WENRA
WORKING GROUP ON WASTE AND DECOMMISSIONING (WGWD)

WASTE AND SPENT FUEL STORAGE SAFETY REFERENCE LEVELS REPORT

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Contents

Executive Summary

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

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

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

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WENRA Policy Statement

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

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

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

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

In order to develop a harmonized approach, we are:

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

We recognise the IAEA standards form a good basis for the continuous improvement of national nuclear regulatory systems and nuclear safety.

The reference levels that we have developed represent good practices in our countries from which we can also seek to learn from each other to further improve nuclear safety and its regulation. Hence, we are committed:

- by the year 2010 to improve and harmonise our nuclear regulatory systems, using as a minimum the reference levels;
- to influence the revision of the IAEA standards when appropriate;
- to regularly revise the reference levels when new knowledge and experience are available.

We strive for openness and improvement of our work. For that purpose we will:

- keep the European Nuclear Safety and Radiation Protection Bodies not belonging to WENRA, and the EU Institutions, informed of the progress made in our work;
- make our public reports available on the Internet (www.wenra.org);
- invite stakeholders to make comments and suggestions on these reports.

Glossary

Acceptance criteria for storage

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

Ageing

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

Ageing degradation

Ageing effects that could impair the ability of a *structure, system or component* to function within its *acceptance criteria*.

Ageing management

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

analysis, Deterministic

Analysis using, for key parameters, single numerical values (taken to have a probability of 1), leading to a single value of the result.

- In nuclear safety, for example, this implies focusing on accident types, releases and consequences, without considering the probabilities of different event sequences.
- Typically used with either 'best estimate' or 'worst case' values, based on expert judgement and knowledge of the phenomena being modelled.

analysis, Probabilistic

Often taken to be synonymous with stochastic analysis. Strictly, however, stochastic conveys directly the idea of randomness (or at least apparent randomness), whereas probabilistic is directly related to probabilities, and hence only indirectly concerned with randomness. Therefore, a natural event or process might more correctly be described as stochastic (as, for example, in stochastic effect), whereas probabilistic would be more appropriate for describing a mathematical analysis of stochastic events or processes and their consequences (such an analysis would, strictly, only be stochastic if the analytical method itself included an element of randomness, e.g. Monte Carlo analysis).

discharge, Authorized

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

Licensee

The *licensee* is the organization having overall responsibility for a facility or activity (the responsible organization)

Remark: WGWD recognizes that this organisation may change as the facility passes to the decommissioning phase according to national strategies

Monitoring

1. The measurement of *dose* or *contamination* for reasons related to the assessment or control of *exposure*

1. Continuous or periodic measurement of radiological or other parameters or determination of the status of a *system, structure or component.* Sampling may be involved as a preliminary step to measurement.

Nuclear facility

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

Nuclear safety

See 'Protection and Safety'

Operation

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

Owner

Owner means usually the licensed organisation having the overall responsibility for the long term management of the waste and spent fuel (it is usually the waste and spent fuel producer), which may be different from the licensee of the storage facility.

Package

Covers waste packages, and storage casks or containers containing spent fuel or smaller waste packages.

Protection and Safety

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

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

Quality management system

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

Radiation protection

See 'protection and safety'

Regulatory body

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

Safety assessment

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

Safety case

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

Safety policy

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

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*.

Treatment

Operations intended to benefit safety and/or economy by changing the characteristics of the waste. Three basic treatment objectives are:
- volume reduction
- removal of radionuclides from the waste, and
- change of composition.

Treatment may result in an appropriate waste form.

Waste

Material for which no further use is foreseen.

waste, Radioactive

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

Waste or Spent fuel acceptance requirements

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

Waste characterization

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

Waste minimization

The process of reducing the amount and *activity* of *radioactive waste* to a level as low as reasonably achievable, at all stages from the *design* of a *facility or activity* to *decommissioning*, by reducing *waste* generation and by means such as recycling and reuse, and *treatment*, with due consideration for secondary as well as primary *waste*.

Waste or spent fuel package

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

List of Abbreviations

AMP	ageing management programme
EU	European Union
IAEA	International Atomic Energy Agency
NEA	Nuclear Energy Agency (OECD)
NPP	nuclear power plant
OEF	operational experience feedback
OLC	operational limits and conditions
PIE	postulated initiating event
PSR	periodic safety review
QM	quality management
R&D	research and development
RHWG	(WENRA) Reactor Harmonisation Working Group
SSCs	structures, systems and components
SRLs	safety reference levels
SA-N	Storage SRLs numbered uniquely in Subpart A; where N is a number.
SB-N	Storage SRLs numbered uniquely in Subpart B; where N is a number.
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators
WGWD	(WENRA) Working Group on Waste and Decommissioning

Part I.

Introduction and Used Methodology

1. Introduction

This report is the result of an effort by the Working Group on Waste and Decommissioning of WENRA, from 2002 to 2005. It presents the safety reference levels (SRLs) for radioactive waste and spent fuel management facilities and practices that are thought to be a good basis for future harmonisation on a European level.

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

1.1. Background

WENRA, which has been established in February 1999, is the association of the Heads of nuclear regulatory authorities of European countries with at least one nuclear power plant in construction, operation or decommissioning phase. WENRA has been formally extended in 2003 to include future new European Union (EU) Member States. Currently following countries are members of WENRA: Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

The original objectives of the Association were:
- to develop a common approach to nuclear safety and regulation, in particular within the EU,
- to provide the EU with an independent capability to examine nuclear safety and regulation in candidate countries,
- to evaluate and achieve a common approach to nuclear safety and regulatory issues which arise.

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

- to develop an independent nuclear safety assessment capability, based on in-depth knowledge of nuclear installations, and
- to develop common approaches to nuclear safety and regulations and to encourage the harmonisation of practices.

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

1.2. Objective

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

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

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

1.3. Scope

The SRLs are focussed on purpose built storage facilities used to store spent fuel and 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.

Because WGWD members do not all regulate the following matters, WGWD has concentrated on nuclear safety requirements and, in particular, it has not taken into account in detail other regulatory requirements such as Environment Impact Assessment regulation (required by EU directives), discharge authorisation, waste disposal, conventional occupational health and safety, physical protection including safeguards, and funding issues. In some countries, these matters are addressed by other national regulatory organisations.

RHWG of WENRA developed SRLs for nuclear reactors. The principles underlying these levels will apply to any type of nuclear facility including waste and spent fuel storage facilities, taking into account the magnitude of the hazard in a graded approach. This document identifies in Subpart A of Part II. areas of common interest and, where appropriate, in Subpart B of Part II. adds SRLs applicable for the purposes of storage.

1.4. Structure

The report consists of three main parts.

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

Part II of the report presents the actual waste and spent fuel storage reference levels grouped into two main subparts.

The reference levels apply to wide range of facilities for the storage of spent fuel and radioactive waste, for which the hazard potential may vary significantly. On the one hand, the reference levels apply to fuel stores which may require active protection systems of high reliability. On the other hand, the reference levels apply to the storage of wastes where the design of both the waste package and the store are based on the concept of passive safety. Consideration therefore needs to be given as to whether individual reference levels are relevant in specific circumstances, and when they are relevant they need to be applied in a proportionate manner, taking account of the magnitude of the hazard.

Subpart A identifies areas of common interest and presents SRLs in original RHWG or modified wording.

In Subpart B new reference levels specific for storage facilities are grouped into the same safety areas as in Subpart A: safety management, design (of storage facilities), operation and safety verification. However the addressed safety issues can differ in both subparts as well as in other WENRA documents.

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.

During the June 2005 meeting of the WGWD in Switzerland it has been agreed to continue with the preparation of the final version of this report according to the following methodology of SRLs derivation, prepared and agreed by WGWD members:
- the SRLs will be presented in two main subparts,
- Subpart A contains generic reference levels based on RHWG report. The structure of Subpart A follows the structure of RHWG safety issues. The RHWG SRLs were reviewed from the perspective of decommissioned facility features,
- facility specific reference levels are presented in Subpart B, which has a similar structure as Subpart A and is based on previous draft versions of WGWD report.

By the drafting of report versions developed in 2002-2004 the importance of the IAEA documents developed till then has been recognised. Therefore the starting point for the definition of facility specific SRLs, which have been later included into the Subpart B, were the topics addressed by corresponding IAEA documents (requirements, guidances, etc). This list has been carefully reviewed and validated by the WGWD. In the case of storage, the available IAEA references were:
- A System for Feedback of Experience from Events in Nuclear Installations, Safety Guide, DS 288, Vienna (2005),
- Safe Storage of Radioactive Waste, Draft Safety Guide, DS 292, Vienna (2005),
- Safety of Fuel Cycle Facilities, DS 316, Vienna (2003),
- Management Systems, Safety Requirements, DS 338, Vienna (2005),
- Predisposal Management of Radioactive Waste Including Decommissioning, Safety Standards Series No. WS-R-2, IAEA, Vienna (2000),
- Design of Spent Fuel Storage Facilities, Safety Series No. 116, IAEA, Vienna (1994),
- Operation of Spent Fuel Storage Facilities, Safety Series No. 117, IAEA, Vienna (1994)
- Safety Assessment for Spent Fuel Storage Facilities, Safety Series No. 118, IAEA, Vienna (1994).

Then following steps have been performed for the derivation of facility specific SRLs:
- based on a systematic approach, the applicable specific IAEA requirements or guidances have be sought and listed. These are henceforth be called “corresponding IAEA statements” and are written in italics after each reference level,
- an analysis grid has been applied to each of the above-defined “corresponding IAEA statements” (see grid model in Appendix). Each member country (referring as appropriate to national contributions to the Joint Convention) has made this systematic analysis. It contains:
  - an analysis of the present situation on each country
  - whether future plans are made to change the regulatory situation of the country
  - a proposal for future action by WGWD

  The answers of each countries to this questionnaire have been brought together and synthesised.
- SRLs taking into account the best practise in Europe, and envisioned as a reference level that could be applied at the end of the decade (2010) were defined.

APPENDIX
TO PART I.

The questionnaire of the analysis grid model applied to IAEA statements

WENRA WGWD – storage regulations harmonisation IAEA statement analysis grid		Country:
IAEA statement reference:	IAEA doc reference:	Statement number:
IAEA statement quotation		
PRESENT SITUATION IN THE COUNTRY		
Is it a requirement? YES : ☐		Requirement part of general regulations? YES : ☐ Case-by-case license condition? YES : ☐
Comments on requirement level including possible sanctions for licensee :		
Is it guidance (not mandatory)? YES : ☐		Comments :
Is it specific to storage or general? specific ☐		Comments :
Is it different for different types of facilities? YES : ☐		Comments :
PROJECTS OF THE COUNTRY		
Will this situation change in the near future? YES : ☐		
Comments :		
GENERAL COMMENTS UPON SITUATION IN THE COUNTRY :		
PROPOSAL FOR WGWD		
Omit statement? YES : ☐ Not within regulator scope ☐ Not useful or applicable ☐	Take statement as it is? YES : ☐	Modify statement? YES : ☐ Relaxing ☐ Editorial change only ☐ Strengthening ☐ Grading for different type of facilities ☐
Proposal for WGWD requirement (if statement is to be modified) :		
Additional statement on topic not covered by IAEA needed? YES : ☐ Proposal :		
GENERAL COMMENTS ON WGWD REQUIREMENT PROPOSAL :		

This questionnaire was answered by the members of WGWD as a basis for selection of preliminary set of IAEA statements for further analysis (see Chapter 2.1)

Part II.

Waste and Spent Fuel Storage Safety Reference Levels

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

Some reference levels apply to the owner of the waste or spent fuel (SB-2, SB-3, SB-4, SB-5, SB-09, SB-28).

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

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

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

For further reference, storage safety reference levels are numbered uniquely SA-N (Subpart A) or SB-N (Subpart B) where N is a number.

Subpart A (Generic SRLs)

1. Safety area: Safety management

1.1. Safety issue: Safety policy

SA-01: A written safety policy shall be issued by the licensee. A safety policy is understood as 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 a visible part of an integrated organisational policy.

*Related **IAEA** safety standards:*

The operating organisation …shall establish and effects policies that gives safety matters the highest priority (NS-R-2, para 2.2, 2.9).

SA-02: The safety policy shall be clear about giving safety first priority in all plant activities.

*Related **IAEA** safety standards:*

The policy shall give safety the utmost priority at the plant, overriding if necessary the demands of production and project schedules (NS-R-2, para 2.9).

SA-03: The safety policy shall include a commitment to continuously develop safety.

*Related **IAEA** safety standards:*

The policy shall include a commitment to excellent performance in all activities important to safety and shall encourage a questioning attitude (NS-R-, 2.9). The operating organisation should demonstrate a commitment a achieving improvements in safety wherever it is reasonable practicable to do so as part of a continuing commitment to the achievement of excellence (NS-G-2.4, para 5.11).

SA-04: The safety policy shall be communicated to all staff [1], with tasks important to safety, in such a way that the policy is understood and applied in their on-site activities.

*Related **IAEA** safety standards:*

…the policy shall be applied by all site personnel (NS-R-2, para 2.9).

SA-05: Key elements of the safety policy shall be communicated to subcontractors, in such a way that the policy is understood and applied in their on-site activities

SA-06: The safety policy shall include directives for implementing the policy and monitoring safety performance.

*Related **IAEA** safety standards:*

..the safety policy requires the ownership and active support of senior managers who should be involved in disseminating the policy throughout the organisation…The operating organisation should develop safety standards that define expectations for the arrangements that are significant to the implementation of the safety policy…The organisation´s improvement strategy …..should be based on a well defined programme with clear objectives and targets against which to monitor progress (NS-G-2.4, paras 5.8, 5.9, 5.11).

SA-07: The safety policy shall require safety objectives and targets, clearly formulated in such a way that they can be easily monitored and followed up by the plant management.

[1] This is addressing the licensee´s own staff. For subcontractor's personnel see the following SA-05

*Related **IAEA** safety standards:*

Where practicable, suitable objective performance measures shall be used. The results shall be made available to plant management and appropriate corrective actions shall be taken (NS-R-2, para 2.13).

SA-08: The adequacy and the implementation status of the safety policy shall be evaluated by the licensee on a regular basis, more frequent than the periodic safety reviews.

*Related **IAEA** safety standards:*

An adequate audit and review system should be established to provide the assurance that the safety policy of the operating organisation is being implemented effectively ….(NS-G-2.4, para 5.17)

1.2. Safety issue: Organizational structure

SA-09: The organisational structure for safe and reliable operation of the facility, and for ensuring an appropriate response in emergencies, shall be justified[2] and documented.

*Related **IAEA** safety standards:*

A document describing the plant´s organisational structure and the management arrangements for discharging all responsibilities shall be made available to the regulatory body for review (NS-R-2, para 2.5). The operating organisation …should establish an organisational structure to meet the general requirements for the safe and reliable operation of the plant, taking into consideration any particular situation or conditions involved (NS-G-2.4, para 2.4).

SA-10: The adequacy of the organisational structure, for its purposes according to SA-09, shall be assessed when organisational changes are made which could be significant for safety. Such changes shall be justified in advance, carefully planned and evaluated[3] after implementation.

*Related **IAEA** safety standards:*

… The organisational plan should be regularly assessed, and if necessary updated to reflect developments in safe operation (NS-G-2.4, para 2.7).

…proposed changes to the structure and associated arrangements, which might be significant to safety, shall be systematically reviewed by the operating organisation and shall be submitted to the regulatory body for review (NS-R-2, para 2.5). For significant organisational changes an implementation plan should be drawn up to make sure that the change is properly considered in safety terms before being implemented (NS-G-2.4, para 2.16).

SA-11: Responsibilities, authorities and lines of communication shall be clearly defined and documented for all staff with duties important to safety.

*Related **IAEA** safety standards:*

..Clear lines of authority shall be established to deal with matters bearing on plant safety. Functional responsibilities, levels of delegated authority and lines of internal and external communication for the safe operation of plants in all operational states, for mitigating the consequences of accident conditions and for ensuring an appropriate response in emergencies shall be clearly defined in writing (NS-R-2, para 2.6).

SA-12: The licensee shall ensure that the plant is operated in a safe manner and in accordance with all applicable legal and regulatory requirements.

*Related **IAEA** safety standards:*

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[2] The arguments shall be provided that the organisational structure supports an appropriate response in emergencies

[3] A verification of that the organisational change has accomplished its safety objectives.

The management of the plant shall ensure that the plant is operated in a safe manner and in accordance with all legal and regulatory requirements (NS-R-2, para 2.1).

SA-13: Safety issues shall be subjected to appropriate safety review, by a suitably qualified independent safety review function.

*Related **IAEA** safety standards:*
Liaison shall be established with the regulatory body, public authorities, organisations for design, construction, manufacturing, operation and others for ensuring understanding of and compliance with safety requirements…and to ensure proper transfer of information, expertise and experience needed for response to safety issues (NS-R-2, para 2.4). Safety related activities should be properly planned to ensure that they can be carried out safely and efficiently (NS-G-2.4, para 5.12).

SA-14: The licensee shall ensure that the staff are provided with the necessary facilities and working conditions to carry out work in a safe manner.

*Related **IAEA** safety standards:*
Adequate resources, services and facilities shall be provided (NS-R-2, para 2.4).

SA-15: The licensee shall ensure that safety performance is continuously monitored through an appropriate review system in order to ensure that safety is maintained and improved as needed.

*Related **IAEA** safety standards:*
Regular reviews of the operation of the plant shall be conducted ensuring appropriate safety consciousness and safety culture, ..for enhancing safety… that documentation is up to date… and no complacency. Where practically objective performance measures shall be used. The results shall be made available to plant management and appropriate measures taken (NS-R-2, para 2.13). The safety performance ..should be routinely monitored in order to ensure that safety standards are maintained and improved. An adequate audit and review system should be established … (NS-G-2.4, para 5.17).

SA-16: The licensee shall ensure that relevant operational experience, international development of safety standards, and new knowledge gained through R&D-projects are analysed in a systematic way and continuously used to improve plant activities.

*Related **IAEA** safety standards:*
Operating experience shall be evaluated in a systematic way…Abnormal events with safety implications shall be investigated to establish the direct and root causes…Information shall be obtained and evaluated on experiences at other plants to derive lessons for its own operations. ..Carefully examination by competent persons so that adequate corrective actions can be taken…All personnel shall be required to report all events and encouraged to report near misses.. Feed- back of information to designer in order to obtain advice (NS-R-2, paras 2.21-2.25).

SA-17: The required number of staff for safe operation, and their competence, shall be analysed in a systematic and documented way.

*Related **IAEA** safety standards:*
…a proper definition and detailed analysis of tasks and activities to be performed should be made; the appropriate staffing and qualification requirements at the different levels in the organisation should be determined and the selection, training and retraining requirements should be specified (NS-G-2.4 para 6.12).

SA-18: The sufficiency of staff for safe operation, their competence and suitability for safety work shall be verified on a regular basis and documented.

*Related **IAEA** safety standards:*
The operating organisation shall be staffed with competent managers and suitably qualified personnel having a proper awareness of the technical and administrative requirements for safety and motivated to be safety conscious.(NS-R-2, para 2.8). A training programme should ensure that personnel involved in all levels of operation of nuclear power plants have the requisite competence (NS-G-2.4, para 6.20).

SA-19: An adequate long term staffing policy[5] shall exist for activities which are important to safety.

*Related **IAEA** safety standards:*
A long term staffing programme tied to the long-range objectives should be developed… to anticipate future personnel needs (NS-G-2.4 para 6.11).

SA-20: Changes to the number of staff which might be significant for safety shall be justified in advance, carefully planned and evaluated after implementation.

*Related **IAEA** safety standards:*
….proposed changes to the (organisational) structure and management arrangements which might be significant to safety shall be systematically reviewed by the operating organisation and submitted to the regulatory body for review (NS-R-2 para 2.5).

SA-21: The licensee shall always have, in house, sufficient and competent staff and resources to understand the licensing basis of the plant (e.g. Safety Analysis Report or Safety Case and other documents based thereon), as well as to understand the actual design and operation of the plant in all plant states.

*Related **IAEA** safety standards:*
…the management should recognise that a nuclear programme …require highly qualified personnel capable of ensuring efficient and safe operation under normal conditions and proper response during emergency conditions (NS-G-2.4, para 6.13).

SA-22: The licensee shall maintain, in house, sufficient competent staff and resources to specify, set standards, manage and evaluate safety work carried out by contractors.

*Related **IAEA** safety standards:*
The operating organisation should contain adequate personnel, possessing the knowledge, training and skills necessary to supervise and evaluate work of contractor personnel (NS-G-2.4, para 4.7).

1.3. Safety issue: Objective of quality management

SA-23: Throughout the life of waste storage facility, the licensee shall develop, implement, and maintain a documented quality management system that defines the required quality and safety objectives applicable to work that is important to safety, health and environment and that is carried out by any organisation[6], unit, or individual who can affect nuclear safety.

*Related **IAEA** safety standards:*

[5] Long term staffing policy has to address any forseen loss of experienced personnel by adequate recruitment and training measures in advance.
[6] Such organisations include all those within the licensees' company as well as designers, vendors, contractors, suppliers, and service providers employed directly or indirectly on work for the licensee.

During all stages in the life of the nuclear power plant, work shall be planned and performed in accordance with established codes, standards, specifications, practices and administrative controls... (50-C/SG-Q Code; Para 301).

SA-24: The quality management system shall grade the requirements set out in it to reflect their relative importance to nuclear safety with respect to each item, service, or process covered.

*Related **IAEA** safety standards:*
The safety management system should comprise such organizational elements as: definition of safety policy; identification of the main responsibilities, competences and activities that are needed to ensure safety; arrangements to ensure that the required activities are implemented safely; monitoring of safety management plans... In addition, the safety management system should set up the framework that will enable individuals involved in plant activities to carry out their tasks safely and successfully. (NS-G-2.4; Para 5.3).

SA-25: The quality management system shall enable the licensee to evaluate compliance with nuclear safety standards and to identify potential safety improvements.

*Related **IAEA** safety standards:*
Information... should include a description of the quality assurance system established to ensure that all items are designed, manufactured, constructed, assembled, tested, qualified, operated, maintained and replaced in compliance with the relevant safety requirements... (50-C/SG-Q Code; Para 206).

Items and services shall be identified and controlled to ensure their proper use. Items shall be shipped, stored, handled, maintained, operated and used as specified to prevent their damage, loss or deterioration. (50-C/SG-Q Code; Para 302).

Design, including subsequent changes, shall be carried out in accordance with established engineering codes and standards, and shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. (50-C/SG-Q Code; Para 304).

Requirements necessary to ensure the quality of items and services shall be developed and specified in the procurement documents. Evidence that purchased items and services meet procurement requirements shall be available before they are used. (50-C/SG-Q Code; Para 307).

Inspection and testing of specified items, services and processes shall be conducted using established acceptance and performance criteria. The level of inspection and testing and the degree of independence of personnel shall be established. (50-C/SG-Q Code; Para 309).

SA-26: The quality management system shall use nuclear safety as the fundamental consideration for identifying items, services, and processes that are important to safety and establishing relevant resources, specifications, codes, and safety requirements, including those required for procurement and use of equipment, components , and consumables.

SA-27: The quality management system shall ensure that the organisational structure, functional responsibilities, levels of authority, and interfaces for all organisations[7], units, or individuals who can affect nuclear safety are described in a document available for people involved in safety issues.

SA-28: The quality management system shall require that any organisational change that may affect safety is evaluated, classified with regard to its importance to safety, and justified.

[7] Such organisations include all those within the licensee's company as well as designers, vendors, contractors, suppliers, and service providers employed directly or indirectly on work for the licensee.

*Related **IAEA** safety standards:*
The change process shall identify any organizational change that may have an effect on safety. Such changes shall be evaluated, classified with regard to the importance to safety and justified. Implementation of such changes shall be monitored to ensure that:
- *Safety is not compromised,*
- *The integrity of the Management System is maintained, and*
- *Changes achieve their objectives. (DS 338; Para 314).*

SA-29: The person holding the most senior management position shall be responsible and accountable for ensuring that an effective quality management system is being implemented and that the senior management team is committed to and meeting its responsibility for reviewing and ensuring the success of the programme.

*Related **IAEA** safety standards:*
The person in the most senior management position in the organization shall be responsible for ensuring that the QA programme is implemented... Satisfactory implementation requires good planning and the deployment of adequate resources... QA programme effectiveness shall be assessed and reviewed at all stages of implementation. The information gained from assessments should be used to achieve continuing improvements in work performance. (50-C/SG-Q-1; Para 401)

Management should demonstrate its commitment to the quality policy through its actions and provide firm and unambiguous support for its implementation. The actions should foster a corresponding commitment to high levels of performance by all personnel, who in turn should be expected to demonstrate their commitment to the policy. Annex I provides an example of the key points of the quality policy. (50-C/SG-Q Code; Para 208)

As part of their daily responsibilities, line managers and supervisors should review the conduct of work under their responsibility. To do this, they should keep abreast of general plant conditions, monitor work to ensure it is being conducted safely and in accordance with requirements, ensure non-conformances are identified and resolved, and be alert to improvement opportunities. (50-C/SG-Q-1; Para 303)

Senior management is responsible and accountable for the planning, development, implementation and success of the QA programme. It is at this level that the success of a QA programme begins, and the responsibility for the effectiveness of that programme cannot and must not be delegated. (50-C/SG-Q Code: Annex, Basic Requirement 1; Para 3)
In establishing the organizational structure of the operating organization, consideration shall be given to the following management functions...

Reviewing functions, which include critical monitoring of the performance of the operating and supporting functions, and review of the design. The purpose of monitoring is to verify compliance with the stipulated objectives for safe operation of the plant; to reveal deviations, deficiencies and equipment failures; and to provide information for the purpose of taking timely corrective action and making improvements. Reviewing functions also include review of the overall safety performance of the organization in order to assess the effectiveness of safety management and to identify opportunities for improvement. (NS-R-2; Para 2.3)

SA-30: The licensee shall establish and maintain sufficient resources and processes to define, achieve, analyse, and preserve the quality of items that are important to safety, and to take timely and effective corrective or preventive action to respond to deviations from required standards.

*Related **IAEA** safety standards:*

...Satisfactory implementation requires good planning and the deployment of adequate resources... QA programme effectiveness shall be assessed and reviewed at all stages of implementation. The information gained from assessments should be used to achieve continuing improvements in work performance. (50-C/SG-Q-1; Para 401)

SA-31: The licensee shall ensure that procured items and services meet established requirements and perform as specified and that selected suppliers continue to provide acceptable items and services during the fulfilment of their procurement obligations. Licensees may delegate procurement activities to other organisations, but shall remain responsible for the overall effectiveness of these activities.

*Related **IAEA** safety standards:*

The responsible organization shall ensure that procured items and services meet established requirements and perform as specified and that selected suppliers continue to provide acceptable items and services during the fulfilment of their procurement obligations. The responsible organization may delegate procurement activities to other organizations, but shall retain the responsibility for the overall effectiveness of these activities. (50-C/SG-Q-6; Para 201)

SA-32: Products and processes that do not conform to specified requirements shall be identified and reported to an appropriate level of management within the organization. The safety implications of the non-conformances shall be evaluated and the actions taken shall be recorded, where appropriate.

*Related **IAEA** safety standards:*
Products and processes that do not conform to specified requirements shall be identified and reported to an appropriate level of management within the organization. The impact of the non-conformances shall be evaluated and the products or processes either:

- *Accepted or,*
- *Some form of corrective action taken within a specified time period or,*
- *Rejected to prevent their inadvertent use. (DS 338; Para 6.8)*

SA-33: The quality management system shall be developed and implemented in collaboration between the management, those performing the work, and those assessing the work.

*Related **IAEA** safety standards:*
...Implementing the QA programme requires the collaborative effort of management, those performing the work and those assessing the work. (50-C/SG-Q-1; Para 401)

The quality assurance programme shall include measures, which ensure that documentation is available in language appropriate to the users. (50-C/SG-Q Code; Para 205)

SA-34: Work that is important to safety shall be controlled and performed using approved current instructions, procedures, drawings, or other means, that have been appropriately validated before first use and are periodically reviewed to ensure adequacy and effectiveness.

*Related **IAEA** safety standards:*

...Work shall be performed under controlled conditions, using approved current instructions, procedures, drawings or other appropriate means that are periodically reviewed to ensure adequacy and effectiveness. (50-C/SG-Q Code; Para 301)

The quality assurance programme shall include measures, which ensure that documentation is available in language appropriate to the users. (50-C/SG-Q Code; Para 205)

One aspect of review involves validating the implementation of the document through simulation, mock-up, walk-throughs or the like. This validating process is usually applied to significant working level instructions and procedures. (50-C/SG-Q-3; Para 311)

SA-35: Personnel shall be trained in the requirements of the quality management system, so that they are competent to perform their assigned work and understand the safety consequences of their activities.

*Related **IAEA** safety standards:*

Personnel shall be trained and qualified so that they are competent to perform their assigned work and understand the safety consequences of their activities. (50-C/SG-Q Code; Para 206)

SA-36: The licensee shall assess the quality management system from time to time to ensure that it provides the required level of safety and shall, where appropriate, incorporate lessons from peer review, operational experience, safety-related research findings, experience from other safety-related events, and developments in science and technology.

*Related **IAEA** safety standards:*
Management should periodically analyse available information, such as nonconformance reports, audit reports, maintenance reports, operating logs, significant event registers, plant safety reviews, etc. This analysis should seek out trends in order to identify problem areas requiring root cause analysis, to confirm that appropriate actions have been taken to prevent repetition of the non-conformances and to enhance plant safety and performance. Information on incidents, events or quality related problems available from other nuclear power plants/organizations (operational experience feedback) should be assessed in order that suitable preventive measures can be developed and implemented. (50-C/SG-Q-2; Para 405)

Other types of assessment such as peer evaluation are more subjective, based on comparison with good practices and judgements against expert opinions. The results of such activities should be evaluated by senior management before proposed actions are adopted. (50-C/SG-Q-5; Para 403)

Peer evaluation is a critical examination of specific nuclear safety related subjects by senior staff from one or more other nuclear power plants to seek improvements and to promote good practices. The evaluation team should consist of experts in all areas of evaluation in order to promote the sharing of experience and to develop relationships between the peers and the people at the nuclear power plants. (50-C/SG-Q-5; Para 613)

The feedback of operational events at nuclear power plants is necessary to improve safety. Management should provide sufficient resources and dedicated personnel for the evaluation and feedback of operating events, including those from other plants. Management should clearly define responsibilities and should be sufficiently involved to ensure completion of any improvements and corrective actions arising. (50-C/SG-Q-13; Para 405)

SA-37: An organisational unit shall be established, or an outside agency assigned, that is responsible for independently assessing the adequacy of management processes and work performed, and that has sufficient authority and organisational freedom to carry out its responsibilities. People who conduct independent assessments shall not participate directly in the work being assessed[8].

*Related **IAEA** safety standards:*
An organizational unit shall be established, or an outside agency assigned, with the responsibility to conduct independent assessments. It shall have sufficient authority and organizational freedom to carry out its responsibilities. (50-C/SG-Q Code; Para 403)

Persons conducting independent assessment shall not participate directly in the work being assessed. (50-C/SG-Q Code; Para 404)

The independent assessment need not necessarily be carried out always by the assessment unit. It may be beneficial for independent assessment to be carried out by other staff brought together for a specific assessment or by a joint team, including members of the assessment unit. (50-C/SG-Q Code; Para 309)

SA-38: All managers shall regularly carry out self-assessment and review of the processes for which they are responsible to determine their efficiency and effectiveness with establishing, promoting, and achieving nuclear safety objectives, and shall take any necessary corrective actions.

[8] However, it is important that the audit team is familiar with the work being assessed. The aim of this requirement is to avoid any conflict of interest on the part of the assessor.

*Related **IAEA** safety standards:*

Management at all levels shall regularly assess the processes for which it is responsible. Management shall determine its effectiveness in establishing, promoting and achieving nuclear safety objectives. Management process weaknesses and barriers that hinder the achievement of the nuclear safety objectives shall be identified and corrected. (50-C/SG-Q Code; Para 401)

1.4. Safety issue: Policy of staff training

SA-39: The licensee shall establish an overall training policy and a comprehensive training plan on the basis of long-term training needs and goals that acknowledge the critical role of nuclear safety. The plan shall be kept up to date.

*Related **IAEA** safety standards:*
The operating organization should formulate an overall training policy. This policy is the commitment by the operating organization and plant management to the training of personnel and an acknowledgement of the critical role that training plays in the safe, reliable operation and maintenance of the plant. (NS-G-2.8, Para 4.2)

A training plan should be prepared on the basis of the long term needs and goals of the plant. This plan should be evaluated periodically in order to ensure that it is consistent with current (and future) needs and goals. Factors which can change a training plan include: commissioning experience, operational experience and decommissioning experience at the plants of the operating organization; feedback of operational experience from other plants; significant modifications to the plant or to the operating organization; changes in regulatory requirements; and changes in the State's education system. (NS-G-2.8, Para 4.4)

SA-40: A systematic approach to training shall be used to provide a logical progression, from identification of the competences required for performing a job, to the development and implementation of training programmes including respective training materials for achieving these competences, and to the subsequent evaluation of this training.

*Related **IAEA** safety standards:*
A systematic approach to training should be used for the training of plant personnel (see Ref. [5]). The systematic approach provides a logical progression, from identification of the competences required for performing a job, to the development and implementation of training towards achieving these competences, and to the subsequent evaluation of this training. The use of a systematic approach to training offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control, leading to greater reliability of training results and enhanced safety and efficiency of the plant. (NS-G-2.8, Para 4.13)

SA-41: Only qualified persons that have the necessary knowledge, skills and safety attitudes shall be allowed to carry out tasks important to safety. The licensee shall ensure that all personnel performing safety-related duties, including contractors, have been adequately trained and qualified.

*Related **IAEA** safety standards:*
Only qualified persons should be entrusted with functions important to the safe supervision, operation and maintenance of a nuclear power plant. These functions and the related duties and responsibilities should be clearly indicated in the description of the operating organization and of each position (work assignment). (NS-G-2.8, Para 3.9)

SA-42: The Licensee shall define and document the necessary competence requirements for its staff.

*Related **IAEA** safety standards:*

For each category of personnel the necessary competence may be defined by means of:
- *Educational level (academic qualification),*
- *Previous experience (including direct and related experience),*
- *Training and continuing training. (NS-G-2.8, Para 3.9)*

SA-43: Appropriate training records and records of assessments against competence requirements shall be established and maintained for each individual with tasks important to safety.

*Related **IAEA** safety standards:*
Appropriate records of assessments against competence and qualification requirements should be established and maintained for each individual at the plant. (NS-G-2.8, Para 3.8)

SA-44: Performance based training programmes shall be established for all staff with tasks important to safety. The programmes shall cover basic training in order to qualify for a certain position and refresher training as needed.

*Related **IAEA** safety standards:*
Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel. The content of each programme should be based on a systematic approach. Training programmes shall promote attitudes which help to ensure that safety issues receive the attention that they warrant. (NS-R-2, Para 3.8)

SA-45: All plant staff including contractors shall have an appropriate level of understanding of nuclear safety, and personal safety depending on theirs levels and tasks.

*Related **IAEA** safety standards:*
All new employees starting work at a plant should be introduced to the organization and their working environment in a systematic and consistent manner.

General personnel training programmes should give new employees a basic understanding of their responsibilities and of safe work practices, the importance of quality programmes and of following procedures, and the practical means of protecting themselves from the hazards associated with their work. Hands-on training in means of radiation protection that are common to all plant personnel should be provided to all those who work in controlled areas. The amount of training to be provided on each topic should be commensurate with the individual's position and duties. The basic principles of safety culture should be taught to all employees, and refresher training on general topics should also be periodically provided. (NS-G-2.8, Para 5.1)

SA-46: Maintenance and technical support staff including contractors shall have practical hands-on-training on the required safety critical activities.

*Related **IAEA** safety standards:*
Maintenance and technical support personnel should have access to workshops, laboratories and facilities that are equipped with mock-ups, models and actual components that enable them to be trained in activities that cannot be practised with installed equipment (because of high dose rates, for example). (NS-G-2.8, Para 6.6)

2. Safety area: Design

The design of the storage facility should incorporate passive safety features as far as reasonably practicable (see SRL SB-11), therby minimising the reliance on active safety system, monitoring and human intervention to ensure safety. Where it is not reasonably practicable to incorporate passive safety features in the design, then the safety function will need to be fulfilled with active safety features. The SRLs in this subsection are connected with relevant design aspects.

2.1. Safety issue: Verification and improvement of design

SA-47: The current design basis shall be clearly and systematically defined and documented.

SA-48: The design basis shall include a set of postulated initiating events, with consideration of failures and hazards (internal and external, natural and man-induced), to demonstrate that the necessary safety functions are accomplished and the safety objectives met.

*Related **IAEA** safety standards:*
The design basis shall specify the necessary capabilities of the plant to cope with a specified range of operational states and design basis accidents within the specified radiological protection requirements (NS-R-1 para 5.4). PIEs shall be selected on the basis of deterministic or probabilistic technique or a combination of both; (NS-R-1 para 5.8)

Internal events and the potential for internal hazards .....shall be taken into account in the design of the plant. Natural external events .... and human induced external events shall be considered ....(NS-R-1 par. 5.9 through 5.17).

Consequential effects from a PIE should be considered as part of the original PIE. (NS-R-1 para 5.20)

The potential for accidents in low power and shutdown states shall be addressed in the design. (NS-R-1 para 5.25)

A systematic approach (analytical methods, comparison with other plants, operating experience) for identification of PIE shall be made. (NS-G-1.2 par. 4.33 to 4.39)

The identification of internal PIE should include challenges to safety functions, failures of safety systems and their support systems, failure of the barriers, all modes of plant operation, consequences of human errors. (NS-G-1.2 paras 4.40 to 4.45)

All naturally occurring events which could arise outside the plant and human induced external events which are credible at a given site should be included in the set of PIE for safety analysis. (NS-G-1.2 para 4.46 to 4.49)

SA-49: The initial and boundary conditions shall be specified in a reasonable conservative way.

*Related **IAEA** safety standards:*
A set of design basis accidents shall be derived from the PIEs for the purpose of setting the boundary conditions according to which the structures, systems and components important to safety shall be designed. (NS-R-1 para 5.27)

SA-50: The single failure criterion shall be applied in all design basis analyses of postulated initiating events.

*Related **IAEA** safety standards:*
The single failure criterion shall be applied to each safety group incorporated in the design … A single failure, and all its consequential failures shall be assumed for each element of the safety group … any potentially harmful consequences of the PIE for the safety group are assumed and the worst permissible configuration of safety systems is assumed. Non-compliance with the single failure criterion shall be exceptional, and shall be clearly justified in the safety analysis. (NS-R-1 par. 5.34 through 5.38)

SA-51: The impact of uncertainties, which are of importance for the results, shall be addressed in the design basis analyses.

*Related **IAEA** safety standards:*
The conservative assumptions made should take account of uncertainties in the initial conditions of the reactor, including safety system actuation set points. (NS-G-1.2, para 4.93)

SA-52: Radiological and other technical acceptance criteria shall be assigned to each plant condition (typically normal operation, anticipated operational occurrences, design basis accidents, additional failure assumptions).

*Related **IAEA** safety standards:*
Acceptance criteria shall be assigned to each [plant state] category that take account of the requirement that frequent PIEs shall have only minor or no radiological consequences, and that events that may result in severe consequences shall be of very low probability. (NS-R-1 para 5.7)

SA-53: Consideration shall be given to the performance of the plant in specified accidents beyond the design basis, including a selection of severe accidents, to determine those sequences for which reasonable practicable preventive or mitigatory measures can be identified.

*Related **IAEA** safety standards:*
Consideration shall be given to severe accident sequences, using a combination of engineering judgement and probabilistic methods, to determine those for which reasonably practicable preventive or mitigative measures can be identified. (NS-R-1 para 5.31)

SA-54: Consideration shall be given, in the same manner as in SA-48 , to combination of postulated initiating events with internal and external hazards.

*Related **IAEA** safety standards:*
Where combinations of randomly occurring individual events could credibly lead to anticipated operational occurrences or accident conditions, they shall be considered in the design. Certain events may be consequences of other events, such as a flood following an earthquake. Such consequential events shall be considered to be part of the original PIE. (NS-R-1, para 5.20)

SA-55: The current design shall on a regular basis, and when needed as a result of operating experience and significant new safety information, be reviewed against current requirements and practices to identify deviations. The safety significance of identified deviations shall be determined with respect to possible design improvements or other measures justified from a safety point of view.

*Related **IAEA** safety standards:*
Systematic safety reassessments of the plant … shall be performed by the operating organisation throughout its operational lifetime, with account taken of operating experience and significant new safety information from all relevant sources. (NS-R-2 para 10.1-2)

SA-56: The design shall have as an objective the prevention or, if this fails, the mitigation of radiation exposures resulting from design basis accidents and selected beyond design basis accidents. Design provisions shall be made to ensure that radiation doses to the public and the site personnel do not exceed acceptable limits and are as low as reasonably achievable.

*Related **IAEA** safety standards:*
The design shall have as an objective the prevention or, if this fails, the mitigation of radiation exposures resulting from design basis accidents and selected severe accidents. Design provisions shall be made to ensure that potential radiation doses to the public and the site personnel do not exceed acceptable limits and are as low as reasonably achievable. (NS-R-1 para 4.11)

SA-57: The design basis shall specify the necessary capabilities of the plant to cope with a specified range of plant states within the defined radiological protection requirements. The design basis shall include normal operation, anticipated operational occurrences and design

bases accidents from Postulated Initiating Events (PIEs), the safety classification, important assumptions and, in some cases, the particular methods of analysis.

*Related **IAEA** safety standards:*
The design basis shall specify the necessary capabilities of the plant to cope with specified range of operational states and design basis accidents within the defined radiological protection requirements. The design basis shall include the specification for normal operation, plant states created by the PIEs, the safety classification, important assumptions and, in some cases, the particular methods of analysis. (NS-R-1 para 5.4)

SA-58: The design basis shall also cover the decommissioning of nuclear facility and take into account the minimization of radioactive waste generation during the operation and decommissioning of nuclear installation.

SA-59: Defence-in-depth shall be applied in order to prevent releases harmful to the public and the environment during normal operation, operational occurrences and design basis accident conditions. The design shall therefore provide multiple physical barriers to the uncontrolled release of radioactive materials to the environment.

*Related **IAEA** safety standards:*

*In the design process, defence in depth shall be incorporated as described in **Section 2** (of NS-R-1) The design therefore shall provide multiple physical barriers to the uncontrolled release of radioactive materials to the environment. (NS-R-1 para 4.1)*

SA-60: The design shall prevent as far as practicable the failure of the integrity of a barrier if PIEs occur.

*Related **IAEA** safety standards:*
To ensure that the overall safety concept of defence in depth is maintained, the design shall be such as to prevent as far as practicable:
- *challenges to the integrity of physical barriers;*
- *failure of a barrier when challenged;*
- *failure of a barrier as consequence of failure of another barrier. (NS-R-1 para 4.2)*

SA-61: The plant shall be able to fulfil the fundamental safety functions:
- control of subcriticality,
- prevention of the exposure of operating personal, general public and environment,
- removal of heat,
- confinement of radioactive material,

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

*Related **IAEA** safety standards:*
The operating organisation shall identify all Postulated Initiating Events (PIEs) that could lead to a release of significant quantities of radiation and/or radiological materials and associated chemicals. The design Basis Event (DBEs) shall be identified as realistic envelopes for significant accident sequences. All safety functions shall be identified for the prevention and/or mitigation of the accident sequences. The appropriate barriers for preventing PIEs and/or mitigating accidents sequences shall be identified. These barriers, which implement the safety functions, can be SCCs or administrative safety requirements. (DS316 para 6)

SA-62: The licensee shall develop a set of design basis accidents derived from the listing of all relevant PIEs for the purpose of setting boundary conditions according to which the structures, systems and components important to safety shall be designed. Structures, systems and components important to safety shall be designed to be capable of withstanding all identified PIEs with sufficient reliability.

*Related **IAEA** safety standards:*

A set of design basis accidents shall be derived from the listing of PIEs (see Appendix) for the purpose of setting boundary conditions according to which the structures, systems and components important to safety shall be designed. (NS-R-1 para 5.27.) Structures, systems and components important to safety shall be designed to be capable of withstanding all identified PIEs with sufficient reliability. (NS-R-1 para 5.32.)

SA-63: The following types of PIEs shall as a minimum be included when relevant in the safety analysis for the design of safety systems.

Selected postulated initiating events

External postulated initiating events

Natural phenomena

- Extreme weather conditions
  precipitation : rain, snow, ice, frazil, 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 (~~terrorism, sabotage,~~ infrastructure failure, strikes and blockages)

Internal postulated events

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

*Related **IAEA** safety standards:*
Selected postulated initiating events (DS316 Appendix 1)

External postulated initiating events

Natural phenomena

- *Extreme weather conditions*
  precipitation : rain, snow, ice, frazil, wind, tornadoes, hurricanes, cyclones, dust or sand storm, lightning, high or low temperature, humidity
- *Flooding*
- *Earthquake and eruption of volcano*
- *Natural fires*
- *Effect of terrestrial and aquatic flora and fauna (blockage of inlet and outlets, damages on structure)*

Human induced phenomena

- *Fire, explosion or release of corrosive/hazardous substance*
- *(from surrounding industrial and military installations or transport infrastructure)*
- *Aircraft crash*
- *Missiles due to structural/mechanical failure in surrounding installations*
- *Flooding (failure of a dam, blockage of a river)*
- *Power supply and potential loss of power*
- *Civil strife (terrorism, sabotage, infrastructure failure, strikes and blockages)*

Internal postulated events

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

SA-64: The fail-safe principle shall be considered and incorporated in the design of systems and components important to safety.

*Related **IAEA** safety standards:*
The principle of fail-safe design shall be considered and incorporated into the design of systems and components important to safety for the plant as appropriate: if a system or component fails, plant systems shall be designed to pass into a safe state with no necessity for any action to be initiated. (NS-R-1 para 5.40)

SA-65: Design features and suitable redundancy and diversity in components shall be provided in order to fulfil the requirements with sufficient reliability for each PIE, on the assumption of a single failure.

*Related **IAEA** safety standards:*
Design features (such as leak detection, appropriate interconnections and isolation capabilities) and suitable redundancy and diversity in components shall be provided in order to fulfil these requirements with sufficient reliability for each PIE, on the assumption of a single failure. (NS-R-1 para 6.36)

SA-66: The reliability of the systems shall be achieved by an appropriate choice of measures including the use of proven components, redundancy, diversity, physical and functional separation and isolation.

*Related **IAEA** safety standards:*
The reliability of the systems shall be achieved by an appropriate choice of measures including the use of proven components, redundancy, diversity, physical separation, interconnection and isolation. (NS-R-1 para 6.40)

SA-67: The licensee shall design the facility to prevent a criticality accident by controlling the criticality relevant parameters of the facility during normal operation, anticipated operational occurrences and design basis accidents.

*Related **IAEA** safety standards:*
All operations with fissile materials shall be performed in such a way as to prevent a criticality accident. (DS316 – para 6)

SA-68: The criticality safety shall be achieved by design rather than by the administrative safety means as far as practicable.

*Related **IAEA** safety standards:*
As far as reasonably practicable, criticality hazard shall be controlled by design. (DS316 para 6.)

SA-69: The licensee shall design and implement measures for protecting the workers, public and environment from the release of radioactive material and from ionising radiation in normal operation, anticipated operational occurrences and design basis accidents.

SA-70: Means for removing residual heat during normal operation, anticipated operational occurrences and design basis accidents shall be provided.

*Related **IAEA** safety standards:*
Radioactive heat emission may result in the release of radioactive material if not adequately managed. Where appropriate this heat emission shall be accounted for in the facility design. (DS316 para 6.)

SA-71: Instrumentation shall be provided for measuring all the main variables that can affect the safety functions of the facility and for obtaining any information on the plant necessary for its reliable and safe operation. Provision shall be made for automatic recording of measurements of any derived parameters that are important to safety.

*Related **IAEA** safety standards:*
Instrumentation shall be provided to monitor plant variables and systems over the respective ranges for normal operation, anticipated operational occurrences, design basis accidents and severe accidents in order to ensure that adequate information can be obtained on the status of the plant. Instrumentation shall be provided for measuring all the main variables that can affect the fission process, the integrity of the reactor core, the reactor cooling systems and the containment, and for obtaining any information on the plant necessary for its reliable and safe operation. Provision shall be made for automatic recording of measurements of any derived parameters that are important to safety, such as the sub cooling margin of the coolant water. Instrumentation shall be environmentally qualified for the plant states concerned and shall be adequate for measuring plant parameters and thus classifying events for the purposes of emergency response. (NS-R-1 6.68)

SA-72: Instrumentation shall be environmentally qualified for the plant states concerned and shall be adequate for measuring plant parameters.

*Related **IAEA** safety standards:*
Instrumentation shall be provided to monitor plant variables and systems over the respective ranges for normal operation, anticipated operational occurrences, design basis accidents and severe accidents in order to ensure that adequate information can be obtained on the status of the plant. Instrumentation shall be provided for measuring all the main variables that can affect the fission process, the integrity of the reactor core, the reactor cooling systems and the containment, and for obtaining any information on the plant necessary for its reliable and safe operation. Provision shall be made for automatic recording of measurements of any derived parameters that are important to safety, such as the sub cooling margin of the coolant water. Instrumentation shall be environmentally qualified for the plant states concerned and shall be adequate for measuring plant parameters and thus classifying events for the purposes of emergency response. (NS-R-1-6.68)

SA-73: If appropriate a control room shall be provided from which the facility can be safely operated in all its operational states, and from which measures can be taken to maintain the

plant in a safe state or to bring it back into such a state after the onset of anticipated operational occurrences and design basis accidents.

*Related **IAEA** safety standards:*
A control room shall be provided from which the plant can be safely operated in all its operational states, and from which measures can be taken to maintain the plant in a safe state or to bring it back into such a state after the onset of anticipated operational occurrences, design basis accidents and severe accidents. Appropriate measures shall be taken and adequate information provided to safeguard the occupants of the control room against consequent hazards, such as undue radiation levels resulting from an accident condition or the release of radioactive material or explosive or toxic gases, which could hinder necessary actions by the operator. (NS-R-1 para 6.71)

SA-74: Redundancy and independence designed into the protection system shall be sufficient at least to ensure that:
- no single failure results in loss of protection function; and
- the removal from service of any component or channel does not result in loss of the necessary minimum redundancy.

*Related **IAEA** safety standards:*
The protection system shall be designed for high functional reliability and periodic testability commensurate with the safety function(s) to be performed. Redundancy and independence designed into the protection system shall be sufficient at least to ensure that:
(1) no single failure results in loss of protection function; and
(2) the removal from service of any component or channel does not result in loss of the necessary minimum redundancy, unless the acceptable reliability of operation of the protection system can be otherwise demonstrated. (NS-R-1 para 6.81)

SA-75: The licensee shall provide a back-up power supply in the case, when lack of power supply can affect the safety of the facility.

2.2. Safety issue: Safety classification of system, structures and components (SSCs) and related requirements

SA-76: All SSCs important for safety shall be identified and classified on the basis of their importance for safety. They shall be designed, constructed and maintained such that their quality and reliability is commensurate with this classification.

*Related **IAEA** safety standards:*
All structures systems and components including software for I&C that are items important for safety shall be first identified and then classified on the basis of their function and significance with regard to safety. They shall be designed, constructed and maintained such that their quality and reliability is commensurate with this classification. (NSR-1 5.1)

SA-77: The classification of SSCs shall be based on deterministic methods, complemented where appropriate by engineering judgment and/or probabilistic methods.

*Related **IAEA** safety standards:*
The method for classifying safety significance of an SSC shall be primarily based on deterministic methods, complemented where appropriate by probabilistic methods and engineering judgment, with account taken of factors such as
- *the safety function to be performed by the item ;*
- *the consequences of failure to perform its function ;*
- *the time following a PIE at which, or period throughout which, it will be called upon (NSR-1 5.2).*

PSA can be used in the design phase to confirm the appropriate classification of SSCs. (NSG-1.2 3.30)

SA-78: SSCs important to safety shall be designed to withstand all relevant PIEs with sufficient reliability.

*Related **IAEA** safety standards:*
SSCs important to safety shall be designed to be capable of withstanding all identified PIEs with sufficient reliability (NSR-1 5.32).

SA-79: The potential for common cause failure shall be considered to determine where diversity, redundancy and independence should be applied to achieve the necessary reliability.

*Related **IAEA** safety standards:*
The potential for common cause failure of items important to safety shall be considered to determine where the principles of diversity, redundancy and independence should be applied to achieve the necessary reliability. (NSR-1 5.33)

SA-80: The failure of a SSC in one safety class shall not cause the failure of other SSCs in a higher safety class. Auxiliary systems supporting equipment important to safety shall be classified accordingly.

*Related **IAEA** safety standards:*
Appropriately designed interfaces shall be provided between SSCs of different classes to ensure that any failure in a system classified in a lower class will not propagate to a system classified in a higher class. (NSR-1 5.3).

The failure of a system and/or component in one safety class should not cause the failure of the other systems and/or component of a higher safety class. The adequacy of the isolation and separation of different and potentially interacting systems assigned to different safety classes should be assessed. (NS-G 1.2 3.31)

SA-81: The design of SSCs important to safety and the materials used shall consider the effects of operational conditions over the plant lifetime and the effects of design basis accidents on their characteristics and performance.

*Related **IAEA** safety standards:*
Materials should meet the standards and requirements for their design and fabrication. The design lifetime of the materials should be determined considering the effects of operational conditions (radiological and chemical environment, single and periodic loads). In addition, effects of design basis accidents on their characteristics and performance should be considered. (NSG-1.2 3.63)

SA-82: A qualification procedure shall be adopted to confirm that SSCs important to safety meet throughout their design operational lives the demands for performing their function, taking into account environmental conditions over the lifetime of the plant and when required.

*Related **IAEA** safety standards:*
A qualification procedure shall be adopted to confirm that the items important to safety are capable of meeting, throughout their design operational lives, the demands for performing their functions while being subject to the environmental conditions (of vibration, temperature, pressure, jet impingement, electromagnetic interference, irradiation, humidity or any likely combination thereof) prevailing at the time of need. The environmental conditions to be considered shall include the variations expected in normal operation, anticipated operational occurrences and design basis accidents. In the qualification programme, consideration shall be given to ageing effects caused by various environmental factors (such as vibration, irradiation and extreme temperature) over the expected lifetime of the equipment. Where the equipment is subject to external natural events and is needed to perform a safety function in or following such an event, the qualification programme shall replicate as far as practicable the conditions imposed on the equipment by the natural phenomenon, either by test or by analysis or by a combination of both. (NSR-1 5.45)

2.3. Safety issue: Operational limits and conditions (OLCs)

SA-83: OLCs shall be developed to ensure that facilities are operated in accordance with design assumptions and intentions as documented in the safety case.

*Related **IAEA** safety standards:*
OLCs shall be developed to ensure that plants are operated in accordance with design assumptions and intent. In order to achieve this requirement the plant safety analysis report should be developed in such a manner as to identify… (NS-G-2.2. Para 3.1)

SA-84: The OLCs shall define the conditions that must be met to prevent situations that might lead to accidents or to mitigate the consequences of accidents should they occur.

*Related **IAEA** safety standards:*
In order to achieve this requirement the plant safety analysis report should be developed in such a manner as to identify clearly the OLCs that must be met to prevent situations from arising which might lead to accident conditions or to mitigate the consequences of accidents if they do occur. (NS-G-2.2. Para 3.1)

SA-85: Each established OLC shall have detailed justification based on facility design, safety analysis and commissioning tests.

*Related **IAEA** safety standards:*
The OLCs shall be based on a safety analysis of the individual plant and its environment in accordance with provisions made in the design… The safety analysis report and OLCs should be reviewed and amended when necessary on the basis of the results of commissioning testing. (NS-G-2.2, Para 3.8)
The necessity for each of the OLCs shall be substantiated by a written statement of the reason for its adoption. (NS-R-2, Para 5.6)

SA-86: OLCs shall be kept updated and reviewed in the light of experience, developments in science and technology, and every time modifications in the facility or in the safety analysis warrant it, and changed if necessary.

*Related **IAEA** safety standards:*
The OLCs shall be reviewed over the operating life of the plant in the light of experience, developments in technology and safety, and changes in the plant, and shall be modified if this is required by the regulatory body or if it is considered appropriate by the operating organization and approved by the regulatory body. (NS-R-2, Para 5.7)
Periodic review of OLCs should be undertaken to ensure that they remain applicable for their intended purpose.... (NS G 2.2 Para 3.15)

SA-87: The process for making modifications or temporary modifications of OLCs shall be defined. Such modifications of OLCs shall be adequately justified.

*Related **IAEA** safety standards:*
Where modifications to the OLCs become necessary, the same approach as that described in Paras 3.8-3.12 should be followed. (NS-G-2.2, Para 3.13)

When it is necessary to modify OLCs on a temporary basis… particular care should be taken to ensure that the effects of change are analysed... (NS-G-2.2, Para 3.14)

SA-88: Operational staff shall be highly knowledgeable of the OLCs and their technical basis and relevant operational decision makers shall be aware of their significance for the safety of the facility.

*Related **IAEA** safety standards:*

It should be understood that OLCs form a logical system in which the elements listed in Para 3.5 are closely interrelated and in which the safety limits constitute the ultimate boundary of the safe conditions. An example explaining such an interrelationship is given in the Annex. The OLCs should be readily accessible to control room personnel. For this they should be collected in one document for control room use. (NS-G-2.2, Para 3.6)

Control room operators should be highly knowledgeable of the OLCs and their technical basis. (NS-G-2.2, Para 3.6)

SA-89: OLCs cover all normal operational states and shall include:

(a) safety limits ;
(b) safety margins ;
(c) equipment required including surveillance;
(d) actions to be taken in case of deviation from OLCs.

*Related **IAEA** safety standards:*
The OLCs shall include requirements for different operational states, including shutdown. (NS-R-2. Para 5.1).
The OLCs shall contain operational requirements for different operational states including shutdown. These operational states should include starting up, power production, shutting down, maintenance, testing and refuelling. (NS G 2.2 Paras 3.2)

The OLCs may be classified as:
- *Safety limits;*
- *Limits on safety systems settings;*
- *Limits and condition for normal operation and for safe transient operational states;*
- *Surveillance requirements. (NS-R-2. Paras 5.3)*

The OLCs at the power plant should include the following items:
- *Safety limits;*
- *Limiting safety system settings,*
- *Limits and conditions for normal operation,*
- *Surveillance requirements,*
- *Action statements for deviations from the OLCs. (NS G 2.2 Paras 3.5)*

SA-90: Adequate margins shall be provided between safety limits, safety systems settings, alarms and operational limits to avoid activating safety systems too frequently.

*Related **IAEA** safety standards:*
Acceptable margins should be ensured between normal operating values and the established safety systems settings to avoid undesirably frequent actuation of safety systems. (NS-G-2.2, Para 6.1)

SA-91: Safety limits shall be established using a conservative approach to take uncertainties in the safety analyses into account.

*Related **IAEA** safety standards:*
The safety limits should be established by means of conservative approach to ensure that all the uncertainties of safety analyses are taken in to account. (NS-G-2.2, Para 4.1)

Established safety system settings should ensure automatic action of safety systems within the parameter values assumed in the SAR, despite possible errors that could occur adjusting the nominal set point. (NS-G-2.2, Para 5.2)

SA-92: Limits and conditions for normal operation shall include limits on operating parameters, stipulation for minimum amount of operable equipment, staffing levels, actions to be taken by the operating staff in the event of deviations from the OLCs and time allowed to complete these actions.

*Related **IAEA** safety standards:*
Limits and conditions for normal operation should include limits on operating parameters, stipulations for minimum amount of operable equipment, minimum staffing levels, prescribed actions to be taken by the operating staff in the event of deviations from the OLCs and time allowed to complete these actions. The limits should also include parameters important to safety, such as the chemical composition of working media, their activity contents and limits on radioactive discharges to the environment. (NS-G-2.2, Para 6.2)

SA-93: Where OLCs have been contravened, the actions to bring the facility to a safer state shall be specified, and the time allowed to complete the action shall be stated.

*Related **IAEA** safety standards:*
Where operability requirements cannot be met to the extent intended, the actions to be taken to manoeuvre the plant to a safer state, such as power reduction or reactor shutdown, should be specified, and the time allowed to complete the action should also be stated. (NS-G-2.2. Paras 6.3)

SA-94: Minimum staff levels to ensure safe operation shall be stated in the OLCs.

*Related **IAEA** safety standards:*
The Limits and conditions for normal operation should include staffing levels. (NS-G-2.2, Para 6.2)
There should be limits and conditions on staff numbers, notably in the control room. (NS-G-2.2, Para 10.5 and Appendix 1)

SA-95: The licensee shall ensure that an appropriate surveillance program is established and implemented to ensure compliance with OLCs and shall ensure that results are evaluated and retained.

*Related **IAEA** safety standards:*
The operating organization shall ensure that an appropriate surveillance program is established and implemented to ensure compliance with OLCs, and that results are evaluated and retained. (NS-R-2, Para 5.5)

Records of plant operation and demonstrations of compliance with OLCs and OPs should be made and stored in accordance with IAEA Safety Guide N°50-SG-Q3 on quality assurance. (NS-G-2.2, Para 10.6)

SA-96: In cases of non-compliance, remedial actions shall be taken immediately to re-establish OLC requirements.

*Related **IAEA** safety standards:*
In the event that the operation of the plant deviates from one or more of the established operational limits and conditions, the appropriate remedial actions shall be taken immediately, and the operating organization shall undertake review and evaluation of the case and shall notify the regulatory body in accordance with the established event reporting system. (NS-R-2 Para 5.8)

SA-97: Reports of non-compliance shall be investigated and corrective action shall be implemented in order to help prevent such non-compliance in the future.

*Related **IAEA** safety standards:*
Reports of non-compliance should be investigated to ensure that corrective action is implemented and to help prevent such non-compliance in future. (NS-G-2.2, Para 10.6)

3. Safety Area : Operation

3.1. Safety issue: Emergency Preparedness

If as consequence from the safety case for the set of design basis accidents events requiring protective measures cannot be excluded, emergency arrangements will be required. These should be proportionate taking account of the magnitude of the accident consequence. For some facilities an off-site emergency plan may not be required, which must be justified.

SA-98: 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 their 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:*

The on-site emergency arrangements shall cover emergencies involving combinations of non-nuclear and nuclear hazards, such as a fire in conjunction with significant levels of radiation or contamination, or toxic or asphyxiating gases in conjunction with radiation and contamination, with account taken of the specific site conditions. (NS-R-2; Para 2.34)

In a nuclear or radiological emergency, the practical goals of emergency response are:
(a) To regain control of the situation;
(b) To prevent or mitigate consequences at the scene;
(c) To prevent the occurrence of deterministic health effects in workers and the public;
(d) To render first aid and to manage the treatment of radiation injuries;
(e) To prevent, to the extent practicable, the occurrence of stochastic health effects in the population;
(f) To prevent, to the extent practicable, the occurrence of non-radiological effects on individuals and among the population;
(g) To protect, to the extent practicable, property and the environment;
(h) To prepare, to the extent practicable, for the resumption of normal social and economic activity. (GS-R-2; Para 2.3)

The practical goal of emergency preparedness may be expressed as:

To ensure that arrangements are in place for a timely, managed, controlled, co-ordinated and effective response at the scene, and at the local, regional, national and international level, to any nuclear or radiological emergency. (GS-R-2; Para 2.6)

SA-99: The licensee shall prepare a site emergency plan and establish the necessary organizational structure for clear allocation of responsibilities, authorities, and arrangements for co-ordinating plant activities and co-operating with external response agencies throughout all phases of an emergency.

Related **IAEA** safety standards:
The emergency arrangements shall include the clear allocation of responsibilities, authorities and arrangements for co-ordination in all phases of the response. These arrangements shall include: ensuring that for each response organization a single position has the authority and responsibility to direct its response actions; clearly assigning the responsibility for the co-ordination of the entire response and for the resolution of conflicts between response organizations; assigning to an on-site position the authority and responsibility for notifying the appropriate organization(s) of an emergency and taking immediate on-site actions; and assigning to an on-site position the responsibility for directing the entire on-site response. (GS-R-2; Para 5.4)

The operating organization [of a facility ……] shall prepare an emergency plan that covers all activities under its responsibility, to be adhered to in the event of an emergency. This emergency plan shall be co-ordinated with those of all other bodies having responsibilities in an emergency, including public authorities, and shall be submitted to the regulatory body. (GS-R-2; Para 5.19 or NS-R-2; Para 2.31)

SA-100: The licensee shall provide for:

(a) Prompt recognition and classification of emergencies;
(b) Timely notification and alerting of response personnel;
(c) Ensuring the safety of all persons present on the site, including the protection of the emergency workers
(d) Informing the authorities and the public, including timely notification and subsequent provision of information as required;
(e) Performing assessments of the situation on the technical, & radiological points of view (on and off site);
(f) Monitoring radioactive releases;
(g) Treatment and first aid of a limited number of contaminated and/or overexposed workers/persons; and
(h) Facility management and damage control[9].

*Related **IAEA** safety standards:*

Arrangements shall be made to assess promptly: abnormal conditions at the facility; exposures and releases of radioactive material; radiological conditions on and off the site; and any actual or potential exposures of the public. These assessments shall be used for mitigatory actions by the operator, emergency classification, urgent protective actions to be taken on the site, the protection of workers and recommendations for urgent protective actions to be taken off the site. (GS-R-2; Para 4.70)

All practicable steps shall be taken to provide the public with useful, timely truthful, consistent and appropriate information throughout a nuclear or radiological emergency. (GS-R-2; Para 4.82)

Arrangements shall be made for taking all practicable measures to provide protection for emergency workers for the range of anticipated hazardous conditions in which they may have to perform response functions on or off the site. This shall include: arrangements to assess continually and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance and international standards; and arrangements for the provision of appropriate specialized protective equipment, procedures and training for emergency response in the anticipated hazardous conditions. (GS-R-2; Para 4.62)

Arrangements shall be made to treat a limited number of contaminated or overexposed workers, including arrangements for first aid, the estimation of doses, medical transport and the initial medical treatment of contaminated or highly exposed individuals in local medical facilities. (GS-R-2; Para 4.78)

The on-site emergency plan shall include arrangements to ensure the safety of all persons on the site in the event of a nuclear or radiological emergency. This shall include arrangements: to notify people on the site of an emergency; for all persons on the site to take appropriate actions immediately upon notification of an emergency; to account for those on the site; to locate and recover those unaccounted for; to take urgent protective action; and to provide immediate first aid. The facility shall provide suitable assembly points for all persons on the site and shall be provided with a sufficient number of safe escape routes, clearly and durably marked, with reliable emergency lighting, ventilation and other building services essential to the safe use of these routes. (GS-R-2; Para 4.51)

SA-101: The site emergency plan shall be based upon an assessment of reasonably foreseeable events and situations that may require protective measures on- or off-site. The

[9] Urgent mitigatory repairs, controls, and other actions that are carried out, primarily at the site, while the emergency is still in progress.

plan shall also be co-ordinated with all other involved bodies and capable of extension should more improbable, severe events occur.

*Related **IAEA** safety standards:*
In designing a threat category I, II or III facility "[a] comprehensive safety analysis is carried out to identify all sources of exposure and to evaluate radiation doses that could be received by workers at the [facility] and the public, as well as potential effects on the environment… The safety analysis examines… event sequences that may lead to [an emergency]. On the basis of this analysis…requirements for emergency [preparedness and] response can be established." (GS-R-2; Para 3.14)

SA-102: The licensee shall have people available at all times with the authority and responsibilities to classify and declare an emergency and, upon classification, to initiate promptly the appropriate on-site response.

*Related **IAEA** safety standards:*
The on-site emergency plan shall include the following:
- *The designation of persons for directing on-site activities and for ensuring liaison with off-site organizations;*
- *The conditions under which an emergency shall be declared, a list of job titles and/or functions of persons empowered to declare it, and a description of suitable means for alerting response personnel and public authorities;*
- *The arrangements for initial and subsequent assessment of the radiological conditions on and off the site;*
- *Provisions for minimizing the exposure of persons to ionizing radiation and for ensuring medical treatment of casualties;*
- *Assessment of the state of the installation and the actions to be taken on the site to limit the extent of radioactive release;*
- *The chain of command and communication, including a description of related facilities and procedures;*
- *An inventory of the emergency equipment to be kept in readiness at specified locations;*
- *The actions to be taken by persons and organizations involved in the implementation of the plan;*
- *and provisions for declaring the termination of an emergency. (NS-R-2; Para 2.33)*

SA-103: Sufficient numbers of qualified personnel shall be available at all times for staffing appropriate positions promptly following the declaration and notification of an emergency.

*Related **IAEA** safety standards:*
Sufficient numbers of qualified personnel shall be available at all times in order that appropriate positions can be promptly staffed as necessary following the declaration and notification of a nuclear or radiological emergency. (GS-R-2; Para 5.9)

SA-104: Arrangements shall be made to provide technical assistance to operational staff. Teams for mitigating the consequences of an emergency (eg. radiation protection, damage control, fire fighting, etc) shall be available.

*Related **IAEA** safety standards:*
For facilities in threat category I, II or III arrangements shall be made to provide technical assistance to the operational staff. Teams for mitigating the consequences of an emergency (damage control, fire fighting) shall be available and shall be prepared to perform actions in the facility. "Any equipment necessary in… response and recovery… shall be placed at the most suitable location to ensure its ready availability at the time of need and to allow human access [to it] in the anticipated [emergency conditions or] environmental conditions." (Ref. [11], Para. 5.30.) The personnel directing mitigatory actions shall be provided with an operating environment, information and technical assistance that allows them to take effective action to mitigate the consequences of the emergency. Arrangements shall be made to obtain support promptly from police, medical and fire fighting services off the site. Off-site support personnel shall be afforded prompt access to the facility and shall be informed of on-site conditions and the necessary protective actions. (GS-R-2; Para 4.40)

SA-105: Arrangements shall be made to alert police, medical, and off-site fire-fighting services and other responsible authorities and/or organisations promptly.

*Related **IAEA** safety standards:*
Emergency plans shall include, as appropriate: .... (d) procedures, including communication arrangements, for contacting any relevant [response organizations] and for obtaining assistance from fire fighting, medical, police and other relevant organizations; .... (GS-R-2; Para 5.18)

SA-106: The licensee shall identify those who are authorised to carry out the response functions assigned in the emergency plan.

*Related **IAEA** safety standards:*
The emergency arrangements shall include the clear allocation of responsibilities, authorities and arrangements for co-ordination in all phases of the response. These arrangements shall include: ensuring that for each response organization a single position has the authority and responsibility to direct its response actions; clearly assigning the responsibility for the co-ordination of the entire response and for the resolution of conflicts between response organizations[72]; assigning to an on-site position the authority and responsibility for notifying the appropriate organization(s) of an emergency and taking immediate on-site actions; and assigning to an on-site position the responsibility for directing the entire on-site response[73]. (GS-R-2; Para 5.4)

SA-107: Appropriate emergency facilities shall be designated for responding to events on site and that will provide off-site monitoring and assessment throughout different phases of an emergency response.

*Related **IAEA** safety standards:*
Adequate tools, instruments, supplies, equipment, communication systems, facilities and documentation (such as procedures, checklists, telephone numbers and manuals) shall be provided for performing the functions specified in [Section 4]. These items and facilities shall be selected or designed to be operational under the postulated conditions (such as the radiological, working and environmental conditions) that may be encountered in the emergency response, and to be compatible with other procedures and equipment for the response (such as the communication frequencies of other response organizations), as appropriate. These support items shall be located or provided in a manner that allows their effective use under postulated emergency conditions. (GS-R-2; Para 5.25)

SA-108: Important information shall be available in the emergency facility about the facility and radiological conditions on and around the site.

*Related **IAEA** safety standards:*
An "on-site emergency control centre", separated from the [facility] control room, shall be provided to serve as [a] meeting place for the emergency staff who will operate from there in the event of an emergency. Information about important [facility] parameters and radiological conditions in the [facility] and its immediate surroundings should be available there. The room should provide means of communication with the control room, the supplementary control room and other important points in the [facility], and with the on-site and off-site emergency response organizations. Appropriate measures shall be taken to protect the occupants for a protracted time against hazards resulting from a severe accident. (GS-R-2; Para 5.27)

SA-109: Instruments, tools, equipment, documentation, and communication systems for use in emergencies shall be kept available and tested sufficiently frequently to demonstrate that they are in good working condition where they are unlikely to be affected by postulated accidents.

*Related **IAEA** safety standards:*
Instruments, tools, equipment, documentation and communication systems to be used in emergencies shall be kept available and shall be maintained in good operating condition, in such a manner that they are unlikely to be affected by or made unavailable by the postulated accidents. (NS-R-2; Para 2.38)

SA-110: Arrangements shall be made to identify the knowledge, skills, and abilities needed for personnel to perform their assigned response functions.

*Related **IAEA** safety standards:*
The operator and the response organizations shall identify the knowledge, skills and abilities necessary to be able to perform the functions specified in [Section 4]. The operator and the response organizations shall make arrangements for the selection of personnel and for training to ensure that the personnel have the requisite knowledge, skills, abilities, equipment, and procedures and other arrangements to perform their assigned response functions.... (GS-R-2; Para 5.31)

SA-111: Arrangements shall be made to inform all employees and all other persons present on the site of the actions to be taken in the event of an emergency.

*Related **IAEA** safety standards:*
All employees and all other persons on the site shall be instructed in the arrangements for them to be notified of an emergency and their actions when notified of an emergency. (GS-R-2; Para 5.32)

SA-112: Training arrangements shall include basic emergency training and ongoing refresher training on an appropriate schedule and shall ensure that emergency response personnel meet the training obligations.

*Related **IAEA** safety standards:*
.... The arrangements shall include ongoing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities for emergency response undergo the specified training. (GS-R-2; Para 5.31)

SA-113: The facility emergency plan shall be exercised on a regular basis. Some exercises shall be integrated to include as many as possible of the off-site organizations concerned.

*Related **IAEA** safety standards:*

.... There shall thereafter at suitable intervals be exercises of the emergency plan, some of which shall be witnessed by the regulatory body. Some of these exercises shall be integrated and shall include the participation of as many as possible of the organizations concerned.... (NS-R-2; Para 2.37)

SA-114: Emergency exercises shall be evaluated systematically, and the emergency preparedness arrangements and the plan shall be subject to review and updating in the light of experience gained.

*Related **IAEA** safety standards:*
..... The plans shall be subject to review and updating in the light of experience gained. (NS-R-2; Para 2.37)

3.2. Safety issue: Operation/Plant modification

SA-115: The licensee shall ensure that no modification to the storage facility, whatever the reason for it, affects the facility's ability to be operated safely. Plant modifications are permanent or temporary changes to SSCs, including hardware and software.

*Related **IAEA** safety standards:*
No modification to a nuclear power plant, whether temporary or permanent, should affect the plant's ability to be operated safely in accordance with the assumptions and intend of the design. (NS-G-2.3, Para 2.3)

Modifications relating to plant configuration are... any permanent or temporary alterations to structures, systems and components, process software, operational limits and conditions, or operating procedures. (NS-G-2.3, Para 4.1)

SA-116: The licensee shall control facility modifications using a graded approach with appropriate criteria for classification according to their safety significance.

*Related **IAEA** safety standards:*
The operating organisation shall establish a procedure to ensure proper design, review, control and implementation of all permanent and temporary modifications. (NS-R-2, Para 7.4)

Modifications should be categorized according to their safety significance. (NS-R-2, Para 7.2)

The criteria applicable in determining the categorization for each specific modification should be defined and documented in order to enable correct assessment of the potential effect on safety. (NS-G-2.3, Para 4.7)

A proposed categorization could be... (NS-G-2.3, Para 4.5)

SA-117: Modifications to instructions and procedures, to organisational aspects, to evaluation methods in the safety case shall follow a similar process, as for technical changes.

*Related **IAEA** safety standards:*
Modifications to a nuclear power plant may consist of:
(1) Modifications to structures, systems and components;
(2) Modifications to the operational limits and conditions;
(3) Modifications to instructions and procedures; or
(4) A combination of the above; and
(5) Modification of organizations. (NS-R-2, Para 7.1)

SA-118: The licensee shall establish a process to ensure that all permanent and temporary modifications are properly designed, reviewed, controlled and implemented, and that all relevant safety requirements are met.

*Related **IAEA** safety standards:*
The operating organization shall establish a procedure to ensure proper design, review, control and implementation of all permanent and temporary modifications. This procedure shall ensure that the requirements of the plant safety analysis report and applicable codes and standards are met. (NS-R-2, Para 7.4)

SA-119: This process shall include the following:
- Reason and justification for modification;
- Feasibility study, if appropriate;
- Design;
- Safety assessment;
- Updating plant documentation and training;
- Fabrication, installation and testing; and
- Commissioning the modification.

*Related **IAEA** safety standards:*
It should be ensured that the various steps shown in Fig. 1,... have been completed. Appropriate justification should be given for each modification and this should be assessed before the modification is made. (NS-G-2.3, Para 2.8)

SA-120: The licensee shall ensure that appropriate safety assessments and reviews have been performed before a modification is commenced.

*Related **IAEA** safety standards:*
The operating organization should ensure that the appropriate safety analyses have been performed before the modification is commenced. The operating organization should submit details of the modifications and the

safety assessment to the regulatory body for its information, review, approval or concurrence, as appropriate, before proceeding with the modification. (NS-G-2.3 Para 3.3)

SA-121: Before starting a modification, an initial safety assessment shall be carried out to determine any consequences for safety.

*Related **IAEA** safety standards:*
An initial safety assessment should be carried out before starting a modification to determine whether the proposed modification has any consequences for safety and whether it is within the regulatory constraints for the plant design and operation. This initial assessment should be carried out by trained and qualified personnel. (NS-G-2.3, Para 4.8)

SA-122: A detailed, comprehensive safety assessment shall be undertaken, unless the results of the initial safety assessment show that the scope of this assessment can be reduced or it can be omitted if the modifications have no safety significance.

*Related **IAEA** safety standards:*
Depending on the results of the initial safety assessment, a more detailed and comprehensive safety assessment may be needed. The extent and complexity of the additional assessment that is necessary will depend on the nature and extent of the consequences of the modification for safety. If the initial assessment has clearly demonstrated that the modification will have no consequences for safety, either as or after the modification is made, then further safety assessment may not be necessary. (NS-G-2.3, Para 4.9)

SA-123: Comprehensive safety assessments shall demonstrate all applicable safety aspects are considered and that the system specifications and the relevant safety requirements are met.

*Related **IAEA** safety standards:*
It should be demonstrated by means of the comprehensive safety assessment that the modified plant can be operated safely and complies with the system specifications and safety requirements. (NS-G-2.3, Para 4.11)

SA-124: The scope, safety implications and consequences of proposed modifications shall be reviewed by personnel independent of their design or implementation.

*Related **IAEA** safety standards:*
The scope, safety implications and consequences of proposed modifications should be reviewed by personnel not immediately involved in their design or implementation. (NS-G-2.3, Para 4.13)

SA-125: Implementation and testing of plant modifications shall be performed in accordance with relevant work control and plant testing procedures.

*Related **IAEA** safety standards:*
Implementation and testing of plant modifications shall be performed in accordance with the plant's work control system and appropriate testing procedures. (NS-R-2, Para 7.5)

SA-126: Before commissioning a modified plant personnel shall have been trained, as appropriate, and all relevant documents necessary for facility operation shall have been updated.

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

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

SA-127: All temporary modifications shall be clearly identified at the point of application and at any relevant control position. Operating personnel shall be clearly informed of these modifications and of their consequences for the operation of the facility.

*Related **IAEA** safety standards:*
Temporary modifications (including defeat of interlocks, installation of jumpers and lifted leads) shall be clearly identified at the point of application and any relevant control position. Operating personnel shall be clearly informed of these temporary modifications and of their consequences for the operation of the plant, under all operating conditions. (NS-R-2, Para, 7.6)

SA-128: Temporary modifications shall be managed according to specific facility procedures.

*Related **IAEA** safety standards:*
An appropriate procedure should be established to control temporary modifications on the plant. (NS-G-2.3, Para 6.9)

SA-129: The number of simultaneous temporary modifications shall be kept to a minimum at all times. The period of a temporary modification shall be limited.

*Related **IAEA** safety standards:*
The number of temporary modifications should be kept to a minimum. A time limit should be specified for their removal or conversion into permanent modifications. (NS-G-2.3, Para 6.3)

SA-130: The licensee shall periodically review outstanding temporary modifications to determine whether they are still needed. The status of temporary modifications shall be periodically reported to the Facility Management.

*Related **IAEA** safety standards:*
The plant management should periodically review outstanding temporary modifications to consider whether they are still needed, and to check that operating procedures, instructions, drawings and operator aids conform to the approved configuration. The status of temporary modifications should be periodically reported (typically at monthly intervals) to the plant manager. (NS-G-2.3, Para 6.5)

3.3. Safety issue: Ageing Management

SA-131: In addition to the maintenance, surveillance and inspection programmes the operating organisation shall have an Ageing Management Programme (AMP) to identify all ageing mechanisms important to safety related SSCs, determine their possible consequences and determine necessary activities in order to maintain the operability and reliability of these SSCs.

*Related **IAEA** safety standards:*
The operating organisation should determine which additional MSS activities will be necessary as the plant ages. At least two phases of the plant's lifetime should receive special attention in the planning of maintenance: the commencement of operation just after commissioning, and the period when ageing mechanisms could contribute significantly to the deterioration of safety related SSCs. There is no specific moment in time at which safety relevant ageing processes at a plant set in, this time is different for different SSCs. The importance of ageing processes for the safety and availability of a nuclear power plant should be recognised in order to maintain and enhance the plant's long term operating characteristics. Assessments should be made of whether and how the ageing of SSCs would increase the potential for common mode failures and for varying levels of incipient, degraded and catastrophic failures, in order to provide assurance of the availability of aged SSCs important to safety until the end of their service life. Monitoring the reliability and performance of the plant for ageing related degradation should therefore be a feature of the safety management programme, and an appropriate preventive maintenance programme should be in place. (NS-G-2.6, Para 7.6)

The safety assessment should take into account the fact that plant structures, systems and components are affected in varying measure by ageing effects. Some effects of this kind are well known and provisions can be taken to cope with them. Others, by experience, are not foreseeable and suitable testing, inspection and surveillance programmes should be employed in order to detect their possible occurrence. A complete programme of actions during the plant lifetime should be drawn up and technical prerequisites for its implementation established at the design stage. Periodic safety reviews are a good way of determining whether ageing and wear-out mechanisms have been correctly taken into account and to detect unpredicted issues. (NS-G-1.2; paragraph 3.97)

SA-132: The licensee shall assess SSCs important to safety taking into account of relevant ageing and wear-out mechanisms and potential age related degradations in order to ensure the capability of the facility to perform the necessary safety functions throughout its planned life.

*Related **IAEA** safety standards:*
Appropriate margins shall be provided in the design for all structures, systems and components important to safety so as to take into account relevant ageing and wear-out mechanisms and potential age related degradation, in order to ensure the capability of the structure, system or component to perform the necessary safety function throughout its design life. (NS-R-1; Para 5.47)

Ageing and wear-out effects in all normal operating conditions, testing, maintenance, maintenance outages and plant states in a postulated initiating event (PIE) and post-PIE shall also be taken into account. (NS-R-1; Para 5.47)

SA-133: The licensee shall provide monitoring, testing, sampling and inspection activities to assess ageing effects to identify unexpected behaviour or degradation during service.

*Related **IAEA** safety standards:*
Provisions shall also be made for monitoring, testing, sampling and inspection, to assess ageing mechanisms predicted at the design stage and to identify unanticipated behaviour or degradation that may occur in service. (NS-R-1; Para 5.47)

Other possible ageing effects, indicated by past experience, refer to:
- *Corrosion of vessel internals, and failure by vibration.*
- *Stress corrosion cracking of core nozzles and, in some cases irradiation assisted, reactor internals.*
- *Thermal and pressure transients in nozzles and piping, including thermal mixing and stripping in pipe joint areas.*
- *Thermal stratification in piping and other erosion mechanisms.*
- *Ageing of organic cable insulation or sealing materials.*
- *The design of the plant should eliminate these problems during the design stage or include means for timely detection of their inception and for implementing appropriate corrective actions. (NS-G-1.2, Para 3.101)*

SA-134: The Periodic Safety Reviews shall be used determine whether ageing and wear-out mechanisms have been correctly taken into account and to detect unexpected issues.

*Related **IAEA** safety standards:*
…Periodic safety reviews are a good way of determining whether ageing and wear-out mechanisms have been correctly taken into account and to detect unpredicted issues. (NS-G-1.2; paragraph 3.97)

SA-135: In its AMP the licensee shall take account of environmental conditions, process conditions, maintenance schedules, service life, testing schedules, and on the other hand replacement strategy.

*Related **IAEA** safety standards:*
Ageing should be taken into account in the design by the appropriate definition of environmental conditions, process conditions, duty cycles, maintenance schedules, service life, testing schedules, replacement parts and replacement intervals. (NS-G-1.2, Para 3.93)

SA-136: The AMP shall be reviewed and updated, in order to incorporate new information as it becomes available.

*Related **IAEA** safety standards:*
An updating process should be considered when managing ageing, in order to incorporate new information as it becomes available, to address new issues as they arise, to use more sophisticated tools and methods as they become accessible and to assess the performance of maintenance practices considered over the life of the plant. (NS-G-1.2, Para 4.6)

3.4. Safety Issue: Operational Experience Feedback

SA-137: The licensee shall establish and conduct a programme to collect, screen, analyse, and document operating experience and events at the facility in a systematic way. Relevant operational experience and events reported by other facilities shall also be considered.

*Related **IAEA** safety standards:*
The operating organization must establish a programme for the collection and analysis of operating experience. (SS N 110, para 513). Operating experience at the plant shall be evaluated in a systematic way. (NS-R-2, para. 2.21) .

The operating organization and the regulatory body shall agree on and establish complementary programmes to analyse operating experience to determine whether equipment, procedures and/or training or related safety requirements need to be modified and to ensure that lessons are learned and acted upon. (SS N 110, para 513, (21), NS-G-2.4, para 4.4))

SA-138: Operating experience at the facility shall be evaluated to identify any undetected safety relevant events or potential precursors and possible tendencies towards degraded safety performance or reduction in safety margin.

*Related **IAEA** safety standards:*
The operating experience at the plant should be evaluated in a systematic way, primarily to make certain that no safety relevant event goes undetected. (NS-G-2.4, para 6.64) Operating experience should be carefully examined by designated competent persons to detect any precursor signs of possible tendencies adverse to safety, so that corrective action can be taken before serious conditions arise. (NS-G-2.4, para 6.66). Low level events and near misses should be reported and reviewed thoroughly as potential precursors to degraded safety performance. (NS-G-2.4, para 6.64).

SA-139: The licensee shall designate staff for carrying out these programmes, for the dissemination of findings important to safety and – where appropriate – for recommendations on actions to be taken. Significant findings and trends shall be reported to the licensee's top management.

*Related **IAEA** safety standards:*
Operating experience should be carefully examined by designated competent persons to detect any precursor signs of possible tendencies adverse to safety, so that corrective action can be taken before serious conditions arise. (NS-G-2.4, para 6.66) The operating organization should provide a means for independent safety review. … The reports resulting from this activity should be formal and should be provided directly to the top management of the operating organization. Particular attention should be paid to the feedback from experience. (NS-G-2.4, para 5.18)

SA-140: Staff responsible for evaluation of operational experience and investigation into events shall receive adequate training, resources, and support from the management.

*Related **IAEA** safety standards:*

The responsibilities, qualification criteria and training requirements of personnel performing activities to review operating experience should be clearly defined. Personnel who conduct investigations of abnormal events should be provided with training in investigative root cause analysis techniques such as accident investigation, human factor analysis (including organizational factors), management oversight and risk tree analysis, change analysis and barrier analysis. Event investigators should be knowledgeable of plant design, procedures and operations. (NS-G-2.4, para 6.67). The line management of a plant should be responsible for assisting in the review of operating events and for specifying and taking corrective actions. (NS-G-2.4, para 6.63)

SA-141: The licensee shall ensure that results are obtained, that conclusions are drawn, measures are taken, good practices are considered and that timely and appropriate corrective actions are implemented to prevent recurrence and to counteract developments adverse to safety.

*Related **IAEA** safety standards:*
Overall responsibility for implementing the operating experience review programme can be placed in either the nuclear power plant or the operating organization. However, the involvement and support of senior management of the operating organization are key for an operating experience review programme to be effective. (NS-G-2.4, para 6.63) The investigation shall, where appropriate, result in clear recommendations to the plant management, which shall take appropriate corrective action without undue delay.(NS-R-2, para 2.2.1) Operating organisations should have the objective of improving safety, plant availability and commercial performance by identifying the causes of events and thereby avoiding their recurrence and by evaluating the applicability of good practices used by others. (DS 288(5), para 4.3)

SA-142: Experience which has been regarded as important to the facility (see SA-137) shall be organised, documented, and stored in such a way that it can be easily retrieved and systematically searched, screened and assessed by the designated staff.

*Related **IAEA** safety standards:*
Reports in the OEF system should be stored in such a manner that information they contain can be easily sorted and retrieved by both the operating organization/licensee and the regulatory body, as appropriate. (NS-R-2, para 2.26)

The information, for example, should be arranged to enable frequently needed searches for: events at similar units; systems or components which failed or were affected; identification of the causes of events; identification of trends or patterns; events with similar consequences to the environment or personnel; identification of failures types or human factor issues and identification of recovery and corrective actions. (DS 288, para 3.12)

SA-143: The licensee shall report incidents and abnormal events of significance to safety in accordance with established procedures and criteria.

*Related **IAEA** safety standards:*
The operating organization shall report incidents significant to safety to the regulatory body. (SS N.100) The operating organization shall develop and effect a procedure for reporting abnormal events to the regulatory body in accordance with established criteria. (NS-R-2, para 2.17)

SA-144: Facility personnel shall be required by the licensee to report abnormal events and be encouraged to report internally near misses relevant to the safety of the facility.

*Related **IAEA** safety standards:*
All plant personnel shall be required to report all events and shall be encouraged to report on any 'near misses' relevant to the safety of the plant. (NS-R-4, para 2.24)

SA-145: Information resulting from the operational experience shall be disseminated to relevant staff and shared with relevant national and international bodies.

*Related **IAEA** safety standards:*
Safety significant information needs to be disseminated to its staff and to relevant national and international organizations. (SS N 110, para 513)

SA-146: A process shall be put in place to ensure that operating experience of events at the facility concerned as well as of relevant events at other facilities is appropriately considered in the training programme for staff with tasks related to safety.

*Related **IAEA** safety standards:*
A programme shall be put in place to ensure that operating experience of events at the plant concerned as well as of relevant events at other plants is appropriately factored into the training programme. The programme shall ensure that training is conducted on the root cause(s) of the events and on the identification and implementation of corrective actions to prevent their recurrence. (NS-R-2, para 3.14)

SA-147: An initial assessment of events important to safety shall be performed without delay to determine whether urgent actions are necessary.

*Related **IAEA** safety standards:*
Actions taken in response to events …. are aimed generally at correcting a situation, preventing recurrence or enhancing safety. Corrective actions can be either immediate, interim or long term necessitating detailed evaluation. Examples of immediate actions are measures to recover from a plant transient or to isolate contaminated areas. (DS 288(5), para. 8.1, 8.6)

SA-148: The licensee shall have procedures specifying appropriate investigation methods. Methods of human performance analysis shall be used to investigate human performance related events.

*Related **IAEA** safety standards:*
Abnormal events important to safety should be investigated in depth to establish their direct and root causes. (NS-G-2.4, para 6.64)

SA-149: Event investigation shall be conducted on a time schedule consistent with the event significance. The investigation shall:
- establish the complete event sequence;
- determine the deviation;
- include direct and root cause analysis;
- assess the safety significance including potential consequences;
- identify corrective actions.

*Related **IAEA** safety standards:*
Methods of human performance analysis should be used to investigate human performance related events. (NS-G-2.4, para 6.64) Accordingly, the operating organization/licensee should have procedures specifying the type of investigation that is appropriate for any particular type of event. Such procedures typically outline the conduct of an investigation in terms of initiation, duration, composition of the investigation team, format of final report and terms of reference for the investigation team. A typical outline for an investigation process is given in Appendix III. (DS 288(5), para. 5.2

SA-150: The licensee shall maintain liaison as appropriate with the organizations (manufacturer, research organization, designer) involved in design and construction, with the aims of feeding back information on operating experience and obtaining advice, if necessary, in case of equipment failures or abnormal events.

*Related **IAEA** safety standards:*
Plant management shall maintain liaison as appropriate with the organizations (manufacturer, research organization, designer) involved in the design, with the aims of feeding back information on operating

experience and obtaining advice, if necessary, in the event of equipment failures or abnormal events .(NS-R-2, 2.25)

SA-151: As a result of the analysis timely corrective actions shall be taken such as technical modifications, administrative measures or personnel training to restore safety, to avoid event recurrence and to improve safety margins and trends.

*Related **IAEA** safety standards:*
The investigation shall, where appropriate, result in clear recommendations to the plant management,... .(NS-R-2, 2.25) The investigation should result in clear recommendations to plant management, which should take appropriate corrective action without undue delay to prevent recurrence. (NS-G-2.4, para 6.64)

SA-152: Periodic reviews of the effectiveness of the OEF process based on performance criteria shall be undertaken and documented either within a self assessment programme by the licensee or by a peer review team.

*Related **IAEA** safety standards:*
The effectiveness of the operating experience review programme should be assessed periodically to identify areas of weakness that require improvement. (NS-G-2.4, para 6.62)

3.5. Safety issue: Maintenance, in-service inspection & functional testing

SA-153: The licensee shall prepare and implement documented programmes of maintenance, testing, surveillance and inspection of SSCs important to safety to ensure that their availability, reliability and functionality remain in accordance with the design over the lifetime of the facility. They shall take into account operational limits and conditions and be re-evaluated in the light of experience.

*Related **IAEA** safety standards:*
The operating organization shall prepare and implement a programme of maintenance, testing, surveillance and inspection of those structures, systems and components which are important to safety. This programme shall be in place prior to fuel loading and shall be made available to the regulatory body. It shall take into account operational limits and conditions as well as any other applicable regulatory requirements and it shall be re-evaluated in the light of experience. (NS-R-2, Para 6.1)

The maintenance, testing, surveillance and inspection of all plant structures, systems and components important to safety shall be to such a standard and at such a frequency as to ensure that their levels of reliability and effectiveness remain in accordance with the assumptions and intent of the design throughout the service life of the plant. (NS-R-2, Para 6.2)

Effective maintenance, surveillance and inspection (MS&I) are essential for the safe operation of a nuclear power plant. They ensure not only that the levels of reliability and availability of all plant structures, systems and components (SSCs) that have a bearing on safety remain in accordance with the assumptions and intent of the design, but also that the safety of the plant is not adversely affected after the commencement of operation. (NS-G-2.6, Para 1.1)

The maintenance programme for a nuclear power plant should cover all preventive and remedial measures, both administrative and technical, that are necessary to detect and mitigate degradation of a functioning SSC or to restore to an acceptable level the performance of design functions of a failed SSC. The purpose of maintenance activity is also to enhance the reliability of equipment. The range of maintenance activities includes servicing, overhaul, repair and replacement of parts, and often, as appropriate, testing, calibration and inspection. (NS-G-2.6, Para 2.1)

SA-154: The programme shall include periodic inspections or tests of SSCs important to safety in order to demonstrate their reliability and to determine whether they are acceptable for continued safe operation of the facility or whether any remedial measures are necessary.

*Related **IAEA** safety standards:*
The programme shall include periodic inspections or tests of systems, structures and components important to safety in order to demonstrate their reliability and to determine whether they are acceptable for continued safe operation of the plant or whether any remedial measures are necessary. (NS-R-2, Para 6.3)

The systems and components of the plant should be examined for possible deterioration so as to assess whether they are acceptable for continued safe operation of the plant or whether remedial measures should be taken. Emphasis should be placed on examination of the pressure boundaries of the primary and secondary coolant systems, because of their importance to safety and the possible severity of the consequences of failure. (NS-G-2.6, Paras 2.13 & 10.2)

SA-155: The extent and frequency of preventive maintenance, testing, surveillance and inspection of SSCs shall be determined through a systematic approach on the basis of:
- their importance to safety
- their inherent reliability
- their potential for degradation (based on operating experience, research and vendor recommendation)
- operational and other relevant experience and results of condition monitoring.

*Related **IAEA** safety standards:*
The frequency of preventive and predictive maintenance, testing, surveillance and inspection of individual structures, systems and components shall be determined on the basis of:
- *The importance to safety of the structures, systems and components;*
- *Their inherent reliability;*
- *Their assessed potential for degradation in operation and their ageing characteristics;*
- *Operational experience. (NS-R-2, Para 6.4)*

Individual maintenance actions should be prioritized according to their importance, and their probable effects on reliability and risk should be quantified. Different approaches can be used for this, all of which are based firstly on the selection of SSCs important to safety and secondly on specifying risk and performance criteria to ensure that the SSCs remain capable of performing their intended functions. The maintenance work that is most important for ensuring the reliability of components and controlling risks should be identified by these means. (NS-G-2.6, Para 8.2)

In establishing the frequency and extent of preventive maintenance, the following aspects should be considered:
- *The importance of SSCs to safety,*
- *Designers' and vendors' recommendations,*
- *Relevant experience available,*
- *Results of condition monitoring,*
- *The probability of failure to function properly,*
- *On-line maintenance,*

The necessity of maintaining radiation doses as low as reasonably achievable (the ALARA principle). (NS-G-2.6, Para 8.4)

SA-156: Data on maintenance, testing, surveillance and inspection of SSCs shall be recorded, stored and analysed. Such records shall be reviewed to look for evidence of incipient and recurring failures, to initiate corrective maintenance and review the preventive maintenance programme accordingly.

*Related **IAEA** safety standards:*
Data on maintenance, testing, surveillance and inspection shall be recorded, stored and analysed to confirm that performance is in accordance with design assumptions and with expectations on equipment reliability. (NS-R-2, Para 6.10)

The operating organization should monitor the performance or condition of SSCs against the goals it has set to provide reasonable assurance that the SSCs are capable of performing their intended function. (NS-G-2.6 Para 2.7)

A brief but complete review of the repairs carried out should be made and documented. This review should explicitly identify the cause of failure, the remedial action taken, the component that failed and its mode of failure, the total repair time and, if different, the outage time and, finally, the state of the system after repair. Even if a system is found to be within its calibration limits, this fact should be recorded, together with details of any replacement or any adjustment carried out at the discretion of maintenance personnel. For major failures of components important to safety, a root cause analysis should be carried out in order to prevent recurrence. (NS-G-2.6, Paras 5.32 & 8.47)

A common database should be established in order to share relevant data and evaluations of results among the organizations that are involved in the planning and implementation of MS&I activities. (NS-G-2.6, Para 2.16)

An adequate condition monitoring programme should be established in support of optimization of the maintenance programme. Such a monitoring programme should be based on the following assumptions as a minimum:
- *That the monitored parameters are appropriate indicators for the condition of the SSCs,*
- *That acceptance criteria are available,*
- *That all potential failure modes are addressed,*
- *That the behaviour of the potential failure is traceable and predictable. (NS-G-2.6, Para 2.8)*

The maintenance group should periodically review the maintenance records for evidence of incipient or recurring failures. When a need for remedial maintenance is identified, either in this review or during preventive maintenance of the plant, the maintenance group should initiate remedial maintenance in accordance with the administrative procedures mentioned above. If appropriate, the preventive maintenance programme should be revised accordingly. Replacement of defective items (NS-G-2.6, Para 8.48)

SA-157: The potential impact of maintenance upon facility safety shall be assessed.

SA-158: The maintenance programme shall be periodically reviewed in light of operating experience, and any proposed changes to the programme shall be assessed to analyse their effects on system availability, their impact on facility safety and their conformance with applicable requirements.

*Related **IAEA** safety standards:*
Changes deriving from the optimization of maintenance should be analysed to assess the effects of the changed maintenance approach on system availability and the overall risks to the plant in all operating and shutdown states. A periodic review of the optimization process should incorporate operating experience, including new failure modes and data. In the optimization process, due attention should be paid to maintaining the required reliability of the SSCs and adequate safety margins. (NS-G-2.6, Para 2.10)

The operating organization should review the preventive maintenance programme as appropriate in order to ensure that items important to safety have been properly identified and classified, and that the applicable requirements of the regulatory body have been met. (NS-G-2.6, Para 8.1)

SA-159: SSCs important to safety shall be designed to be tested, maintained, repaired and inspected or monitored periodically in terms of integrity and functional capability over the lifetime of the facility, without undue risk to workers and significant reduction in system availability. Where such provisions cannot be attained, proven alternative or indirect methods shall be specified and adequate safety precautions taken to compensate for potential undiscovered failures.

SA-160: Procedures shall be established, reviewed and validated for all maintenance, testing, surveillance and inspection tasks.

*Related **IAEA** safety standards:*
The operating organization shall establish procedures for all maintenance, testing, surveillance and inspection tasks. These procedures shall be prepared, reviewed, validated, issued and modified in accordance with established administrative procedures. (NS-R-2, Para 6.6)

SA-161: A comprehensive work planning and control system shall be implemented to ensure that maintenance, testing, surveillance and inspection work is properly authorized, carried out according to the procedures

*Related **IAEA** safety standards:*
A comprehensive work planning and control system shall be implemented to ensure that maintenance, testing, surveillance and inspection work is properly authorized and is carried out in accordance with established procedures. Co-ordination shall be established among different maintenance groups (for mechanical, electrical, instrumentation and control, and civil maintenance), and with operations and support groups (groups for fire protection, radiation protection, physical protection and industrial safety). (NS-R-2, Para 6.7)

SA-162: The licensee shall ensure that equipment is not removed from or returned to service without full consideration and approval of the proposed reconfiguration, followed by a documented confirmation of its correct configuration and, where appropriate, functional testing.

*Related **IAEA** safety standards:*
The work control system shall ensure that plant equipment is only released from service for maintenance, testing, surveillance or inspection with the authorization of designated operations staff and in compliance with the operational limits and conditions. It shall also ensure that, following maintenance, the plant is not returned to service before completion of a documented check of its configuration and, where appropriate, a functional test. (NS-R-2, Para 6.8)

Plant items that have been repaired in the workshop should be inspected and tested to ensure, as far as possible, their full return to serviceability. If testing cannot be completed in the workshop, cautionary labels or tags should be applied to the respective item to warn that testing has still to be completed before reuse. When these post-repair processes are complete, items not intended for immediate installation should be returned to the stores through normal receiving processes. (NS-G-2.6, Para 8.54)

Before any system or component is returned to service after maintenance, tests should be performed to ensure that the objective of the maintenance has been achieved, that the limits and conditions for normal operation associated with that system or component are satisfied, and that the plant can be operated safely. This procedure should include testing of connected systems and others systems in the work area that may have been affected by the maintenance action. (NS-G-2.6, Para 8.55)

SA-163: The actions to be taken in response to deviations from the acceptance criteria of results in the maintenance, testing, surveillance and inspection tasks, shall be defined in the procedures.

*Related **IAEA** safety standards:*
The MS&I programme should include appropriate actions to be taken in response to postulated deviations from the acceptance criteria, on the basis, primarily, of design information and design analysis. As a general rule, the actions to be taken when a deviation is detected should include, as appropriate: […] (NS-G-2.6 Paras 6.9 & 2.16)

The need for remedial maintenance may arise when deficiencies or failures are detected during plant operation. The plant's management, in anticipation of such cases, should prepare appropriate procedures detailing how such failures are to be reported to the maintenance group and how plant items are to be withdrawn from service for remedial maintenance (for example, procedures for work order authorizations and equipment isolation work permits). These procedures should require the operating personnel to assign priority to remedial work on the basis of its importance to safety, with account taken of the operational limits and conditions as well as the necessity of preventing the loss of any safety function. (NS-G-2.6, Para 8.46)

SA-164: Repairs to SSCs shall be identified, authorized, and carried out as promptly as practicable. Priorities shall be established with account taken first of the relative importance to safety of the defective SSC.

*Related **IAEA** safety standards:*
Repairs to structures, systems and components shall be performed as promptly as practicable. Priorities shall be established with account taken first of the relative importance to safety of the defective structure, system or component. (NS-R-2, Para 6.5)

SA-165: Following any abnormal event, the licensee shall revalidate the safety functions and functional integrity of any SSC that may have been challenged by the event and carry out any necessary remedial actions, including inspection, testing, maintenance and repair, as appropriate.

*Related **IAEA** safety standards:*
Following any abnormal event, the operating organization shall revalidate the safety functions and functional integrity of any component or system which may have been challenged by the event. Necessary remedial shall include inspection, testing and maintenance as appropriate. (NS-R-2, Para 6.9)

SA-166: All items of equipment used for examinations and tests together with their accessories shall be qualified and calibrated before they are used. All equipment shall be properly identified in the calibration records, and the validity of the calibration shall be regularly verified by the licensee in accordance with the quality management system.

*Related **IAEA** safety standards:*
All equipment used for examinations and tests should be of a quality, range and accuracy that are acceptable according to standards recognized by the regulatory body (NS-G-2.6, Para 10.21)

All items of equipment together with their accessories should be calibrated before they are used. All equipment should be properly identified in the calibration records, and the validity of the calibration should be regularly verified by the operating organization in accordance with the quality assurance programme. All items should be calibrated against standards recognized by the regulatory body. (NS-G-2.6, Para 10.23)

4. Safety area: Safety verification

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

SA-167: The Licensee shall provide a safety case and use it as a basis for continuous support of safe operation.

*Related **IAEA** safety standards:*
NS-R-2 "Safety of NPPs: Operation" contains several requirements referring to the need to maintain consistency with the plant safety analysis report (e.g. §§4.1, 5.1, 7.4). This SAR is expected to be available and approved before plant commissioning.

The regulatory body shall issue guidance on the format and content of documents to be submitted by the operator in support of applications for authorization. The operator shall be required to submit or make available to the regulatory body, in accordance with agreed timescales, all information that is specified or requested. This information should be presented in the form of a report, hereinafter referred to as a safety analysis report (SAR). (GS-G-4.1 §1.1)

SARs represent an important communication between the operating organization and the regulatory body, and they form an important part of the basis for licensing an NPP and of the basis for the safe operation of the plant. (GS-G-4.1 §2.1)

SA-168: The Licensee shall use the safety case as a basis for assessing the safety implications of changes to the facility or to operating practices.

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

SA-169: The safety case shall among others:
- describe the site, the facility layout and normal operation; and demonstrate how safety is achieved.
- contain detailed descriptions of the safety functions; all safety systems and safety-related SSCs; their design basis and functioning in all operational states, including shut down and accident conditions.
- identify applicable regulations codes and standards.
- describe the relevant aspects of the plant organization and the management of safety.
- contain the evaluation of the safety aspects related to the site.
- outline the general design concept and the approach adopted to meet the fundamental safety objectives.
- describe the safety analyses performed to assess the safety of the facility in response to postulated initiating events against safety criteria and radiological release limits.
- describe the emergency operation procedures and accident management guidelines, the inspection and testing provisions, the qualification and training of personnel, the operational experience feedback programme, and the management of ageing.
- contain the technical bases for the operational limits and conditions.
- describe the policy, strategy, methods and provisions for radiation protection.
- describe the emergency preparedness arrangements.
- describe the on-site radioactive waste management provisions.
- describe how the relevant decommissioning and end-of-life aspects are taken into account during operation.

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

The beneath reference levels are a short summary of the parts of §3 of GS-G-4.1 that are relevant for an operating plant.

SA-170: The licensee shall update the safety case to reflect modifications and new regulatory requirements and relevant standards, as soon as practicable after the new information is available and applicable.

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

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

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

4.2. Safety issue: Periodic safety review

SA-171: The licensee shall have the prime responsibility for performing periodic safety reviews

*Related **IAEA** safety standards:*
The primary responsibility for conducting a PSR and reporting its findings lies with the owner/operator of the plant. The regulator has the responsibility of specifying or approving the requirements for a PSR… (DS 307, Paras 5.1 and 5.2)

SA-172: The review shall confirm the compliance with its licensing requirements and any deviations shall be resolved

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

SA-173: The review shall identify and evaluate the safety significance of deviations from applicable current safety standards and best practices.

*Related **IAEA** safety standards:*
The procedure… should identify any differences between the safety status of a nuclear power plant and current safety standards and practices. (DS 307, Para 7.1).

SA-174: All reasonably practicable improvement measures shall be taken by the licensee as a result of the review.

*Related **IAEA** safety standards:*
The procedure does not require that a nuclear power plant meet all current standards, however, reasonably practicable improvements should be made towards meeting them. (DS 307, Para 7.1)

SA-175: The review shall be made periodically, at least every ten years.

*Related **IAEA** safety standards:*
A PSR is a comprehensive safety review addressing all important aspects of safety, carried out at regular intervals, typically of ten years. The PSR should be conducted typically every ten years and its duration should not exceed 3 years. (DS 307, Paras 1.4 and 3.5)

SA-176: The scope of the review shall be clearly defined and justified.

*Related **IAEA** safety standards:*
The scope of a PSR includes all nuclear safety aspects of a nuclear power plant. (DS 307, Para 3.1). It is recommended that the scope should include, as a minimum, the safety factors: Plant, Safety analysis, Performance and feedback of experience, Management, Environment and Global assessment. (DS 307, Para 6.2)

SA-177: The scope shall be as comprehensive as reasonably practical, with regard to significant safety aspects of an operating plant.

*Related **IAEA** safety standards:*
The PSR safety factors ... are structured into five subject areas… In addition, there is a global assessment to integrate results of the review of individual safety factors. (DS 307, Para 4.1)

- *Plant:*
  - *1 Plant design*
  - *2 Actual condition of systems, structures and components (SSCs)*
  - *3 Equipment qualification*
  - *4 Ageing*
- *Safety Analysis:*
  - *5 Deterministic safety analysis*
  - *6 Probabilistic safety analysis*
  - *7 Hazard analysis*
- *Performance and feedback of experience*
  - *8 Safety performance*
  - *9 Use of experience from other nuclear power plants and of research findings*
- *Management*
  - *10 Organization and administration*
  - *11 Procedures*
  - *12 Human factor*
  - *13 Emergency planning*
- *Environment*
  - *14 Radiological impact on environment*
  - 15 *Global assessment*

SA-178: As a minimum the following areas shall be covered by the review:
- plant design as built and actual condition of systems, structures and components;
- continued validity of the current safety case and its use;
- operating experience during the review period and the effectiveness of the system used for experience feed-back;
- organisational arrangements;
- safety performance and the effectiveness and quality management;
- staffing and qualification of staff;
- emergency preparedness;
- continued compliance with safety criteria for workers and public.

SA-179: The review shall use an up to date systematic and documented methodology.

*Related **IAEA** safety standards:*
Each safety factor is reviewed using current methods… There is a need to record the results of the review in a systematic and audible manner. Probabilistic safety assessment is a useful contributor to a PSR. (DS 307, Paras 3.3, 3.6 and 6.5)

SA-180: Each area shall be reviewed and the findings compared to the licensing requirements as well as to current safety standards and practices. Conclusions shall be drawn with regard to reasonable and practical improvements measures taking into account interactions and overlaps between the different safety issues.

*Related **IAEA** safety standards:*
Each safety factor is reviewed… the findings are compared to current safety standards and practices. Reasonable and practical corrective actions are determined and an implementation plan is agreed with account taken of the interactions and overlaps between safety factors… (DS 307, Para 3.3)

SA-181: If studies made for other purposes are utilised in the periodic safety review, their contribution to the review shall be explained. These studies shall be available and appropriate references given.

*Related **IAEA** safety standards:*
The results of relevant studies, and of routine and special safety reviews, should be utilised in the PSR to minimise duplication of effort. Appropriate references should be made and an explanation on the use of these references provided. (DS 307, Para 3.8)

Subpart B (Storage Facility Specific SRLs)

1. Safety area: Safety management

1.1. Safety issue: Responsibilities

SB-01: The licensee shall be responsible for all aspects of safety of the storage facility, including the waste or spent fuel stored.

SB-02: There shall be clear and unequivocal ownership of the waste and spent fuel stored in the facility.

SB-03: The waste or spent fuel owner shall be responsible for the overall strategy for the management of its spent fuel and waste, taking into account interdependencies between all stages of waste and spent fuel management, and options available, from generation to disposal, and the overall national radioactive waste and spent fuel management strategy. The owner shall analyse the available options and justify the reasons for the chosen strategy.

SB-04: The interface between the responsibilities of the licensee of the storage facility and the waste or spent fuel owner shall be clearly defined, agreed and documented.

SB-05: 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.

1.2. Safety issue: Licensee's safety policy

No specific reference level

1.3. Safety issue: Licensee's operating organisation

No specific reference level

1.4. Safety issue: Quality management

No specific reference level

Note: WGWD has developed SRLs on waste package quality acceptance procedure and surveillance in section 3 "Operation".

1.5. Safety issue: Record keeping

SB-06: The licensee shall develop and maintain a record system on the location and characteristics of every waste package or spent fuel element in storage, including information on its ownership and origin.

SB-07: The licensee shall ensure that each package or spent fuel element can be uniquely identified with a marking system that will last for the storage period.

SB-08: The licensee shall implement an adequate system to provide up-to-date information on the radioactive inventory within the storage facility.

SB-09: The owner shall ensure that sufficient records are preserved, and updated (taking into account in particular the condition of spent fuel and waste during storage), to enable implementation of its strategy for the management of waste or spent fuel, including disposal.

2. Design

2.1. Safety issue: Storage facility design requirements

SB-10: The design shall take into account the expected lifetime of the facility to ensure that the safety conditions, the operational limits and conditions identified in the safety case will be met.

*Related **IAEA** safety standards:*

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

SB-11: The design of the storage facility shall incorporate passive safety features as far as reasonably practical.

*Related **IAEA** safety standards:*

It shall be designed and constructed (…) preferably with passive safety features. (WS-R-2)

SB-12: The licensee shall demonstrate that the construction standards used are applicable and the chosen materials appropriate, in particular taking into account the length of the storage period.

2.2. Safety issue: Handling and retrieval requirements

SB-13: 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.

SB-14: The storage facility shall be designed in such a way that all waste or spent fuel can be retrieved within an appropriate time, at the end of the facility operation, or in order to intervene in the event of unexpected faults.

*Related **IAEA** safety standards:*

The storage facility shall be designed in such a way that the waste can be retrieved whenever required (WS-R-2 5.27).

SB-15: The storage facility shall be designed so that individual packages or unpackaged spent fuel elements can be inspected and retrieved.

*Related **IAEA** safety standards:*

Provisions shall be made for regular monitoring, inspection and maintenance of the waste and the storage facility to ensure continued integrity. (WS-R-2 .23)

SB-16: Appropriate equipment (e.g. packaging) shall be available in due time to deal with packages or spent fuel elements that show signs of degradation.

*Related **IAEA** safety standards:*

The storage facility shall be designed in such a way that the waste can be retrieved whenever required. (WS-R-2 5.27)

2.3. Safety issue: Reserve storage capacity

SB-17: The licensee shall ensure that safety reserve storage capacity is included in the design or is otherwise available, e.g. to allow reshuffling of packages or spent fuel elements for inspection, retrieval or maintenance work.

2.4. Safety issue: Safety classification of systems, structures and components (SSCs) and related equipments

No specific reference levels

2.5. Safety issue: Operation/Operational limits and conditions

Specific hazards to be taken into account

SB-18: The safety case shall define the OLCs under which packages or spent fuel elements are stored including, e.g. in-store environmental conditions.

SB-19: The safety case shall, in particular justify storage limits for the properties of packages and fuel elements during storage which may deviate from the original acceptance criteria, taking into account at least suitability for handling and retrieval. In particular, changes of the spent fuel, the waste products and the packages have to be considered.

SB-20: The defined OLCs (see SB-18) 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 package as well as the whole store;
- potential aspects of gas generation form waste or spent fuel, in particular the hazards of fire ignition, explosion, package deformations and radiation protection aspects;
- criticality, prevention, covering both each individual package as well as the whole store (including operational occurrences and accidental conditions).

*Related **IAEA** safety standards:*

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

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

3. Operation

SB-21: The storage facility shall be operated so that individual packages or unpackaged spent fuel elements, e. g. in case of pool type storage facilities, can be inspected and retrieved.

SB-22: The licensee shall ensure that the safety reserve storage capacity (see SB-17) will always stay available.

3.1. Safety issue: On site emergency preparedness

No specific reference level

3.2. Safety issue: Operational experience feedback

No specific reference level

3.3. Safety issue: Operation/plant modification

No specific reference level

3.4. Safety issue: Ageing management

No specific reference level

3.5. Safety issue: In-service inspection, functional testing and operability control

SB-23: The safety case shall :
- include the demonstration of the continuing compliances of packages or spent fuel stored within the limits (see SB-19);
- define a monitoring regime for the required environmental conditions within the storage facility;
- define an appropriate program for demonstrating the future compliances of packages or spent fuel stored within the storage limits (see SB-19).

SB-24: For storage facilities, the program of inspection and maintenance shall include:
- the monitoring regime for the required environmental conditions within the storage facility ;
- the appropriate program for monitoring of the state of packages or spent fuel elements, as deduced from the safety case.

3.6. Safety issue: Specific contingency plans

SB-25: The licensee's procedures for the receipt of packages or spent fuel elements shall contain provisions to deal safely with incoming packages that fail to meet the acceptance criteria, e.g. returning to the owner, taking remedial actions.

SB-26: The licensee shall have plans to deal with deviations that may be linked to the loss of integrity or degradation of packages or spent fuel elements beyond the storage limits (see SB-19).

SB-27: The licensee shall consider appropriate contingency arrangements for packages or spent fuel elements that are not retrievable by normal means.

3.7. Safety issue: Requirements for acceptance of packages and spent fuels elements

SB-28: The owner is responsible for ensuring that the package fulfils all relevant design requirements such as :
- compatibility with handling, transport and storage requirements, including suitability for retrieval and transport after the anticipated storage period ;
- known or likely requirements for subsequent disposal or other management aspects included in the owner's waste and spent fuel management strategy, such as the need for further treatment or conditioning of the waste or spent fuel.

SB-29: The licensee shall establish acceptance criteria for its storage facility.

SB-30: These acceptance criteria shall take into account storage conditions and shall ensure compatibility with the safety case of the storage facility, including suitability for handling and retrieval.

SB-31: The licensee shall make sure that appropriate processes are set up and implemented, involving auditing, inspection and testing, to ensure that waste packages or spent fuel elements meet the acceptance criteria for storage when they are received.

*Related **IAEA** safety standards:*

A comprehensive quality assurance programme [12] shall be applied to all stages and elements of predisposal radioactive waste management having a bearing on safety. It may include the siting, design, construction, operation and maintenance of radioactive waste management facilities. (WS-R-2 7.6)

4. Safety verification

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

SB-32: The safety case shall cover both the store and the packages or spent fuel elements and their respective safety-relevant features.

SB-33: Independently of the periodic safety reassessments, the safety case shall be revised in particular if :
- there has been significant unexpected deviations in the environment conditions in the store;
- a significant change in the package and spent fuel elements acceptance criteria is proposed, or, if safety-relevant waste and spent fuel properties change significantly from those that have been taken as a basis in the safety case;
- the properties of packages or spent fuel elements stored have changed unexpectedly beyond the storage limits (see SB-19), and it is not intended to take remedial action.

4.2. Safety issue: Periodic safety review

SB-34: The periodic safety review shall include consideration of the acceptance criteria and the limits for deviation from these criteria during storage of packages and spent fuel elements.