shall be adjusted on the basis of experience and shall be such as to ensure adequate reliability. […]

(SSR-4; para 9.80)

Programmes based on the safety assessment report shall be established for the maintenance, periodic testing and inspection of all items important to safety and shall be documented. It shall be ensured by means of these programmes that the level of safety is not reduced during the conduct of maintenance, periodic testing and inspection. (SSR-4; para 9.76)

S-46:

The result of maintenance, periodic testing and inspection shall be recorded and assessed.

*Related **IAEA** safety standards:*

Programmes based on the safety assessment report shall be established for the maintenance, periodic testing and inspection of all items important to safety and shall be documented. […] (SSR-4; para 9.76)

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, periodic testing and inspection programmes and their performance shall be reviewed at regular intervals to incorporate lessons learned from experience (see Requirement 73). All maintenance, periodic testing and inspection of items important to safety shall be carried out by following approved procedures. (SSR-4; para 9.77)

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:*

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 waste management programme shall include, as appropriate, the collection, characterization, classification, processing (pretreatment, treatment and conditioning), transport and storage of radioactive waste, the discharge of effluents and the disposal of waste. All activities concerning radioactive waste and associated hazardous chemical waste and effluents shall be conducted in accordance with the management system. Further requirements on the predisposal management of radioactive waste are established in GSR Part 5. (SSR-4; para 9.103)

The integrity of stored spent fuel should be monitored during the operation of a spent fuel storage facility. [….] (SSG-15 Rev. 1; para 6.101)

2.3.6 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, with account taken of all relevant operational limits and conditions and future demands for reprocessing or disposal, including retrieval of the spent fuel. Before spent fuel is transferred to a storage facility, acceptance must be given by the operating organization of the facility and the regulatory body. Contingency plans should be developed and made available to cover how to deal safely with spent fuel that does not comply with acceptance criteria. (SSG-15 Rev. 1; 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 appropriate monitoring should be provided to detect any failure of the outer containment. 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.

(SSG-15 Rev. 1; para 6.127)

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)

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

S-51:

The owner and/or the licensee 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 typically include the following:

(d) Development and application of acceptance criteria for the storage of spent fuel, as approved by the regulatory body; […] (SSG-15 Rev. 1; 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. (SSG-15 Rev. 1; para 6.118)

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 to determine gamma and neutron radiation levels, leakage and surface contamination and to ensure that the casks are consistent with the accompanying documentation. Characterization of the spent fuel, for example by means of process control and process monitoring, should be applied as part of the management system for the facility.
(SSG-15 Rev. 1; para 6.120)

2.4
Safety area: Safety verification

-

2.4.1 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 analysis 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. See also requirement 13, S-55)

The licensing documentation shall provide a basis for the safety of the facility at all stages of its lifetime and shall be updated periodically, to take account of modifications made to the facility and other changes. (SSR-4; requirement 1)

The safety case and supporting safety assessment, including the management system for their implementation, should be periodically reviewed in accordance with regulatory requirements. The review of the management system should include aspects of safety culture. In addition, the safety case and supporting safety assessment should be reviewed and updated:

(a) When there is any significant change to the facility or to its radionuclide inventory that might affect safety.
(b) When changes occur in the site characteristics that might impact the storage facility (e.g. industrial development or changes in the surrounding population).
(c) When significant changes in knowledge and understanding occur (e.g. from research data or from feedback of operating experience).
(d) When there is an emerging safety issue due to a regulatory concern or an incident.
(e) Periodically, at predefined periods, as specified by the regulatory body. Some States specify that periodic safety review be carried out at least once every ten years.

(SSG-15 Rev. 1; para 5.26)

Safety should be reassessed in the case of significant, unexpected deviations in storage conditions, for example if those properties of the spent fuel that are relevant to safety begin to deviate from those taken as a basis in the safety assessment. (SSG-15 Rev. 1; para 5.27)

2.4.2 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; para 5.12)

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:*

In accordance with national regulatory requirements, the operating organization shall carry out systematic periodic safety reviews of the nuclear fuel cycle facility throughout its lifetime, with account taken of ageing, modifications, human and organizational factors, operating experience, technical developments, new information on site evaluation and other information relating to safety from other sources. The operating organization shall verify by analysis, surveillance, testing and inspection that the physical state of the facility, including any modifications, is as described in the safety analysis report and other safety documents and that the facility was commissioned and is operated in accordance with the safety analysis and operational limits and conditions. (SSR-4; para 4.26)

(see also S-59)

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)

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)

All PSR documentation should be stored using a suitable system to allow easy retrieval and examination, by both the operating organization and the regulatory body. The documentation should contain the final versions of the PSR documents and information on lessons learned from the PSR.
(SSG-25; para 9.2)

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

Natural phenomena would include:

(a) Extreme weather conditions: precipitation including rain, hail, snow, ice, frazil ice; wind including tornadoes, hurricanes, cyclones, dust storms, sand storms; lightning; extreme high or low temperatures; extreme humidity.
(b) Flooding.
(c) Earthquakes and eruptions of volcanoes.
(d) Natural fires.
(e) Effects of terrestrial and aquatic flora and fauna (leading to blockages of inlets and outlets, and damage to structures).

Human induced phenomena

Human induced phenomena would include:

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

INTERNAL POSTULATED INITIATING EVENTS

Internal events would include:

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

(NS-R-5 Rev. 1; Annex I)[5]

[5] A more detailed list of selected postulated initiating events can be found in the Appendix of SSR-4, the document that has superseded NS-R-5 Rev. 1 in 2017

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).

Since formulation of this section, NS-R-5 has been superseded by SSR-4. The relevant passages of SSR-4 and, in conjunction therewith, of GSR Part 7 are as follows:

The emergency plan shall cover all the functions planned to be carried out in an emergency, as stated in section 5 of GSR Part 7, in accordance with a graded approach. Emergency procedures shall be based on the accidents analysed in the safety analysis report as well as those additionally postulated for the purposes of emergency planning, in accordance with the requirements of GSR Part 7. (SSR-4; para9.124)

***Requirement 6:** Managing operations in an emergency response*
The government shall ensure that arrangements are in place for operations in response to a nuclear or radiological emergency to be appropriately managed.

***Requirement 7:** Identifying and notifying a nuclear or radiological emergency and activating an emergency response*
The government shall ensure that arrangements are in place for the prompt identification and notification of a nuclear or radiological emergency and for the activation of an emergency response.

***Requirement 8:** Taking mitigatory actions*
The government shall ensure that arrangements are in place for taking mitigatory actions in a nuclear or radiological emergency.

***Requirement 9:** Taking urgent protective actions and other response actions*
The government shall ensure that arrangements are in place to assess emergency conditions and to take urgent protective actions and other response actions effectively in a nuclear or radiological emergency.

Requirement 10: *Providing instructions, warnings and relevant information to the public for emergency preparedness and response*
The government shall ensure that arrangements are in place to provide the public who are affected or are potentially affected by a nuclear or radiological emergency with information that is necessary for their protection, to warn them promptly and to instruct them on actions to be taken.

Requirement 11: *Protecting emergency workers and helpers in an emergency*
The government shall ensure that arrangements are in place to protect emergency workers and to protect helpers in a nuclear or radiological emergency.

Requirement 12: *Managing the medical response in a nuclear or radiological emergency*
The government shall ensure that arrangements are in place for the provision of appropriate medical screening and triage, medical treatment and longer term medical actions for those people who could be affected in a nuclear or radiological emergency.

Requirement 13: *Communicating with the public throughout a nuclear or radiological emergency*
The government shall ensure that arrangements are in place for communication with the public throughout a nuclear or radiological emergency.

Requirement 14: *Taking early protective actions and other response actions*
The government shall ensure that arrangements are in place to take early protective actions and other response actions effectively in a nuclear or radiological emergency.

Requirement 15: *Managing radioactive waste in an emergency*
The government shall ensure that radioactive waste is managed safely and effectively in a nuclear or radiological emergency.

Requirement 16: *Mitigating non-radiological consequences of a nuclear or radiological emergency and of an emergency response*
The government shall ensure that arrangements are in place for mitigation of non-radiological consequences of a nuclear or radiological emergency and of an emergency response.

Requirement 17: *Requesting, providing and receiving international assistance for emergency preparedness and response*
The government shall ensure that adequate arrangements are in place to benefit from, and to contribute to the provision of, international assistance for preparedness and response for a nuclear or radiological emergency.

Requirement 18: *Terminating a nuclear or radiological emergency*
The government shall ensure that arrangements are in place and are implemented for the termination of a nuclear or radiological emergency, with account taken of the need for the resumption of social and economic activity.

Requirement 19: *Analysing the nuclear or radiological emergency and the emergency response*
The government shall ensure that the nuclear or radiological emergency and the emergency response are analysed in order to identify actions to be taken to avoid other emergencies and to improve emergency arrangements.

(GSR Part 7; requirements 6-19)

In addition to the listed requirements of GSR Part 7 addressing the essential functions in response to a nuclear or radiological emergency, paras 5.2 to 5.105 offer detailed specifications on how to understand and implement these requirements.

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 section 1.1.3) and therefore does not specifically address items such as EIA, physical protection including 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 specific safety case and supporting assessment for a spent fuel storage facility 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. (…) (SSG-15 Rev. 1; para 5.21)

The components of the safety case are indicated in Fig. 1 and should include the following: the context; the safety strategy; the facility description; safety assessment; limits, controls and conditions; iteration and design optimization; uncertainty management; and integration of safety arguments. (GSG-3; para 4.2)

Therefore, the facility design and the fundamental assumptions upon which the design is based should be addressed in depth in the safety case. The safety case should include: a full description of the structures, systems and components of the facility and their importance for safety; the quantity and characteristics of the waste to be handled at the facility; the range of conditions under which the facility may operate; the hazards to which the facility may be exposed; and the required performance criteria. (GSG-3; para 4.36)

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

  *Related **IAEA** safety standards:*

  A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)
  (b) A description of spent fuel handling and storage activities and any other operations at the facility. (…) (SSG-15 Rev. 1; para 5.21)

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

  *Related **IAEA** safety standards:*

  Safety assessment should cover the storage facility and the type of spent fuel to be stored and the storage arrangements. In this regard, the types, quantities, initial enrichment, burnup, integrity, heat production, storage mode (wet or dry storage) and physical and chemical characteristics of the spent fuel are basic aspects that need to be included in the safety assessment of the spent fuel storage facility. (SSG-15 Rev. 1; para 5.19)

  Data on the type of radioactive waste to be processed (i.e. pretreated, treated and conditioned) or stored, as well as on material that is to be cleared or discharged at the facility or within the activity, should be collected with respect to the volume and form of the waste, the radionuclides of concern, the radioactive content, the presence of fissile materials, and other physical, chemical and pathogenic properties. Secondary waste streams that may arise from waste processing should be included. (GSG-3; para 4.44)

- 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 should provide evidence for the expected lifetime of the facility. The expected lifetime of the facility needs to be sufficient for the activity being undertaken. [...]
  (GSG-3; para 6.47)

- 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:*

  A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: […]

(h) Documentation of safety analyses and the safety assessment for inclusion in the licensing documentation for the facility. (…)
(m) The expected values for subcriticality, heat removal capacity and radiation doses within and at the boundary of the spent fuel storage facility. (…) (SSG-15 Rev.1; para 5.21)

The safety case has to address operational safety and all safety aspects of the facility and activities. The safety case has to include considerations for reducing hazards posed to workers, members of the public and the environment during normal operation and in possible accident conditions. (GSR Part 5; para 5.5)

– describe the management system;

*Related **IAEA** safety standards:*

A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)
(t) The management system. (…) (SSG-15 Rev.1; para 5.21)

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. These activities are required to be sup-ported by means of an effective management system that establishes and maintains a strong safety culture. (GSR Part 5; para. 3.24)

(…) The other important aspects subject to safety assessment are site and engineering aspects, operational safety, non-radiological impacts and the management system. (…) (GSG-3; para 4.4)

– describe the provisions for the management and minimization of waste produced during operation of the facility;

*Related **IAEA** safety standards:*

A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)
(v) Provisions for the management of radioactive waste and for decommissioning. (…)
(SSG-15 Rev. 1; para 5.21)

The design of the facility, the arrangements for operational management and the systems and processes that are used have to be considered and justified in the safety case. This has to involve the identification of waste arisings and the establishment of an optimal programme of waste management to minimize the amount of waste generated and to determine the design basis and operational basis for the treatment of effluents, the control of discharges and clearance procedures. The primary aim of the safety case is to ensure that the safety objectives and criteria set by the regulatory body are met. (GSR Part 5; para 5.5)

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

  *Related **IAEA** safety standards:*

  A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)
  (i) The commissioning programme. (…) (SSG-15 Rev. 1; para 5.21)

  In commissioning, specific attention should be paid to the performance of structures, systems and components important to safety. The safety case should be capable of demonstrating that the as-built facility meets the safety requirements specified in the final design. This should include the impact of any modifications to the design that have been implemented during the construction period. (GSG-3; para 6.17)

  A schedule should be prepared for commissioning that details the tests to be undertaken and the expected results, to ensure that all aspects of the facility important to safety are adequately tested. (GSG-3; para 6.18)

- 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 specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: […]
  (n) Monitoring programmes, including a programme for verification of the integrity of the shielding, a programme for surveillance of the condition of stored spent fuel and a programme for surveillance of stored spent fuel assemblies, if appropriate. […]
  (SSG-15 Rev. 1; para 5.21)

  As long term storage is an interim measure, the safety case should describe the provisions for the regular surveillance, inspection and maintenance of the waste and the storage facility to ensure their continued integrity over the anticipated lifetime of the facility. (GSG-3; para 6.58)

- 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 specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)

(g) Establishment of operational limits and 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. (…)

(SSG-15 Rev. 1; para 5.21)

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 specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as:[…]

(k) Procedures and operational manuals for activities with significant safety implications, including procedures for response to the malfunction of equipment. […]

(SSG-15 Rev. 1; para 5.21)

Operations shall be based on documented procedures. [...] (GSR Part 5; requirement 19).

- the operational inspection, maintenance and testing provisions,

*Related **IAEA** safety standards:*

A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: (…)

(j) Organizational control of operations.

(l) The programme for periodic maintenance, inspection and testing. […]

(SSG-15 Rev. 1; para 5.21)

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).

As long term storage is an interim measure, the safety case should describe the provisions for the regular surveillance, inspection and maintenance of the waste and the storage facility to ensure their continued integrity over the anticipated lifetime of the facility. (GSG-3; para 6.58)

- the operational experience feedback programme,

*Related **IAEA** safety standards*

A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: …
(o) A programme for feedback of operating experience and its inclusion in manuals, guidelines and training. […] (SSG-15 Rev.1; para 5.21)

[…] the safety case and supporting safety assessment are to be reviewed and updated periodically as necessary to reflect actual experience and increasing knowledge and understanding (e.g. knowledge gained from scientific research), with account taken of any relevant operational experience feedback or other aspects that are relevant for safety. […] (GSG-3; para 4.15)

- the programme for management of ageing;

*Related **IAEA** safety standards*

For storage beyond the original design lifetime, a re-evaluation should be performed 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. If, during the design lifetime, an extension to the storage period is foreseen, a precautionary approach should be applied, in particular through validation of the adequacy of the design assumptions for the extended period envisaged. (SSG-15 Rev. 1; para 5.28)

[…] An ageing management programme should be established to deal with ageing related degradation. The monitoring necessary for early detection of any deficiency should be specified in the ageing management programme. (GSG-3; para 6.50)

– describe the arrangements for qualification and training of personnel;

*Related **IAEA** safety standards:*

A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: …
(p) The training programme for staff. […] (SSG-15 Rev.1; para 5.21)

In addition to issues relating to the design and construction, the safety of a facility or activity also depends on operational aspects such as operating and maintenance procedures, controls and monitoring. The organizational structure and staffing of the operator, particularly those aspects of safety culture, required personnel competencies, safety measures and the quality of training, have often been linked to the frequency of human induced events. (GSG-3); para 4.41)

Although operational aspects of the facility or activity are difficult to quantify, their consideration forms an important part of the safety case. Their importance to the overall safety of a facility or activity requires that they be given appropriate consideration in the safety assessment and within the broader context of the safety case for the facility or activity. […] (GSG-3; para 4.42)

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

  *Related **IAEA** safety standards:*

  A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as […]
  (q) The on-site emergency plan. […] (SSG-15 Rev. 1; para 5.21)

  Although operational aspects of the facility or activity are difficult to quantify, their consideration forms an important part of the safety case. Their importance to the overall safety of a facility or activity requires that they be given appropriate consideration in the safety assessment and within the broader context of the safety case for the facility or activity. In the context of addressing operational aspects, emergency planning and security measures should also be addressed.
  (GSG-3; para 4.42)

  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[6];

  *Related **IAEA** safety standards:*

  A specific safety case and supporting assessment for a spent fuel storage facility should generally include aspects such as: […]
  (v) Provisions for the management of radioactive waste and for decommissioning. […]
  (SSG-15 (Rev. 1); para 5.21)

  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 safety case should provide evidence that the facility can be safely decommissioned. Where a treatment facility is developed for all decommissioning waste, it should be recognized that the treatment facility itself will also generate decommissioning waste in the future that will need some sort of appropriate treatment. (GSG-3; para 6.25)

  Every waste management facility will eventually be closed and decommissioned. From the very earliest stage of the development of the safety case, this must be addressed to justify decisions on its safety. The justification should be based upon techniques that are currently available and should take into account the level of resources that are likely to be available at the time of closure.
  (GSG-3; para 6.27)

[6] Further details on the structure and content of decommissioning plan are covered by WGWD document "Decommissioning Safety Reference Levels Report", the current version of which can be found at https://wenra.eu/wgwd

Part 3

Benchmarking Results and Action Plans

WENRA WGWD started to work in 2002 on the development of Safety Reference Levels for the storage of spent fuel and radioactive waste – at first a set of 77 SRLs, the so-called version 1, later refined to 61 SRLs that make up version 2 which still constitutes the basis for this report.

This SRL set was used to benchmark the member states' regulatory framework, the so-called 'legal' benchmark. To put the requirements expressed in the SRLs into effect in the member states, the SRLs must be transposed or otherwise included in the national regulatory framework. The benchmarking itself is a stepwise process to establish confidence that this has been done in each member state. It consists of an initial self-assessment in which each WENRA member reflects about the state of SRL implementation within their national regulations and offers supporting proof, for the cases where the implementation is seen as sufficient, by providing the relevant excerpts from their regulatory framework. This self-assessment is then reviewed and evaluated by the other members. The results are expressed in form of a rating with the categories being defined as follows:

- An 'A' rating means that the requirement is covered explicitly by the national regulatory system: no action is required.
- A 'B' rating means that a difference exists but can be justified from a safety point of view: no action is required.
- A 'C' rating means that a difference exists and needs to be addressed by the member.

The list of SRLs for which implementation in the regulatory framework has been found to be lacking or insufficient – the so-called 'C' ratings – define the National Action Plan. It is each member's responsibility to resolve any such deficiencies in their national regulations and then present it back to their WENRA peers, essentially starting a new benchmarking process for the contents of its National Action Plan.

While the details of benchmarking have undergone some changes with time – in particular an increase in the use of online technologies in the wake of Covid and international conflicts – the principles stayed the same since the inception of the process some 20 years ago, so that benchmarking as a form of regulatory peer review, based on set of requirements tailor-made

for a specific group of countries in a specific situation, has become one of the cornerstones of WENRA's efforts to develop a harmonized international approach to nuclear safety.

This report tries to highlight recent efforts of the members, i.e. since the publication of the last report version in 2014, to implement the storage SRLs into their national regulatory framework. This entails those efforts of the past – e.g. the refining of SRLs while at the same time starting the benchmarking process, or the conduct of an 'implementation benchmark' to analyse how the storage SRLs had been implemented not at a regulatory but at the facility level in the member states – have been deemphasized in the composition of this report. However, version 2.2 of the Storage Report will be kept available on WENRA's Web site[7], including its detailed account of the early efforts of WGWD to arrive at the point that was to be the starting point of the efforts portrayed here.

[7] The report can currently be found at
https://www.wenra.eu/sites/default/files/workinggroups/wgwd/wgwd_storage_report_final.pdf

3.1
Country Implementation Reports

The initial benchmarking process for the storage SRLs was to be concluded at the end of 2013. Last benchmarking exercises were conducted up into the spring meeting of 2014, WGWD 32, which culminated in the publication of version 2.2 of the Storage Report in April 2014. At this point, 10 of the then 17 members had provided conclusive proof of their implementation of the full set storage SRLs in their national regulations. However, for some member states, not all 'C' ratings had been resolved in time to include their efforts in this report version. This was mainly due to the duration legislative processes can demand when the SRL requirements are to be implemented on a statutory level. The following section aims to present the regulatory progress made by these member states in implementing the SRL requirements since 2014.

This progress is presented, as done previously, in the form of tables reflecting on the current state of the National Action Plans, i.e., the 'C' ratings remaining within the v2.2 Storage Report. Thus, the only results presented here are those that were rated 'C' before, and any change to an 'A' or a 'B' rating signifies regulatory progress made by the member state. This table is supported by an explanatory text provided by the WENRA member in which the steps and efforts of the preceding reporting period are summarised and the planned steps for the implementation of remaining 'C' ratings, if any, are described.

A special case is SNRIU of Ukraine which joined WENRA as a full member only in 2015, after the publication of the previous report version. The benchmarking results presented in this report are the outcome of the very first Ukrainian benchmarking for the storage of spent fuel and radioactive waste, and the found 'C' ratings now define the National Action Plan to be implemented. Furthermore, the Czech Republic has implemented so significant updates to their national regulatory framework since 2014 that it opted to re-do a full benchmarking from scratch. This has been completed and full compliance of the Czech regulations for storage has been found by WGWD; for reasons of consistency, only those SRLs are presented here that were found 'C' in the previous benchmarking.

Belgium

Regulatory changes taken for the National Action Plan

In Belgium, most of the WENRA Waste and Spent Fuel Storage Safety Reference Levels are covered by the generic chapter 2 of the Royal Decree "Safety requirements for nuclear installations", published on November 30th, 2011. This chapter 2 includes the WENRA Reactor Safety Reference Levels that Belgium considered to be applicable to all its major nuclear installations (class I installations), which includes Waste and Spent Fuel Storage installations. A modification of article 14 "Periodic safety review" of this chapter 2 was published on October 19th, 2018 and responds to the Safety Reference Level S-59.

To comply with the remaining Waste and Spent Fuel Storage Safety Reference Levels, an additional chapter 4 on spent fuel and radioactive waste storage facilities, was added to the Royal Decree on 30th November 2011. The addition to the Royal decree was finally published on June 18th, 2018. Given that all (proposed) changes were endorsed by the WENRA WGWD at the 29th WGWD meeting, Belgian regulations is now in full agreement with the requirements mandated by the WGWD SRLs.

Belgian benchmarking results of the NAP

Spent fuel and radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-16	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 36 : Operation)
S-19	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 33 : Safety functions)
S-20	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-21	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-22	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section III Nuclear safety verification, Article 40 : Safety case)

S-27	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 35 : Operational limits and conditions)
S-31	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-32	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-33	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-34	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section I Storage facility design and construction, Article 34 : Design and construction)
S-35	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 36 : Operation)
S-36	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 36 : Operation)
S-48	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 38 : Inspection program)
S-49	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 39 : Deviation)
S-50	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 39 : Deviation)
S-51	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 37 : Compliance criteria)
S-52	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 37 : Compliance criteria)
S-53	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 37 : Compliance criteria)

S-54	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 37 : Compliance criteria)
S-57	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section III Safety verification, Article 40 : Safety case)
S-59	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 2, Section IV Nuclear safety verification, Article 14 : Periodic review)
S-60	**A**	FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section II Storage facility operation, Article 39 : Deviation) FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 4, Section III Nuclear safety verification, Article 41 : Periodic safety review of storage facilities) FANC 30/11/2011 : Royal Decree of 30 November 2011 on the safety requirements for nuclear installations (Chapter 2, Section IV Nuclear safety verification, Article 14 : Periodic review)

Bulgaria

As per v2.2 of this report, the Bulgarian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Czech Republic

Regulatory changes taken for the National Action Plan

The WGWD Safety Reference Levels for waste and spent fuel storage were considered by the development of new legal framework which went into the force on January 1, 2017.

New Atomic Act No. 263/2016 Coll., Decree No. 377/2016 Col., on the requirements for the safe management of radioactive waste and on the decommissioning of nuclear installations or category III or IV workplaces and other decrees consider all WGWD safety reference levels. Based on them a new self-assessment has been performed in 2017 and benchmarked by the WGWD members in 2021. As the same requirements as those applicable to radioactive waste are applicable to spent fuel, the self-assessment results are the same for radioactive waste and for the spent fuel. These results are listed in table below.

It can be concluded that the Czech regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Czech benchmarking results of the NAP

Spent fuel storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-02	**A**	Article 14 (408/2016 Coll.) Article 15, Section 3 (408/2016 Coll.)
S-10	**A**	Article 49 (263/2016 Coll.) Article 30 (263/2016 Coll.) Article 12 (408/2016 Coll.)
S-11	**A**	Article 3 (408/2016 Coll.)
S-12	**A**	Article 29 (263/2016 Coll.) Article 9 (263/2016 Coll.)
S-13	**A**	Article 29 (263/2016 Coll.)
S-14	**A**	Article 14 (408/2016 Coll.) Article 29 (263/2016 Coll.)
S-16	**A**	Article 6 (377/2016 Coll.
S-21	**A**	Article 12 (329/2017 Coll.) Article 2 (377/2016 Coll.)
S-23	**A**	Article 46 (263/2016 Coll.) Article 2 (377/2016 Coll.)
S-28	**A**	Article 10 (329/2017) Article 21 (329/2017)
S-34	**A**	Article 18 (329/2017 Coll.)
S-36	**A**	Article 6 (377/2016 Coll.)
S-37	**A**	Article 5 (263/2016 Coll.) Article 49 (263/2016 Coll.) Article 153 (263/2016 Coll.) Article 151 (263/2016 Coll.) Article 156 (263/2016 Coll.)
S-40	**A**	Article 5 (263/2016 Coll.) Article 13 (162/2017 Coll.) Article 11 (408/2016 Coll.)
S-41	**A**	Article 5 (263/2016 Coll.) Article 22 (21/2017 Coll.)
S-47	**A**	Article 22 (21/2017 Coll.) Article 2 (377/2016 Coll.)
S-49	**A**	Article 2 (377/2016 Coll.) Article 9 (377/2016 Coll.) Article 2 (377/2016 Coll.)
S-50	**A**	Article 6 (377/2016 Coll.)
S-52	**A**	Article 9 (377/2016 Coll.)

S-53	**A**	Annex 1., Part 1. (263/2016 Coll.) Article 9 (377/2016 Coll.)
S-54	**A**	Article 2 (377/2016 Coll.) Article 10 (377/2016 Coll.)
S-57	**A**	Annex 1. (263/2016 Coll.)
S-58	**A**	Article 2 (408/2016 Coll.) Article 4 (408/2016 Coll.) Article 229 (263/2016 Coll.) Article 22, Section (7) (162/2017 Coll.) Article 5 (263/2016 Coll.)

Radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-02	**A**	Article 14 (408/2016 Coll.) Article 15, Section 3 (408/2016 Coll.)
S-10	**A**	Article 49 (263/2016 Coll.) Article 30 (263/2016 Coll.) Article 12 (408/2016 Coll.)
S-11	**A**	Article 3 (408/2016 Coll.)
S-12	**A**	Article 29 (263/2016 Coll.) Article 9 (263/2016 Coll.)
S-13	**A**	Article 29 (263/2016 Coll.)
S-14	**A**	Article 14 (408/2016 Coll.) Article 29 (263/2016 Coll.)
S-16	**A**	Article 6 (377/2016 Coll.
S-19	**A**	Article 2 (377/2016 Coll.)
S-21	**A**	Article 12 (329/2017 Coll.) Article 2 (377/2016 Coll.)
S-23	**A**	Article 46 (263/2016 Coll.) Article 2 (377/2016 Coll.)
S-28	**A**	Article 10 (329/2017) Article 21 (329/2017)
S-33	**A**	Article 18 (329/2017 Coll.)
S-34	**A**	Article 18 (329/2017 Coll.)
S-35	**A**	Article 6 (377/2016 Coll.)
S-36	**A**	Article 6 (377/2016 Coll.)
S-37	**A**	Article 5 (263/2016 Coll.) Article 49 (263/2016 Coll.) Article 153 (263/2016 Coll.) Article 151 (263/2016 Coll.) Article 156 (263/2016 Coll.)
S-40	**A**	Article 5 (263/2016 Coll.) Article 13 (162/2017 Coll.) Article 11 (408/2016 Coll.)
S-41	**A**	Article 5 (263/2016 Coll.) Article 22 (21/2017 Coll.)
S-47	**A**	Article 22 (21/2017 Coll.) Article 2 (377/2016 Coll.)
S-48	**A**	Article 2 (377/2016 Coll.) Article 6 (377/2016 Coll.)

S-49	**A**	Article 2 (377/2016 Coll.) Article 9 (377/2016 Coll.) Article 2 (377/2016 Coll.)
S-50	**A**	Article 6 (377/2016 Coll.)
S-52	**A**	Article 9 (377/2016 Coll.)
S-53	**A**	Annex 1., Part 1. (263/2016 Coll.) Article 9 (377/2016 Coll.)
S-54	**A**	Article 2 (377/2016 Coll.) Article 10 (377/2016 Coll.)
S-57	**A**	Annex 1. (263/2016 Coll.)
S-58	**A**	Article 2 (408/2016 Coll.) Article 4 (408/2016 Coll.) Article 229 (263/2016 Coll.) Article 22, Section (7) (162/2017 Coll.) Article 5 (263/2016 Coll.)

Finland

As per v2.2 of this report, the Finnish regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

France

Regulatory changes taken for the National Action Plan

Since the publication of the WGWD Safety Reference Levels for waste and spent fuel storage in February 2011, France has continued to fulfil its obligations to implement necessary changes into its national regulations. The ministerial order of February 7, 2012 setting general rules relative to nuclear installations was published and entered into effect on July 1, 2013. This order was an important update of the French regulatory framework and allowed to transpose directly a number of safety reference levels identified by WENRA, such as those related to safety policy, integrated management system and safety verification. Additionally, this ministerial order includes a dedicated section on waste management and specific requirements for storage and disposal facilities. However, this ministerial order sets generic requirements that had to be further developed in regulatory decisions to be issued by ASN. Thus, several decisions have been developed by ASN, some of which being specific to waste management, decommissioning, storage and disposal facilities, periodic safety review and integrated management system. The drafting process includes different steps of consultation of stakeholders.

At the 30 WGWD meeting in Prague in February 2013, France reported its regulatory implementations for benchmarking, relying on dispositions of the Ministerial order of 7th February and on early drafts of the decisions under validation. This benchmarking enabled France to check that its obligations will be fulfilled once these decisions are finally approved. ASN's decision on storage facilities development process has been on hold since 2018 due to other priorities, in particular the development of a regulatory decision related to disposal facilities.

French benchmarking results of the NAP

Spent fuel and radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-14	**C**	Environmental code L593-6 - MO of 7/2/12
S-16	**C**	ASN resolution on storage (under development)
S-20	**C**	ASN resolution on storage (under development)
S-21	**C**	ASN resolution on storage (under development)
S-22	**C**	ASN resolution on storage (under development)
S-29	**C**	ASN resolution of 7th October 2014 on criticality + ASN resolution on storage (under development)
S-31	**C**	ASN resolution on storage (under development)
S-34	**C**	ASN resolution on storage (under development)
S-35	**C**	MO of 7/2/12 - article 8.4.2 + ASN resolution on storage (under development)
S-36	**C**	ASN resolution on storage (under development)
S-43	**C**	Environment code (Previous Decree of 2nd November 2007) + ASN resolution of 30th November 2017 on significant modifications
S-46	**C**	MO of 7/2/12
S-47	**C**	MO of 7/2/12 - title 2 chapter VII
S-48	**C**	ASN resolution on storage (under development)
S-49	**C**	ASN resolution on storage (under development)
S-53	**C**	MO of 7/2/12 - article 8.4.2 + ASN resolution on storage (under development)
S-57	**C**	MO of 7/2/12 - article 8.4.2 + ASN resolution of 21th April 2015 on waste management produced in nuclear facilities + ASN resolution of 23th march 2017 on waste processing + ASN resolution on storage (under development)

Germany

As per v2.2 of this report, the German regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Hungary

Regulatory changes taken for the National Action Plan

Radioactive waste storage

After Government decree 155/2014 (VI. 30.) *on the safety requirements for facilities ensuring interim storage or final disposal of radioactive wastes and the corresponding authority activities* had entered into force, the Hungarian Atomic Energy Authority started the oversight activity concerning the two Hungarian radioactive waste repositories. In this framework, at first, the authority collected and organized the associated and available documents (licences, resolutions, assessments, etc.) regarding these facilities. Based on Govt. Decree 155/2014. (VI. 30.) the Hungarian self-assessment - against the radioactive waste storage safety reference levels (SRL) - has been performed and benchmarked by the WGWD members in three consecutive Webex meetings during the C-19 pandemic in 2020 and 2021. At the WGWD-44 Webex plenary session, 55 of 61 legislative references were accepted with an "A" rating.

During the sub-group Webex meeting held in February 2021, 4 of the 6 SRLs previously suspended were accepted. And two SRLs were referred for plenary discussion. During WGWD-45 Webex plenary, the acceptance of the above 4 correspondences were approved, and the last two correspondences (S-36 and S-50) were also accepted by the WGWD board.

As a result of the change in its legal status, the HAEA has been an independent regulatory body since January 1, 2022 and it has been empowered to issue regulations in the scope of its tasks defined by the Act on Atomic Energy based on the authorization of the Fundamental Law of Hungary. In this context the previous Govt. Decree (Govt. Decree 155/2014. (VI. 30.)) was replaced by the HAEA Presidential Decree in 2022, but the requirements have not changed in the meantime. The official name of the effective legislation is the following: *HAEA Decree 9/2022 (XII. 29.) on the safety requirements for facilities ensuring interim storage or final disposal of radioactive wastes and the corresponding authority activities*.

As per v2.2 of this report, the Hungarian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste storage Safety Reference Levels presented here. No further actions remain to be taken regarding this part.

Spent fuel storage

Regarding the spent fuel storage Safety Reference Levels the vast majority of correspondences have been accepted, but some actions remain to be taken.

Hungary has already introduced some necessary amendments in the legal regulations based on previous benchmarks, but the final official presentation to the WGWD board has not yet taken place concerning the 8 SRLs (see table below) due to other priorities.

Nuclear Safety Codes, Vol.6 generally covers the reference levels of WENRA for now, although some more improvements may still be necessary, in particular, regarding the ownership of spent fuels.

The self-assessment has already been prepared relating to the above mentioned SRLs and it could be presented at the next WGWD meeting.

In 2022 the previous Govt. Decree (Govt. Decree 118/2011. (VII.11.)) was replaced by the HAEA Presidential Decree, but the requirements have not changed in the meantime. The official name of the effective legislation is the following: *1/2022 (IV. 29.) HAEA Decree on the nuclear safety requirements of nuclear facilities and on related regulatory activities.*

Hungarian benchmarking results of the NAP

Spent fuel storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-04	**C**	Introduction of a general requirement regarding ownership
S-06	**C**	Introduction of a general requirement regarding ownership
S-07	**C**	introduction of a requirement regarding ownership
S-50	**C**	New requirements in the Nuclear Safety Codes, Vol.6. Could be presented at the next WGWD meeting
S-51	**C**	Is covered by amendment to the regulation, New requirements in the Nuclear Safety Codes, Vol.6. Could be presented at the next WGWD meeting
S-53	**C**	New requirements in the Nuclear Safety Codes, Vol.6. Could be presented at the next WGWD meeting
S-54	**C**	New requirements in the Nuclear Safety Codes, Vol.6. Could be presented at the next WGWD meeting
S-57	**C**	New requirements in the Nuclear Safety Codes, Vol.6. Could be presented at the next WGWD meeting

Radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-02	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-04	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-05	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-06	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-07	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-08	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-09	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-10	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-11	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-12	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-13	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-14	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-15	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-16	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-18	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)

S-19	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-20	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-21	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-22	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-23	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-24	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-25	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-26	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-27	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-28	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-29	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-31	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-32	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-33	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-34	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-35	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-36	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)

S-37	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-40	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-41	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-42	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-43	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-44	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-45	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-46	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-47	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-48	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-49	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-50	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-51	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-54	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-57	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)
S-58	**A**	New Govt. Decree published in 2014 - Govt. Decree 155/2014. (VI. 30.) HAEA Decree 9/2022 (XII. 29.)

Italy

Regulatory changes taken for the National Action Plan

After benchmarking the Italian legal system to the WGWD safety reference levels for the storage of radioactive waste during 32nd WGWD meeting in Rome in February 2014, Italy presented its self-assessment resulting in a total of 2 C-ratings (S-11 and S-13). During the same 32nd WGWD meeting the National Action Plan was presented: the NAP foresaw the implementation of the remaining C-ratings in the national legislations by the publication of a Technical Guide.

ISIN, which regulates the use of nuclear energy in Italy and gives detailed guidance in the form of legally binding guides, published in October 2020 the Technical Guide n. 30 “Safety and radiation protection criteria for radioactive waste and spent fuel storage facilities”, to comply with the remaining storage safety reference levels.

Due to changes in the regulations used in the 2014 benchmarking, in 2023 there was the need to re-evaluate the benchmarking with respect to six SRLs (S-27, S-34, S-36, S-41, S-42, S-58) in addition to the two previous C-ratings.

During the 50th WGWD Italy submit the group additional legislative references for those C-ratings to demonstrate the compliance of national legislation with SRLs with the result of 1 further C rating for S-27.

As far as the SRLs on spent fuel storage is concerned, Italy is of the opinion that it is not necessary to develop specific regulatory guide for spent fuel storage for the reason that, in line with the governmental guidelines, reprocessing abroad is planned through intergovernmental agreements and the signing of specific contracts with French and British operators. At the moment almost all of the spent fuel has been transferred. There remain – pending transfer – 13 tHM stored at the Avogadro Deposit.

No reprocessing is planned for the Elk River spent fuel, currently stored at the ITREC installation inside the ENEA Trisaia Research Centre in Rotondella (MT). For this fuel, dry storage and storage in a temporary repository built at the plant itself has been planned. Technical Guide n. 30 is supposed to cover safety requirements for dry cask storage.

Italian benchmarking results for the NAP

Radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-11	**A**	Update of the Regulatory guide ISIN n. 30
S-13	**A**	Update of the Regulatory guide ISIN n. 30
S-27	**C**	Update of the Regulatory guide ISIN n. 30
S-34	**A**	Update of the Regulatory guide ISIN n. 30
S-36	**A**	Update of the Regulatory guide ISIN n. 30
S-41	**A**	Update of the Regulatory guide ISIN n. 30
S-42	**A**	Update of the Regulatory guide ISIN n. 30
S-58	**A**	Update of the Regulatory guide ISIN n. 30

Lithuania

As per v2.2 of this report, the Lithuanian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

The Netherlands

Regulatory changes taken for the National Action Plan

The Netherlands committed itself in 2011 to implement the WGWD Safety Reference Levels (SRLs) on radioactive waste management in its legal system.

The most relevant elements of the Dutch legal system are given by the Nuclear Energy Act, the Nuclear Installations, Fissionable Materials and Ores Decree, the Decree on Basic Safety Standards for radiation protection (2018, implementation of 2013/57/Euratom) and the Regulation on Nuclear Safety for Nuclear Installations (2017, implementation of 2009/71/Euratom and 2014/87/Euratom). This legislation provides for a system of mainly general goal oriented rules and regulations. It also establishes a licensing system.

The Netherlands has a small nuclear program with one national radioactive waste management organization, i.e. the Central Organisation for Radioactive Waste (COVRA), located at one site. The single and unique role of COVRA in the Netherlands has been established in legislation. Due to this fact, The Netherlands has decided in the past to regulate waste and spent fuel storage mainly by means of the COVRA license conditions rather than by means of generic guidelines in legislation.

The implementation of the SRLs into the Dutch legal system was benchmarked for the first time at the 21st WGWD meeting in 2008. At the 29th WGWD meeting in 2012, the Netherlands reported its progress in the legal implementations for re-benchmarking. A next benchmark on the eight remaining C-ratings was performed for the 45th WGWD meeting in 2021.

As a result of this last benchmark, four C-rated SRLs were changed to B-rated SRLs. The B-rated SRLs are implemented in the COVRA license, based on the single case in the Netherlands described above. The remaining C-rated SRLs are due to incomplete implementation of the SRLs on aspects of the management system. Although several aspects of the management system have been implemented in the legal framework since 2017, not all aspects from these SLRs are covered yet. These SRLs will be considered in the ongoing ANVS-project which investigates the further implementation of the relevant international requirements (i.e. the IAEA requirements and the WENRA Safety Reference Levels (SRL's)) in the national system.

Dutch benchmarking results of the NAP

Spent fuel and radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-05	**B**	COVRA-license
S-11	**C**	Part of ongoing project on implementation of international requirements
S-12	**C**	Part of ongoing project on implementation of international requirements
S-13	**C**	Part of ongoing project on implementation of international requirements
S-14	**C**	Part of ongoing project on implementation of international requirements
S-47	**B**	COVRA-license
S-48	**B**	COVRA-license
S-50	**B**	COVRA-license

Romania

As per v2.2 of this report, the Romanian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Slovakia

As per v2.2 of this report, the Slovakian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Slovenia

Regulatory changes taken for the National Action Plan

The amendments of the Rules on radiation and nuclear safety factors were published in 2016, providing the reference for the last remaining C-rated SRL. Based on the new rules and as per results of WGWD 42 meeting, the Slovenian regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Slovenian benchmarking results of the NAP

Spent fuel and radioactive waste storage

# SRL (open NAP)	Current status	Actions taken / relevant regulations
S-36	**A**	Amendments of JV5, published 2016

Spain

As per v2.2 of this report, the Spanish regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Sweden

As per v2.2 of this report, the Swedish regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Switzerland

As per v2.2 of this report, the Swiss regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.

Ukraine

Regulatory framework regarding the storage of radioactive waste and spent fuel

The State Nuclear Regulatory Inspection of Ukraine (SNRIU) establishes regulatory requirements in the area of radioactive waste (RAW) and spent fuel (SF) management in Ukraine, including requirements for the storage of RAW and SF.

The regulatory system contains a quite big number of documents that regulate storage of RAW and SF.

The main of them in the area of radioactive waste management is "General safety provisions for predisposal radioactive waste management" NP306.4.213-2017. This document came into force in 2017 and aims to harmonize the Ukrainian regulations with the European Union requirements and the WENRA reference levels.

NP 306.4.213-2017 generally covers the reference levels of WENRA, but needs some improvements, in particular, regarding the ownership of RAW.

The main documents that regulate SF management are:

- Law of Ukraine “On Nuclear Energy Use and Radiation Safety” (1995)
- Law of Ukraine “On Ratification of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste” No. 1688-III (2000)
- NP 306.2.105-2004 - “General Safety Provisions for Dry Interim Storage Facilities for Spent Nuclear Fuel” (2004)
- “Safety Requirements on Nuclear Fuel Management” (2019)

SNRIU is developing new regulatory document instead of NP 306.2.105-2004 - “General Safety Provisions for Dry Interim Storage Facilities for Spent Nuclear Fuel” (2004):

- "General safety provisions of dry-type spent nuclear fuel storage facilities"

It is expected that this document will come into force in the second part of 2023.

The SNRIU performed the self-assessment of the Ukrainian regulations in the area of RAW and SF storage and presented the results of self-assessment at the 41st meeting of the WGWD in September 2018 in Ljubljana.

Mark “C” has 5 reference levels for storage of RAW.

Mark “C” has 11 reference levels for storage of SF.

The results of the review at the WGWD meeting are presented in the tables.

Ukrainian benchmarking results of the self-assessment

Spent fuel storage

# SRL (NAP)	Current status	Actions taken / relevant regulations
S-15	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-18	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-36	**C**	Safety Requirements on Nuclear Fuel Management (2019)
S-39	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-48	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-49	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-50	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-51	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-53	**C**	Safety Requirements on Nuclear Fuel Management (2019)
S-58	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)
S-60	**C**	"General safety provisions of dry-type spent nuclear fuel storage facilities" (under development)

Radioactive waste storage

# SRL (NAP)	Current status	Actions taken / relevant regulations
S-04	**C**	
S-05	**C**	
S-06	**C**	
S-07	**C**	
S-27	**C**	

United Kingdom

As per v2.2 of this report, the British regulatory framework has been found to be in full compliance with the WENRA requirements defined by the radioactive waste and spent fuel storage Safety Reference Levels presented here. No further actions remain to be taken.