

Safety principles of radioactive waste management activities and supportive IAEA documents

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2-6 November 2015

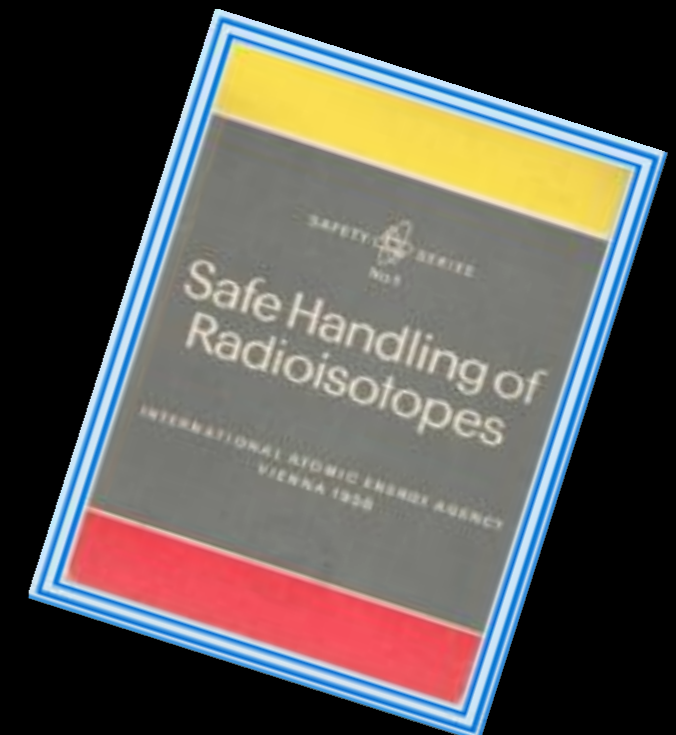
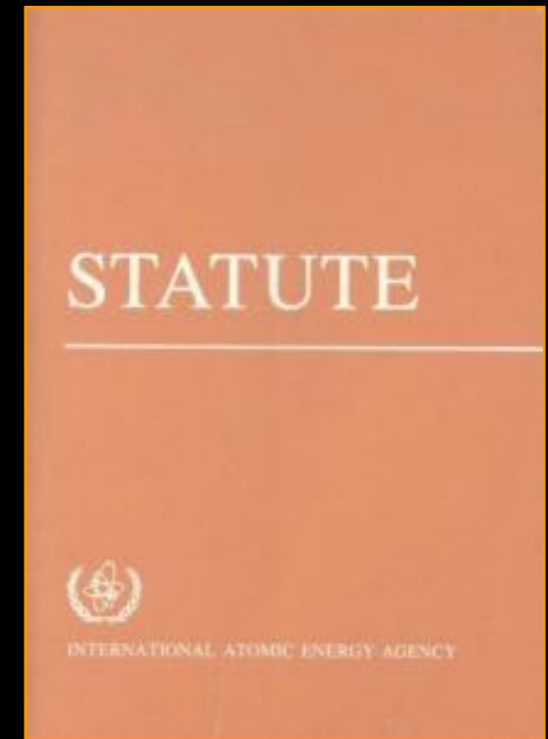
Trieste, Italy

Contents

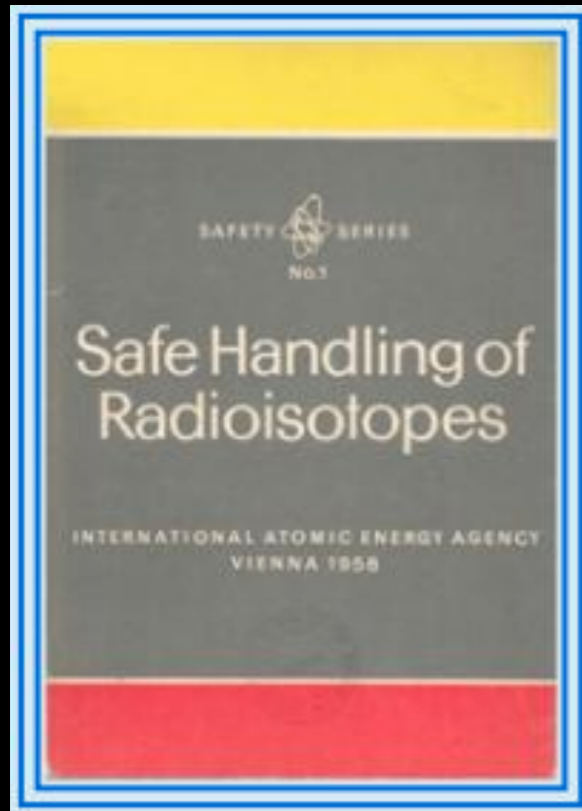
- History of IAEA Safety Standards
- Development of IAEA Safety Standards
- Hierarchy and Structure of the IAEA Safety Standards
- The IAEA Safety Fundamentals
- Overview of the IAEA Safety Requirements
- Overview of IAEA Safety Guides for Radioactive Waste Management
- Summary

History – IAEA statute

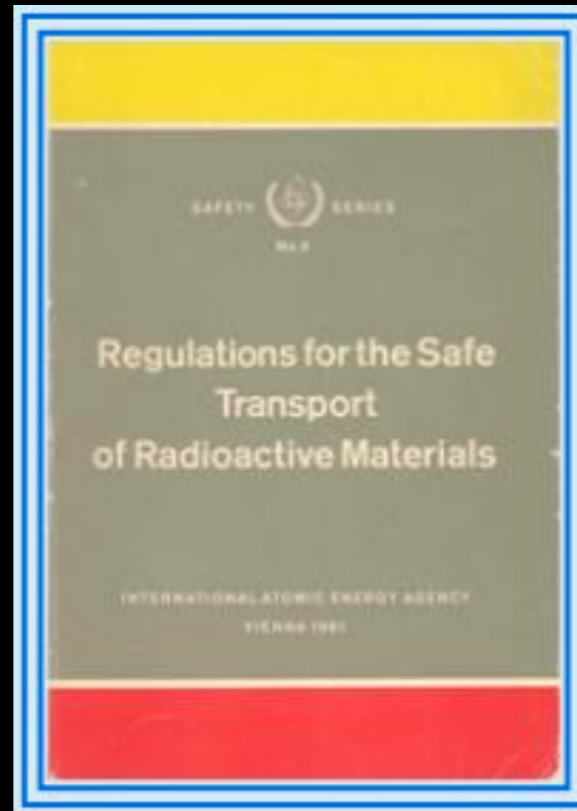
- Under Article III.A.6 of its Statute, the IAEA is required:
 - “To establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property.”
- In 1958, the IAEA published its first Safety Standard, Safety Series No. 1, Safe Handling of Radioisotopes.
- Over the years, some 200 publications have been issued in the Safety Series.



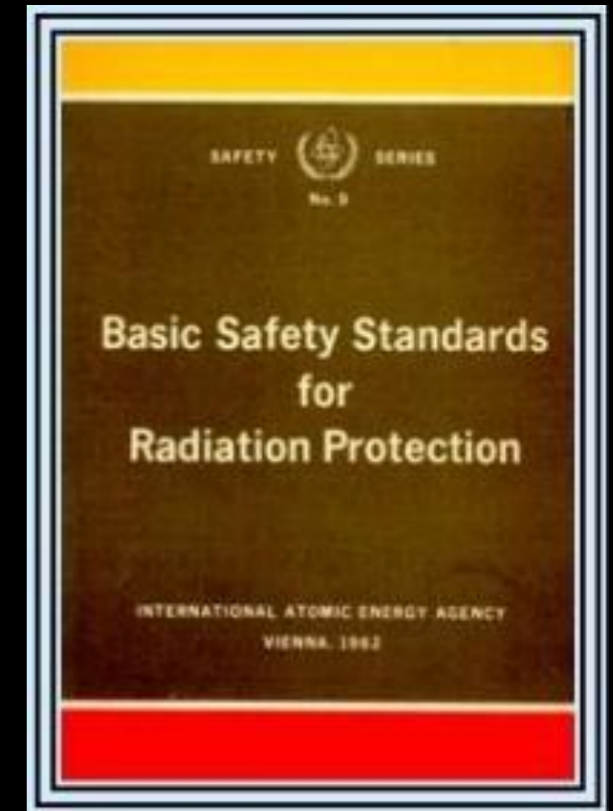
History – Safety Series



1958



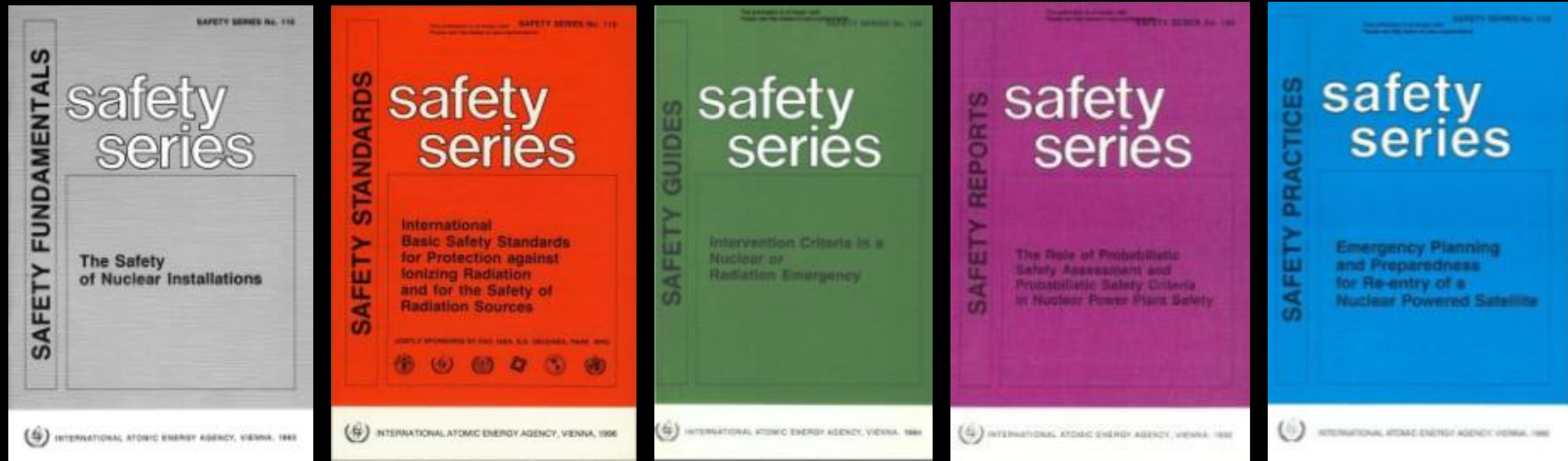
1961



1962

All kinds of documents related to safety, no structure.

History – Safety Series

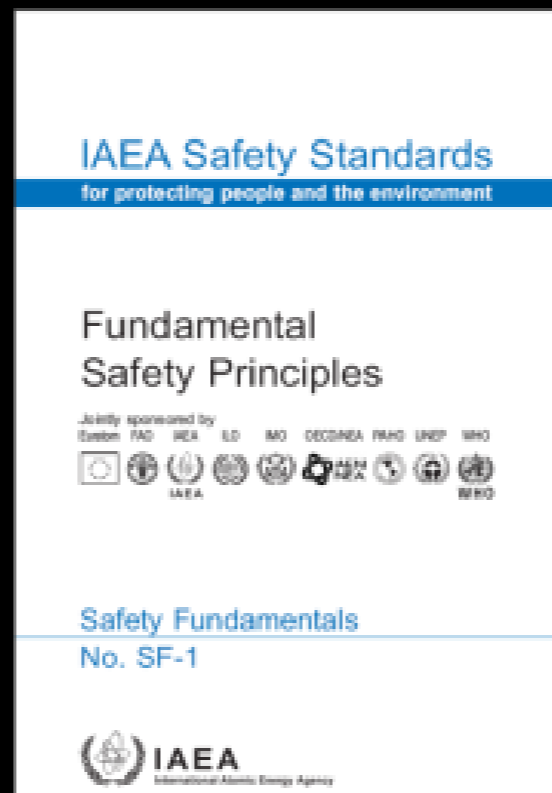


All kinds of documents related to safety:
fundamentals (silver), standards (red), guides (green),
reports (brown/purple), practices (blue)

History – Safety Series

Three safety fundamentals merged into
SF-1

Safety = protection of people and the environment against radiation risks, and the safety of facilities and activities that give rise to radiation risks.



2006

Development

Outline and work plan
(draft preparation profile, DPP)
prepared by the Secretariat



Review by Safety Standards Committee(s)
and
Commission on Safety Standards

Safety Standards Committees

Nuclear Safety
Standards
Committee
(NUSSC)

Radiation Safety
Standards
Committee
(RASSC)

Transport Safety
Standards
Committee
(TRANSSC)

Waste Safety
Standards
Committee
(WASSC)

- Standing bodies of senior experts (mandate of 3 years)
- They advise the IAEA DDG on the overall programme for the development, review and revision of standards
- They review and approve DPP's and draft Safety Standards (at different stages in the development process)

Commission on Safety Standards

- Standing body of senior government officials (mandate of 4 years)
- Overview role with regard to the international safety standards and provide advice to the IAEA Director General on the overall programme on regulatory aspects of safety
- Ensures coherence and consistency between the safety standards
- Resolve issues referred to it by the committees
- Endorse draft safety standards that are approved by the committees

Development

Outline and work plan (DPP)
prepared by the Secretariat
Review by the Safety Standards Committees and
the Commission on Safety Standards

Drafting or revising
of safety standard
(by the Secretariat and consultants)

Review
(by the safety
standards
committee(s))

Member
States

Endorsement
(by Commission on Safety Standards)

Establishment by the IAEA's
Director General or Board of Governors

Publication



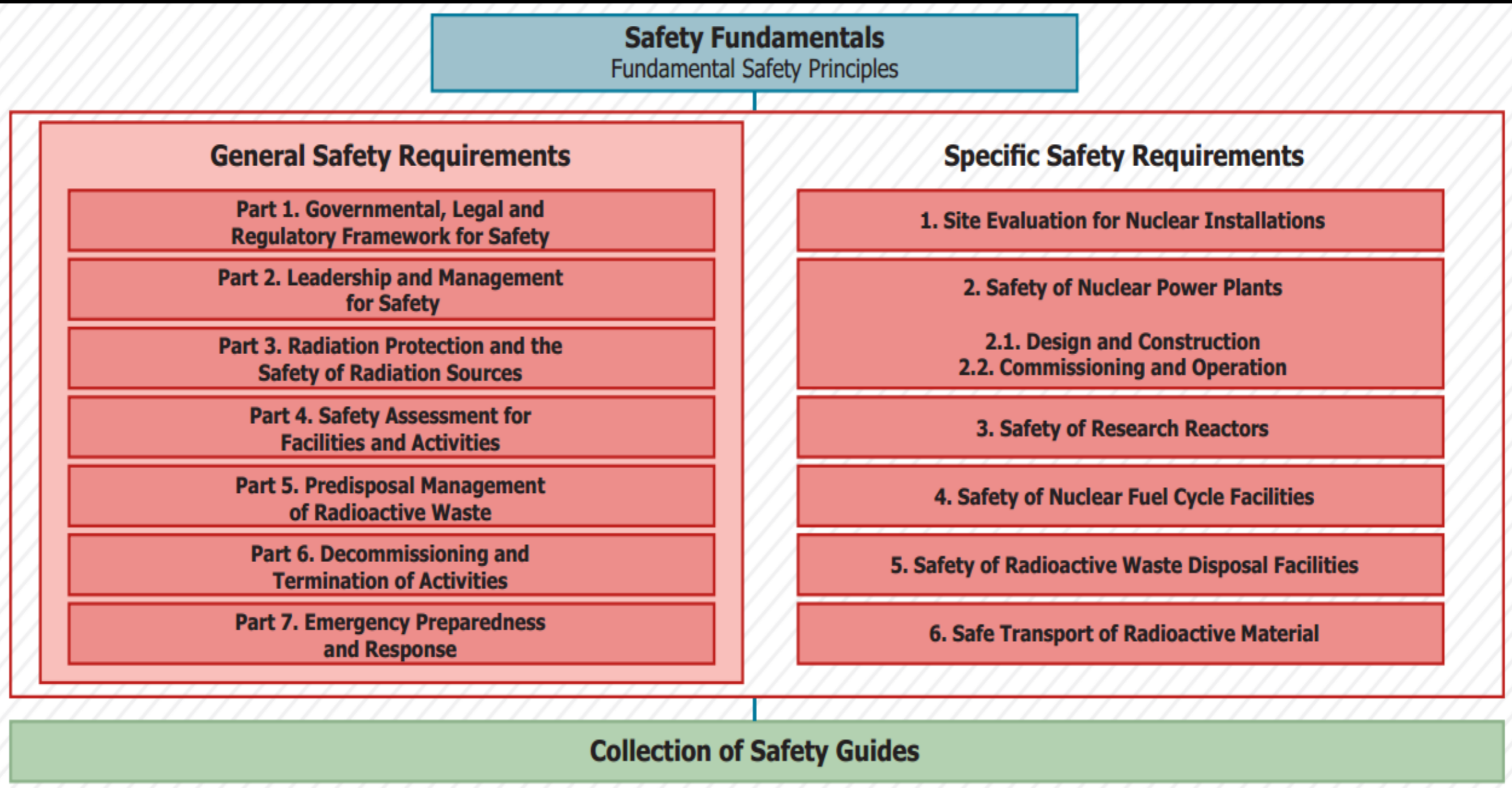
Hierarchy



Requirements to be applied to meet the principles (shall)

Recommended ways of meeting the requirements (should)

Structure



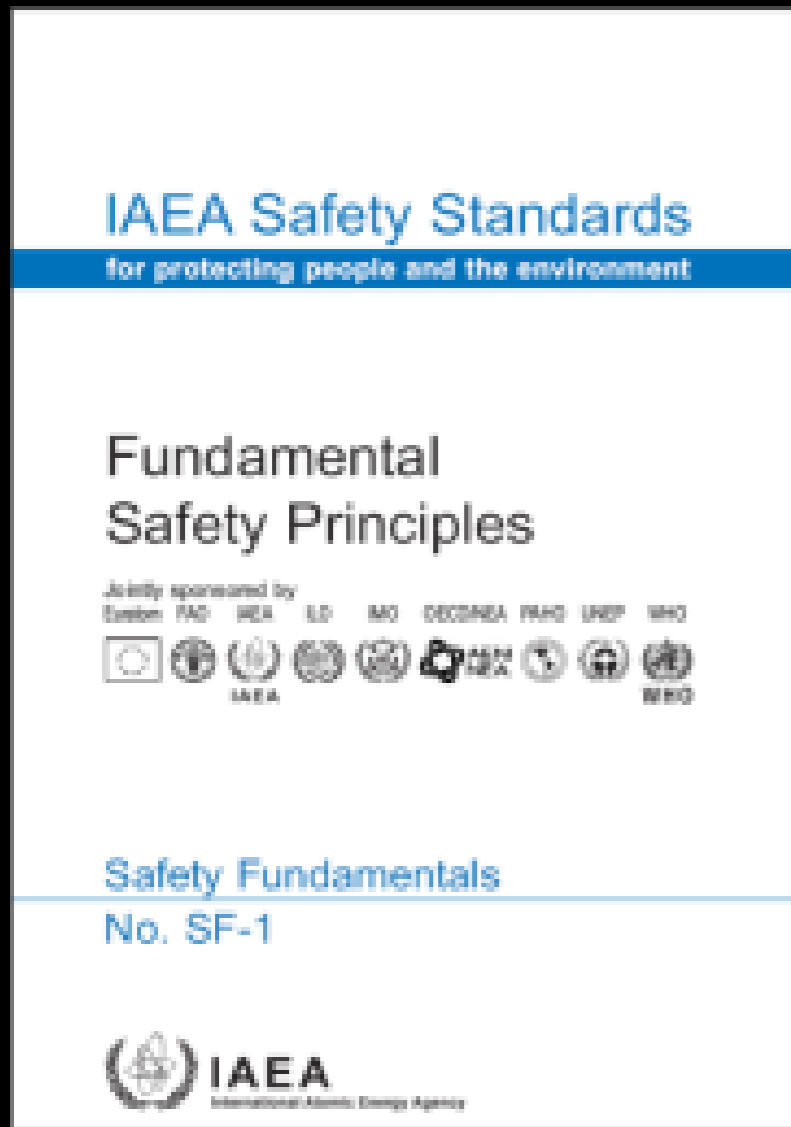
The Safety Fundamentals

Safety Fundamentals
Fundamental Safety Principles

Safety Requirements

Safety Guides

SF-1, The Safety Fundamentals



2006

The objective of this publication is to establish the fundamental safety objectives, principles and concepts that provide the basis for the IAEA's safety standards and its related programme.

Related requirements are established in the Safety Requirements publications.

Guidance on meeting these requirements is provided in the related Safety Guides.

Fundamental Safety Objective

The fundamental safety objective is

to protect people - individually and collectively - and the environment from harmful effects of radiation (without unduly limiting the operation of facilities or the conduct of activities that give rise to radiation risks).

Fundamental Safety Objective

To achieve the highest standards of safety that can reasonably be achieved, measures have to be taken:

- ★ to control the radiation exposure of people;
- ★ to control the release of radioactive material to the environment;
- ★ to restrict the likelihood of events that may lead to loss of control of a source of radiation; and
- ★ to mitigate the consequences of such events if they were to occur.

Fundamental Safety Principles

Principle 1: Responsibility for safety

The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

Principle 2: Role of government

An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.

Regulatory Body

Regulatory Body is defined as:

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.

Fundamental Safety Principles

Principle 3: Leadership and management for safety

Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks.

Principle 4: Justification of facilities and activities

Facilities and activities that give rise to radiation risks must yield an overall benefit.

Fundamental Safety Principles

Principle 5: Optimization of protection

Protection must be optimized to provide the highest level of safety that can reasonably be achieved.

Principle 6: Limitation of risks to individuals

Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm.

Fundamental Safety Principles

Principle 7: Protection of present and future generations
People and the environment, present and future, must be protected against radiation risks.

Principle 8: Prevention of accidents
All practical efforts must be made to prevent and mitigate nuclear or radiation accidents.

Fundamental Safety Principles

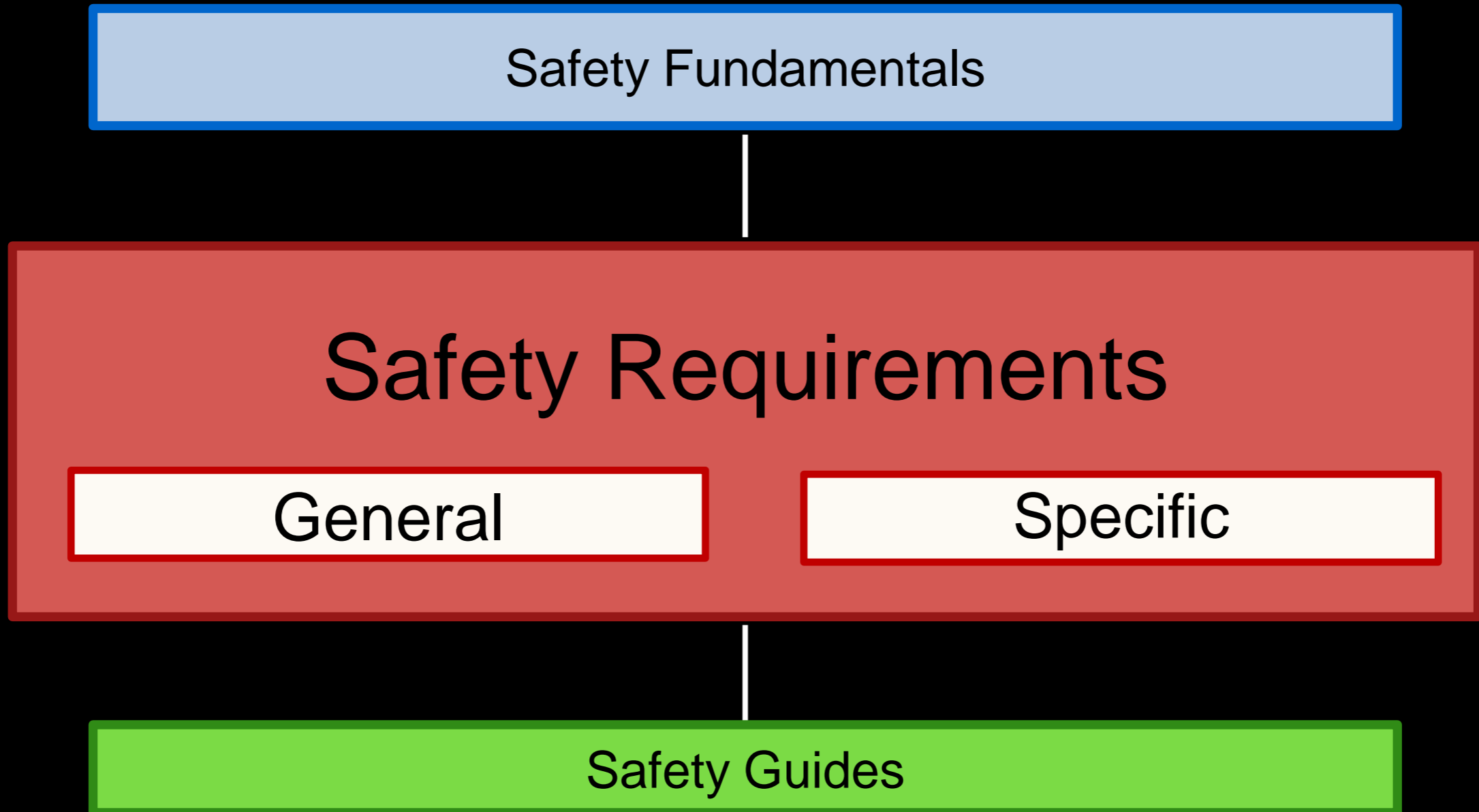
Principle 9: Emergency preparedness and response

Arrangements must be made for emergency preparedness and response for nuclear or radiation incidents.

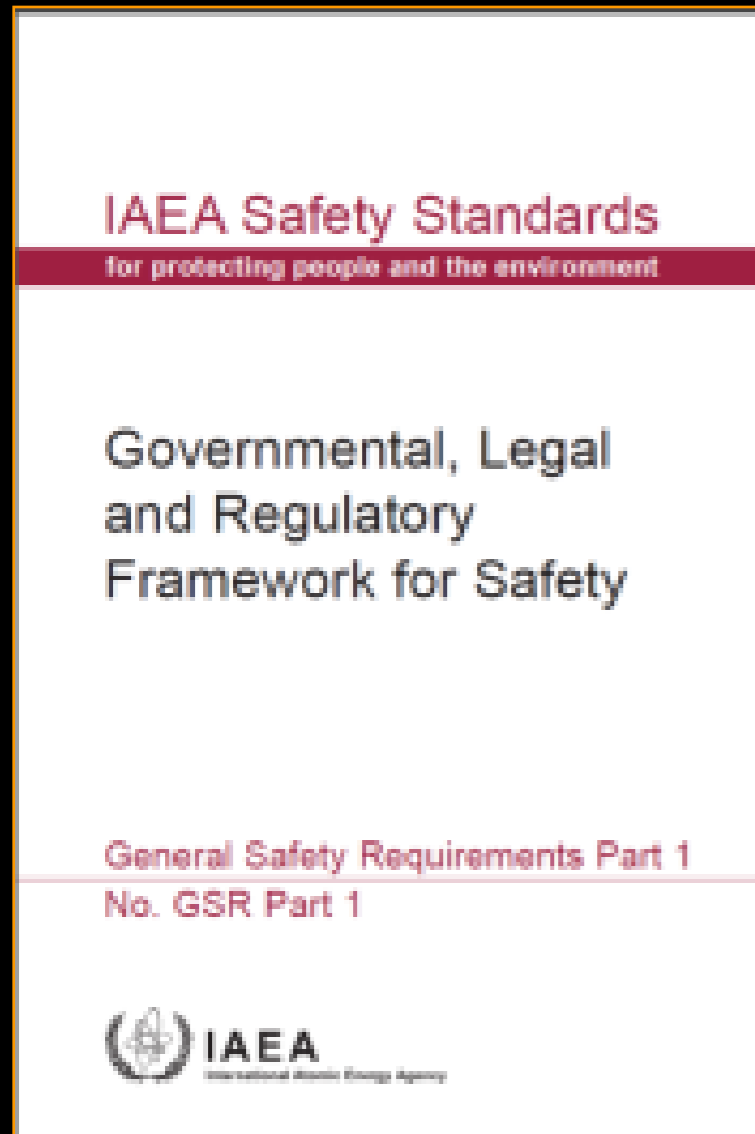
Principle 10: Protective actions to reduce existing or unregulated radiation risks

Protective actions to reduce existing or unregulated radiation risks must be justified and optimized.

The Safety Requirements



General Safety Requirements Part 1

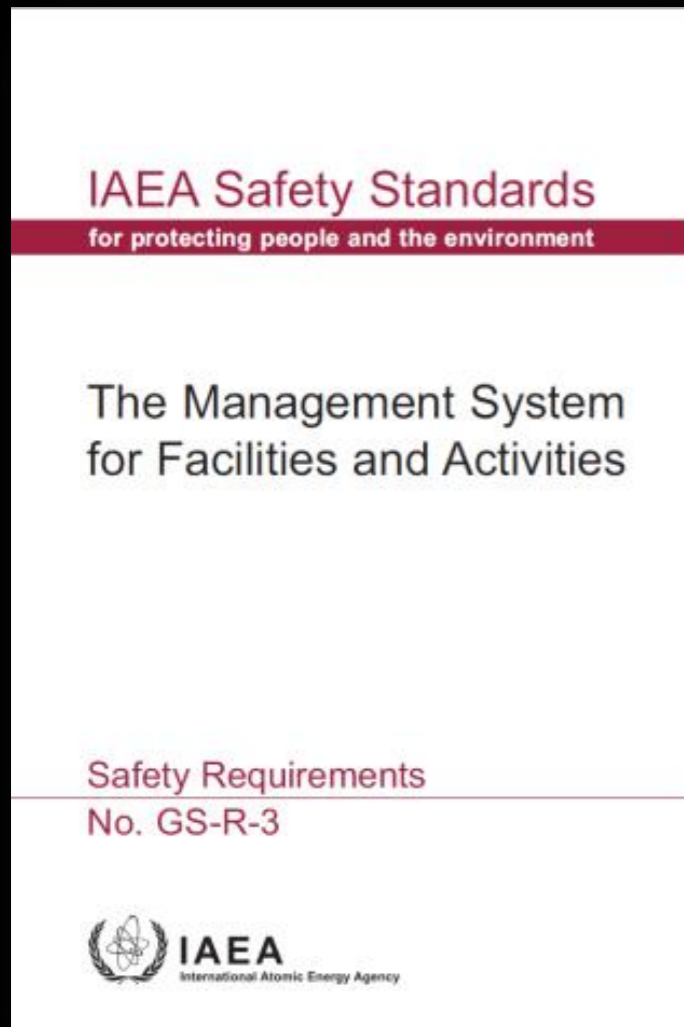


Objective

This publication establishes requirements in respect of the governmental, legal and regulatory framework for safety. The framework for safety is to be established for the entire range of facilities and activities, from the use of a limited number of radiation sources to a nuclear power programme.

General Safety Requirements Part 2

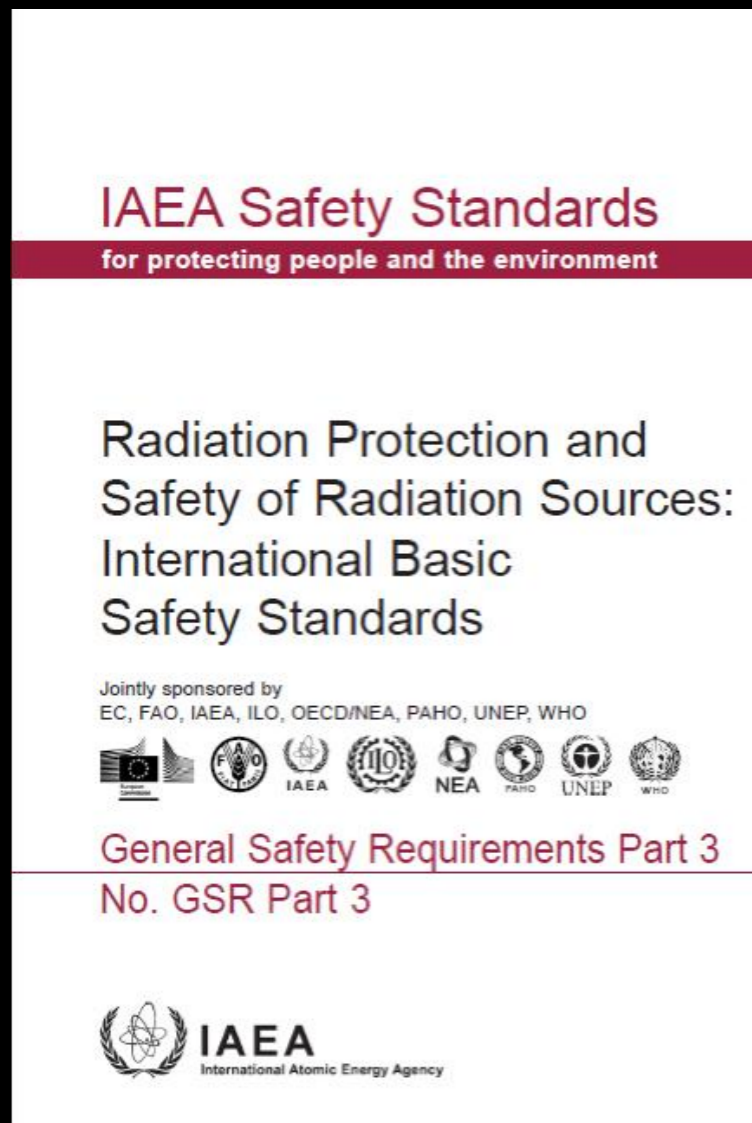
will replace GS-R-3



Objectives

- To define requirements for establishing, implementing, assessing and continually improving a management system that integrates safety, health, environmental, security, quality and economic elements to ensure that safety is properly taken into account in all the activities of an organization.
- To ensure, by considering the implications of all actions not within separate management systems but with regard to safety as a whole, that safety is not compromised.

General Safety Requirements Part 3



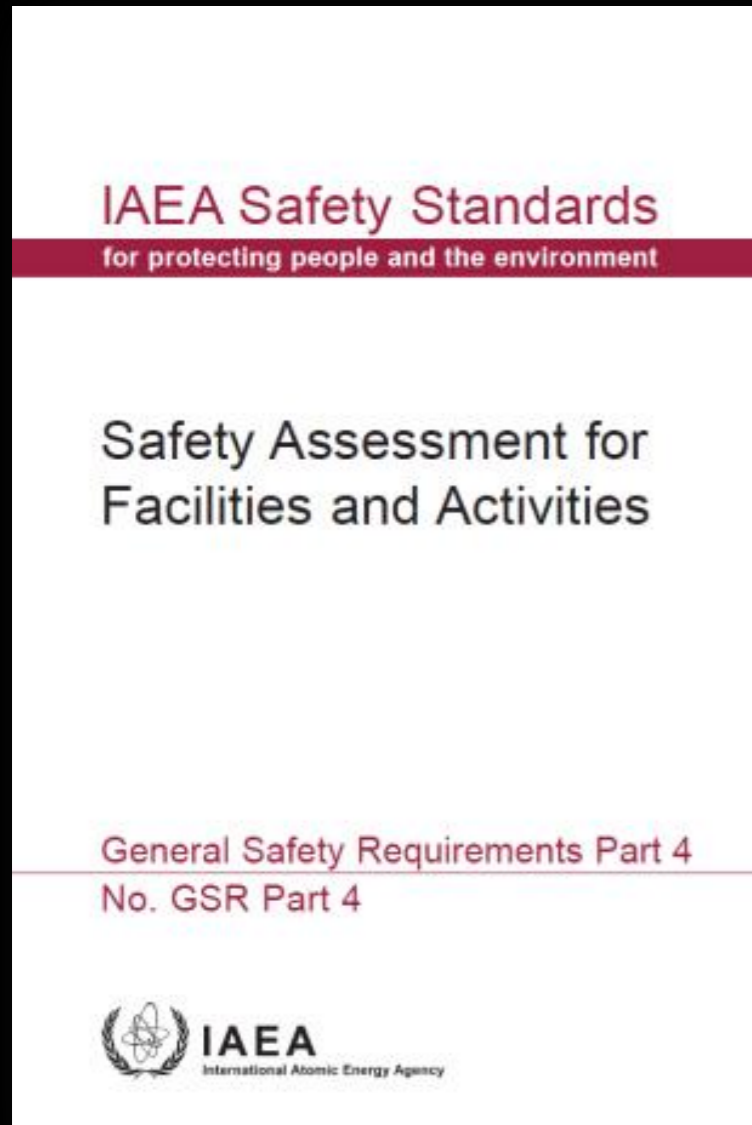
Objective

This publication establishes requirements for the protection of people and the environment from harmful effects of ionizing radiation and for the safety of radiation sources.

General Safety Requirements Part 4

Objectives

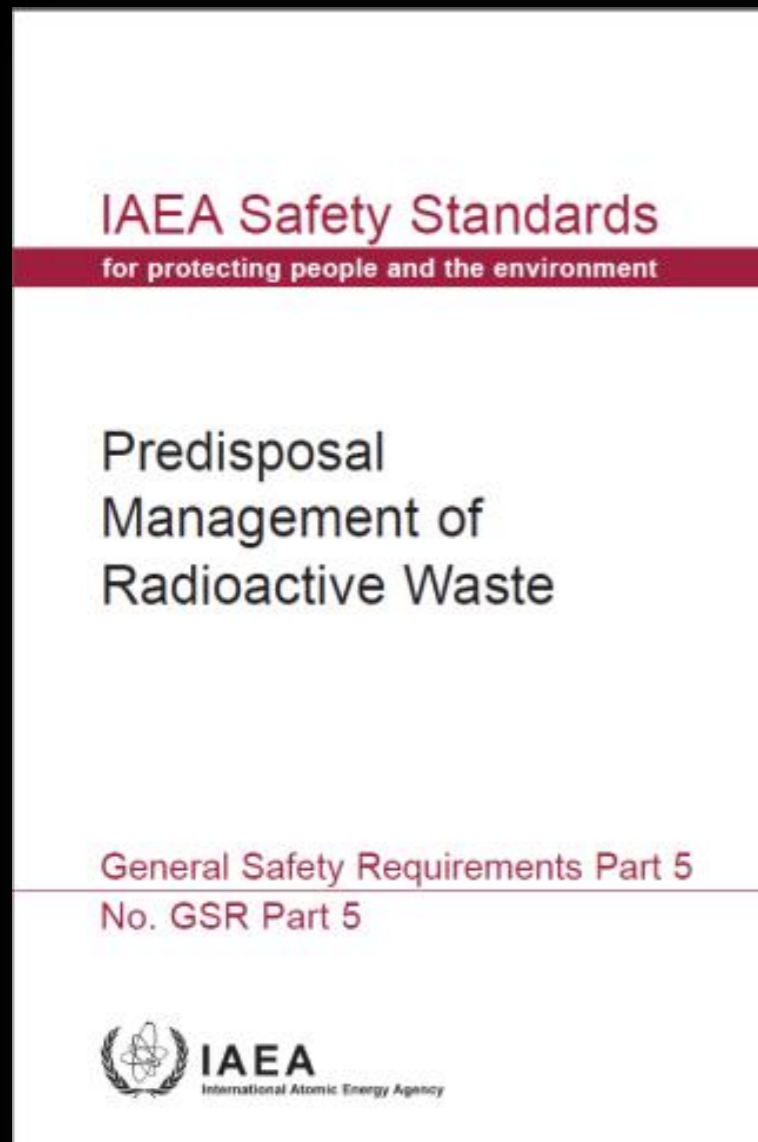
- This publication establishes the generally applicable requirements to be fulfilled in safety assessment for facilities and activities, with special attention paid to defence in depth, quantitative analyses and the application of a graded approach to the ranges of facilities and of activities that are addressed.
- It also addresses the independent verification of the safety assessment that needs to be carried out by the originators and users of the safety assessment.



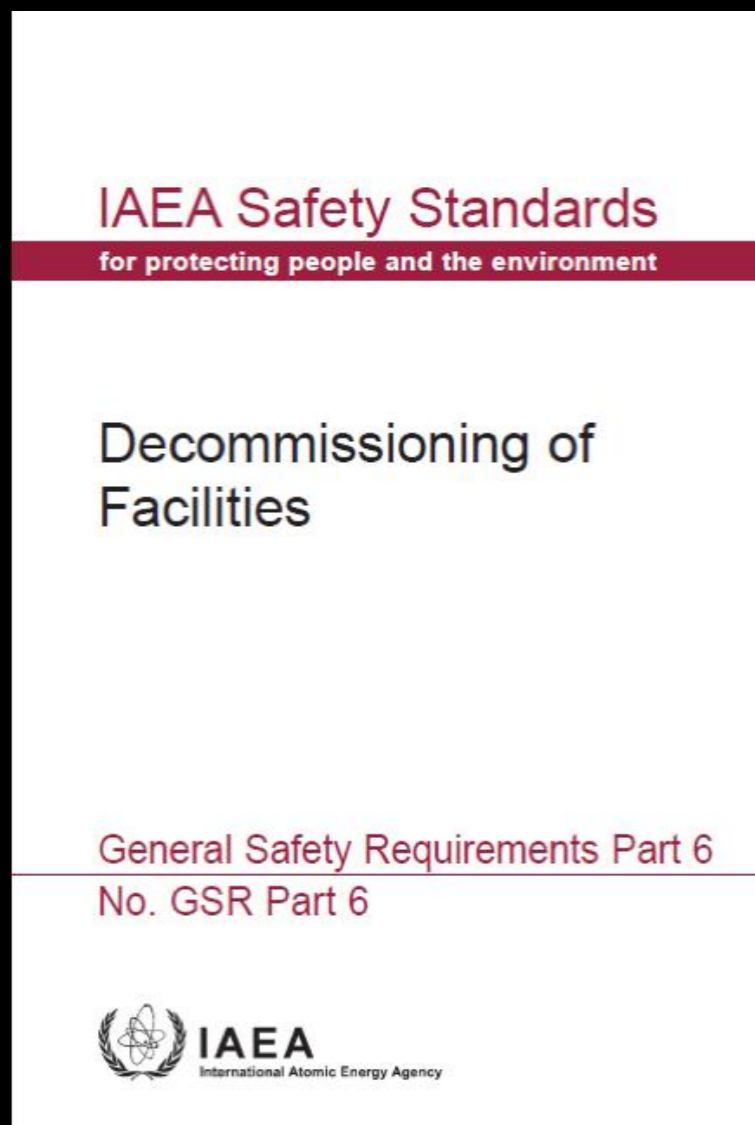
General Safety Requirements Part 5

Objectives

- This publication establishes the requirements that must be satisfied in the predisposal management of radioactive waste.
- It sets out the objectives, criteria and requirements for the protection of human health and the environment that apply to the siting, design, construction, commissioning, operation and shutdown of facilities for the predisposal management of radioactive waste, and the requirements that must be met to ensure the safety of such facilities and activities.



General Safety Requirements Part 6



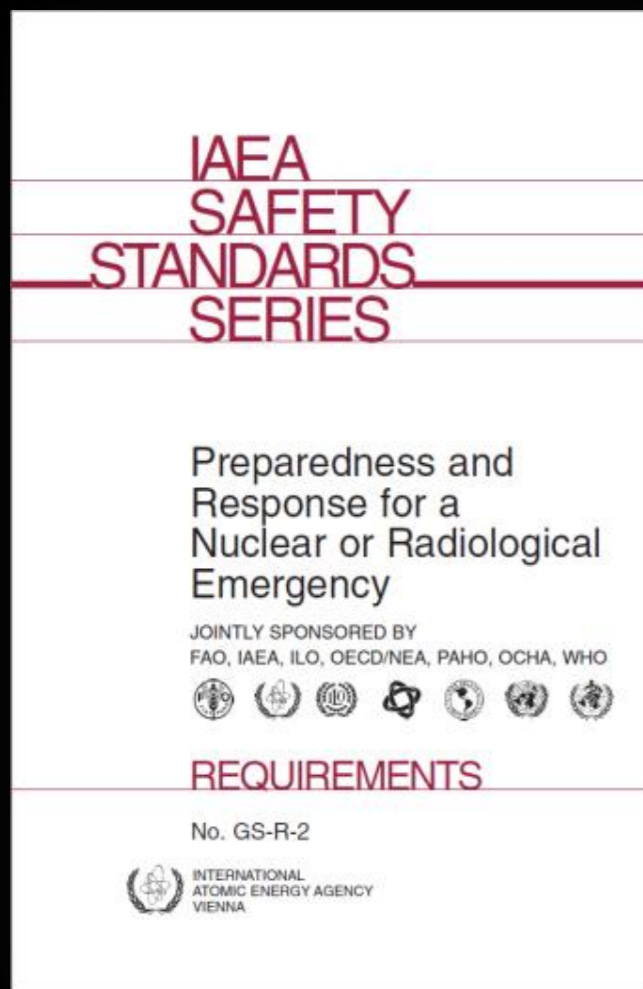
Objective

This publication establishes the general safety requirements to be met during planning for decommissioning, during conduct of decommissioning actions and during termination of authorization for decommissioning.

General Safety Requirements Part 7

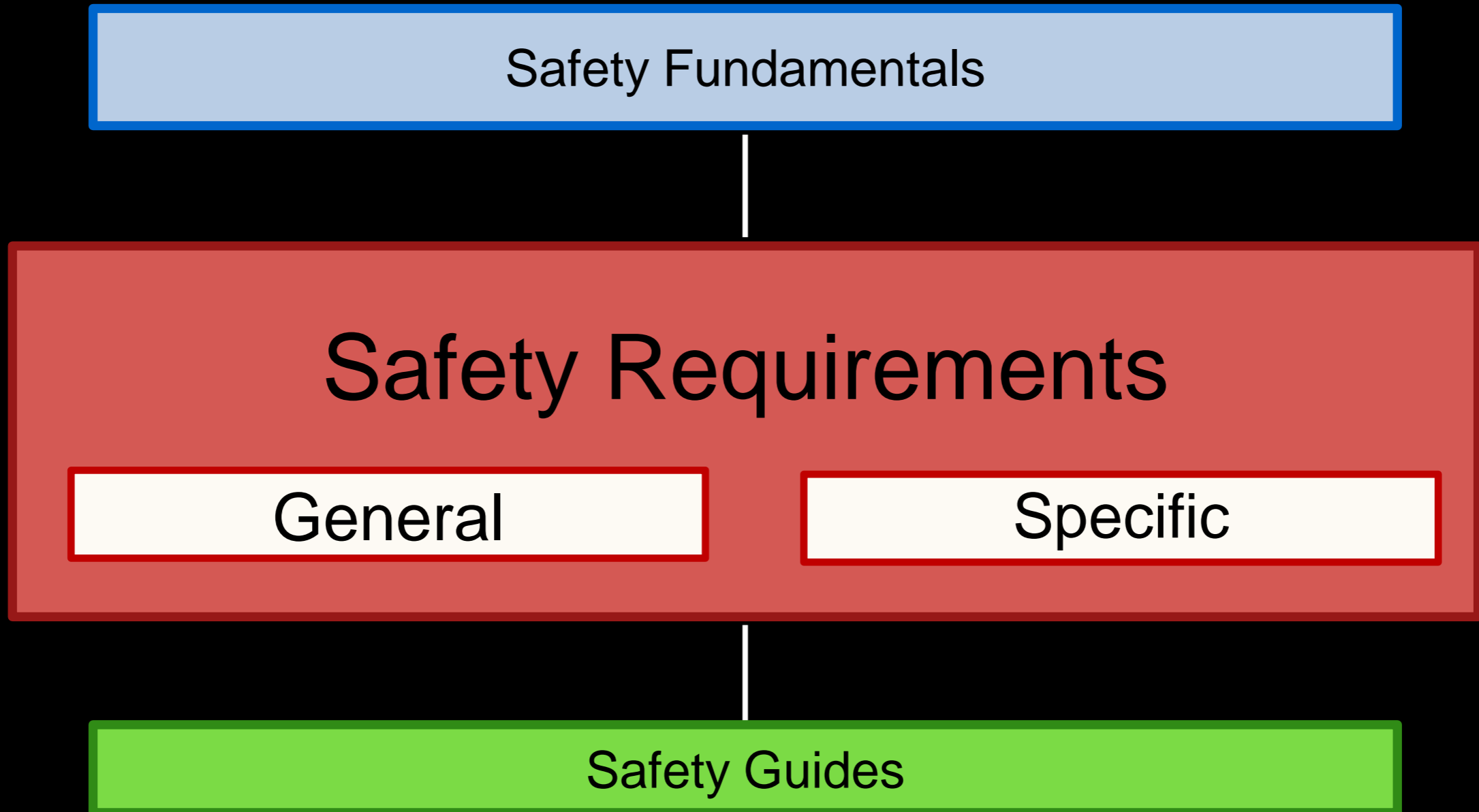
Objectives

will replace GS-R-2



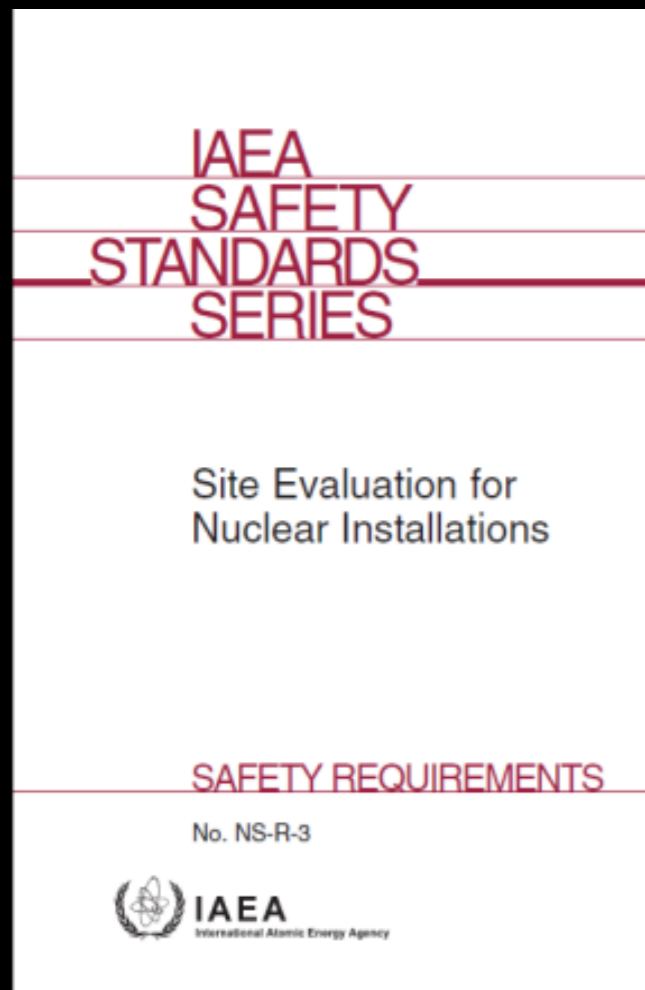
- This publication establishes the requirements for an adequate level of preparedness and response for a nuclear or radiological emergency in any State.
- These requirements are intended to be applied by authorities at the national level by means of adopting legislation, establishing regulations and assigning responsibilities.

The Safety Requirements



Specific Safety Requirements SSR-1

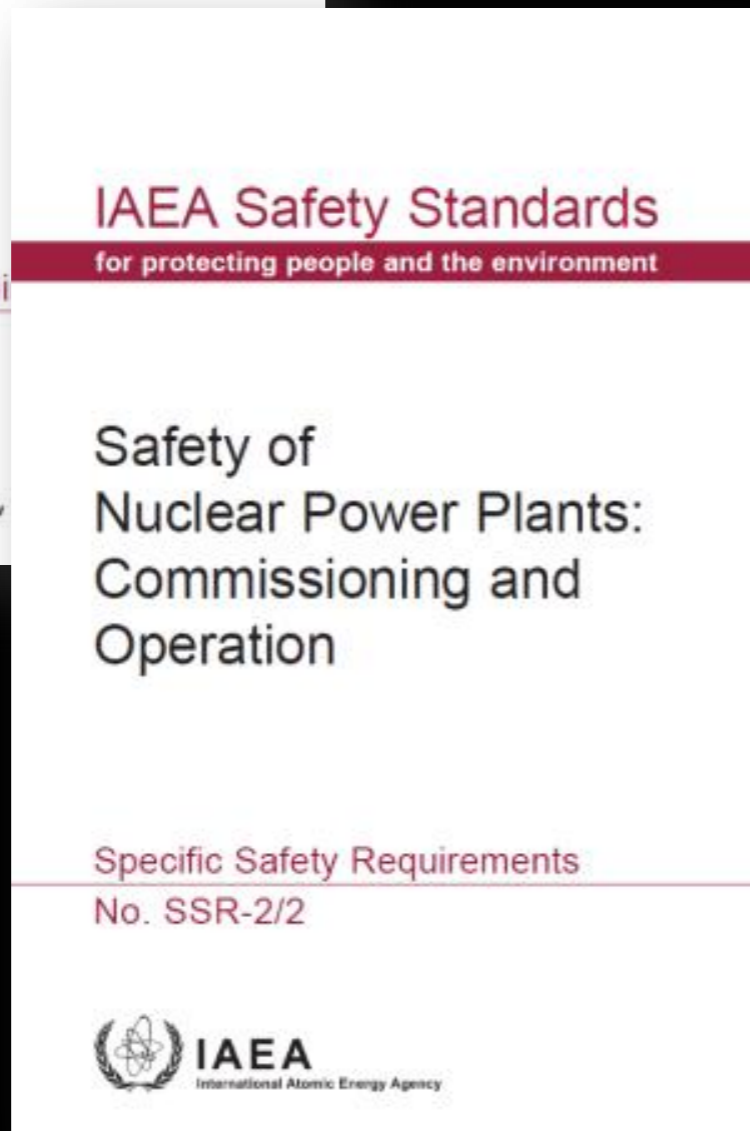
will replace NS-R-3



Objective

This publication establishes the requirements for the elements of a site evaluation for a nuclear installation so as to characterize fully the site specific conditions pertinent to the safety of a nuclear installation.

Specific Safety Requirements SSR-2/1 and 2/2



Objectives

SSR 2/1: Design requirements for the structures, systems and components of a nuclear power plant and procedures and organizational processes important to safety.

SSR 2/2: Requirements to satisfy to ensure the safe operation of nuclear power plants

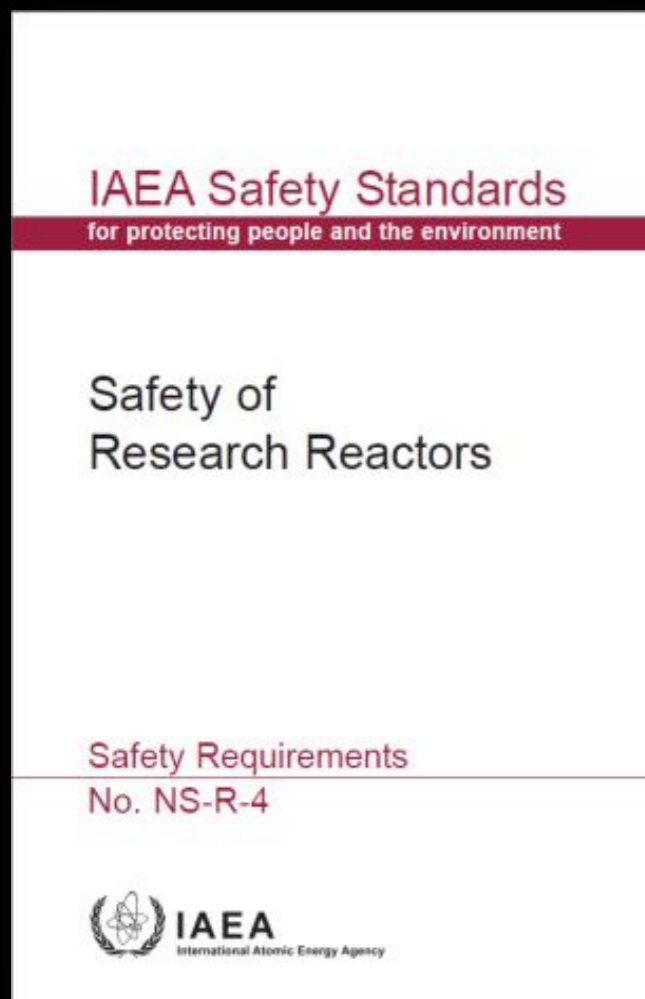
Specific Safety Requirements SSR-3

Objectives

will replace NS-R-4

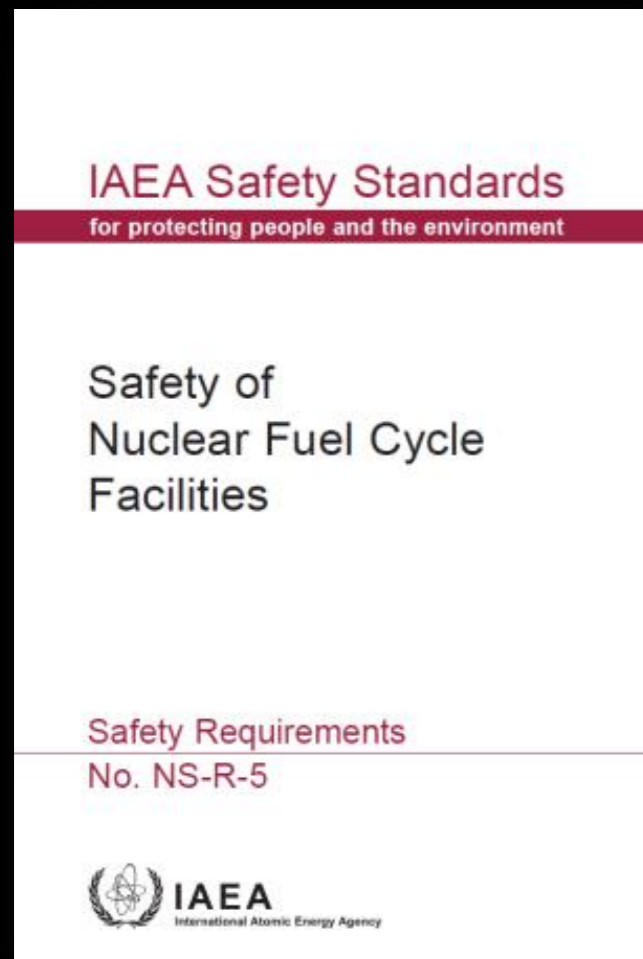
- To provide a basis for safety and a basis for safety assessment for all stages in the lifetime of a research reactor.
- To establish requirements on aspects relating to regulatory control, the management of safety, site evaluation, design, operation and decommissioning.

This publication is intended for use by organizations engaged in the site evaluation, design, manufacturing, construction, operation and decommissioning of research reactors as well as by regulatory bodies.



Specific Safety Requirements SSR-4

will replace NS-R-5



Objective

This publication establishes requirements that, in the light of experience and the present state of technology, must be satisfied to ensure safety, for all stages in the lifetime of a nuclear fuel cycle facility, i.e. its siting, design, construction, commissioning, operation and decommissioning.

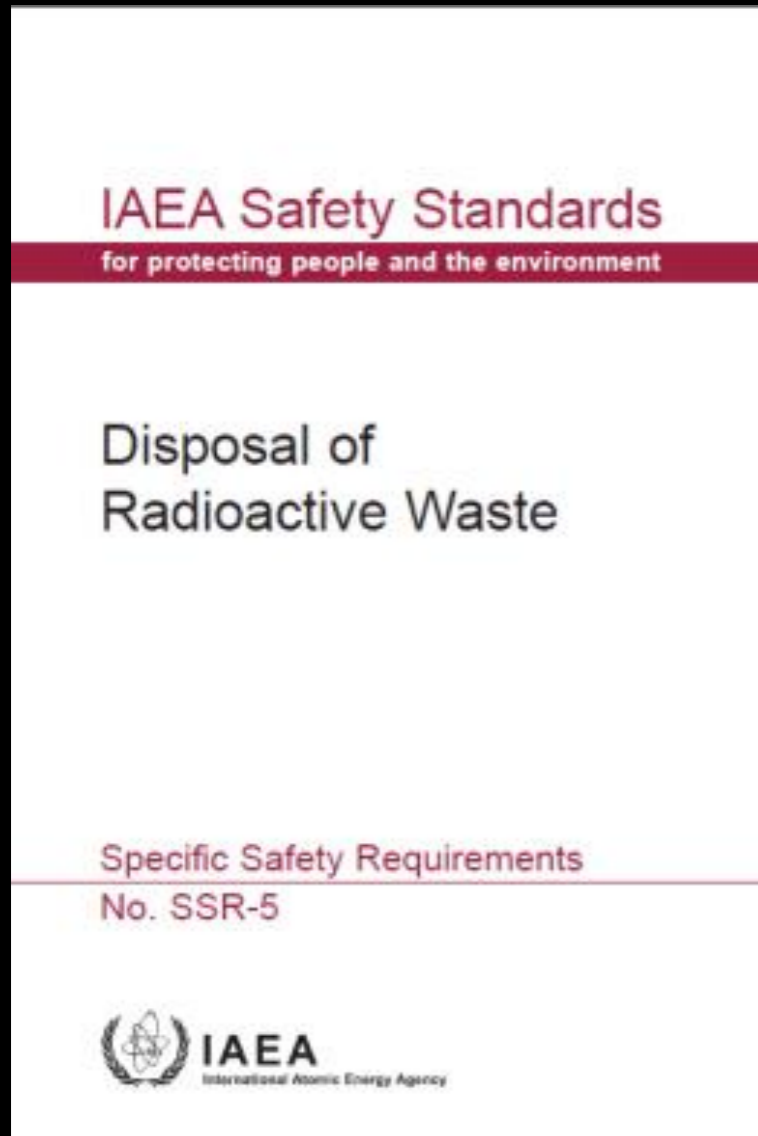
This publication is intended to be used by designers, operating organizations and regulators for ensuring the safety of fuel cycle facilities.

Specific Safety Requirements SSR-5

Objective

This publication sets out the safety objective and criteria for the disposal of all types of radioactive waste and establishes the requirements that must be satisfied in the disposal of radioactive waste.

This publication is intended for use by all persons responsible for, and concerned with, radioactive waste management and making decisions in relation to the development, operation and closure of disposal facilities, especially those persons concerned with the related regulatory aspects.



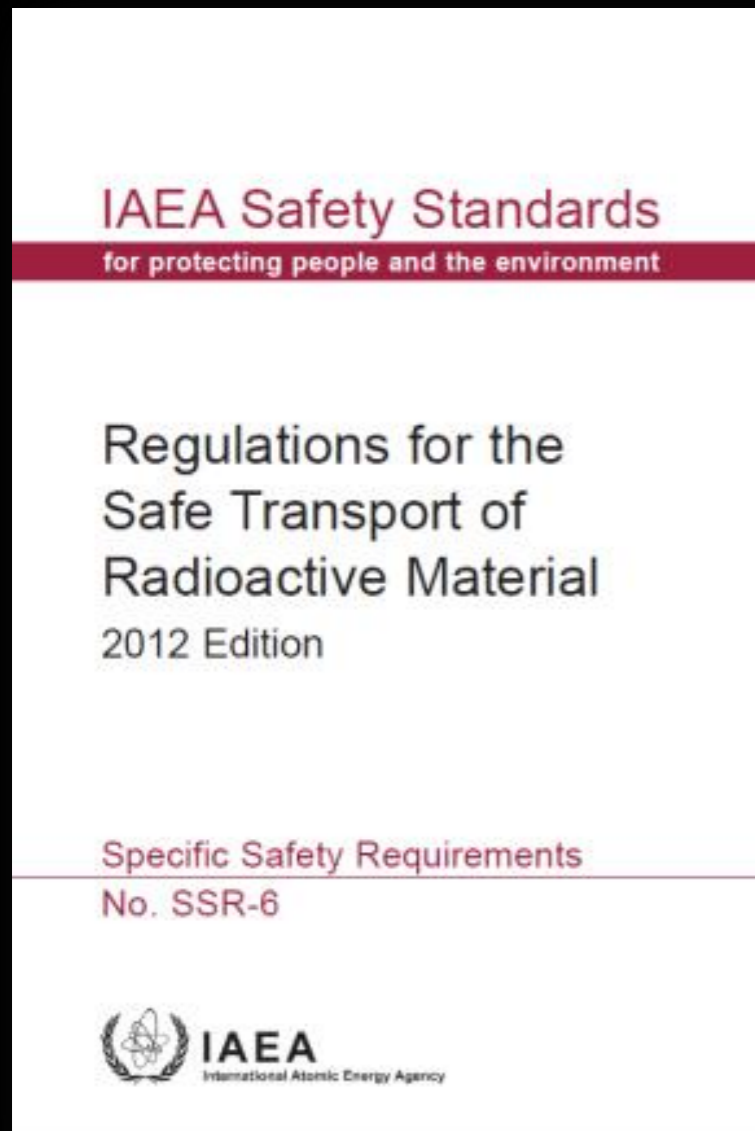
Specific Safety Requirements SSR-6

Objective

This publication establishes requirements that must be satisfied to ensure safety and to protect persons, property and the environment from the effects of radiation in the transport of radioactive material.

This protection is achieved by requiring:

- Containment of the radioactive contents;
- Control of external radiation levels;
- Prevention of criticality; and
- Prevention of damage caused by heat



The Safety Guides

Safety Fundamentals

Safety Requirements

Safety Guides

General

Specific

Safety Guides for RWM

- GSR Part 1, Governmental, Legal and Regulatory framework for Safety (2010)
- GS-G-1.1, Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002)
- GS-G-1.2, Review and Assessment of Nuclear Facilities by the Regulatory Body (2002)
- GS-G-1.3, Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002)
- GS-G-1.4, Documentation for Use in Regulating Nuclear Facilities (2002)
- GS-G-1.5, Regulatory Control of Radiation Sources (2004)
- GSG-4, Use of External Experts by the Regulatory Body (2013)
- SSG-12, Licensing Process for Nuclear Installations (2010)

Safety Guides for RWM

- GS-R-3, The Management System for Facilities and Activities (2006)
- GS-G-3.1, Application of the Management System for Facilities and Activities (2006)
- GS-G-3.3, The Management System for the Processing, Handling and Storage of Radioactive Waste (2008)
- GS-G-3.4, The Management System for the Disposal of Radioactive Waste (2008)
- GS-G-3.5, The Management System for Nuclear Installations (2008)

Safety Guides for RWM

- GSR Part 3, Radiation Protection and Safety of Radiation Sources (2014)
- RS-G-1.7, Application of the Concepts of Exclusion, Exemption and Clearance (2004)
- RS-G-1.8, Environmental and Source Monitoring for Purposes of Radiation Protection (2005)
- SSG-17, Control of Orphan Sources and Other Radioactive Material in the Metal Recycling and Production Industries (2012)

Safety Guides for RWM

- GSR Part 4, Safety Assessment for Facilities and Activities (2009)
- WS-G-5.2, Safety Assessment for the Decommissioning of Facilities Using Radioactive Material (2009)
- GSG-3, The Safety Case and Safety Assessment for the Predisposal of Radioactive Waste (2013)
- SSG-23, The Safety Case and Safety Assessment for the Disposal of Radioactive Waste (2012)
- SSG-15, Storage of Spent Nuclear Fuel (2012)

Safety Guides for RWM

- GSR Part 5, Predisposal Management of Radioactive Waste (2009)
- WS-G-1.2, Management of Radioactive Waste from the Mining and Milling of Ores (2002)
- WS-G-2.3, Regulatory Control of Radioactive Discharges to the Environment (2000)
- WS-G-2.5, Predisposal Management of Low and Intermediate Level Radioactive Waste (2003)
- WS-G-2.6, Predisposal Management of High Level Radioactive Waste (2003)
- WS-G-2.7, Management of Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education (2005)
- WS-G-6.1, Storage of Radioactive Waste (2006)
- GSG-1, Classification of Radioactive Waste (2009)
- GSG-3, The Safety Case and Safety Assessment for the Predisposal of Radioactive Waste (2013)
- SSG-15, Storage of Spent Nuclear Fuel (2012)

Safety Guides for RWM

- GSR Part 6, Decommissioning of Facilities (2014)
- WS-G-2.1, Decommissioning of Nuclear Power Plants and Research Reactors (1999)
- WS-G-2.2, Decommissioning of Medical, Industrial and Research Facilities (1999)
- WS-G-2.4, Decommissioning of Nuclear Fuel Cycle Facilities (2001)
- WS-G-3.1, Remediation Process for Areas Affected by Past Activities and Accidents (2007)
- WS-G-5.1, Release of Sites from Regulatory Control upon Termination of Practices (2006)

Safety Guides for RWM

- GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency (2002)
- GS-G-2.1, Arrangements for Preparedness for a Nuclear or Radiological Emergency (2007)
- GSG-2, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency (2011)

Safety Guides for RWM

- NS-R-3, Site Evaluation for Nuclear Installations (2003)
- SSG-9, Seismic Hazards in Site Evaluation for Nuclear Installations (2010)
- SSG-18, Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2011)
- SSG-21, Volcanic Hazards in Site Evaluation for Nuclear Installations (2012)

Safety Guides for RWM

- SSR-2/1, Safety of Nuclear Power Plants: Design (2012)
- NS-G-1.13, Radiation Protection Aspects of Design for Nuclear Power Plants (2005)
- SSR-2/2, Safety of Nuclear Power Plants: Commissioning and Operation (2011)
- NS-G-2.7, Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (2002)

Safety Guides for RWM

- NS-R-4, Safety of Research Reactors (2005)
- NS-G-4.6, Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors (2009)
- NS-R-5 (Rev 1), Safety of Nuclear Fuel Cycle Facilities (May 2014)
- SSG-5, Safety of Conversion Facilities and Uranium Enrichment Facilities (2010)
- SSG-6, Safety of Uranium Fuel Fabrication Facilities (2010)
- SSG-7, Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities (2010)
- SSG-15, Storage of Spent Nuclear Fuel (2012)
- SSG-27, Criticality Safety in the Handling of Fissile Material (2014)

Safety Guides for RWM

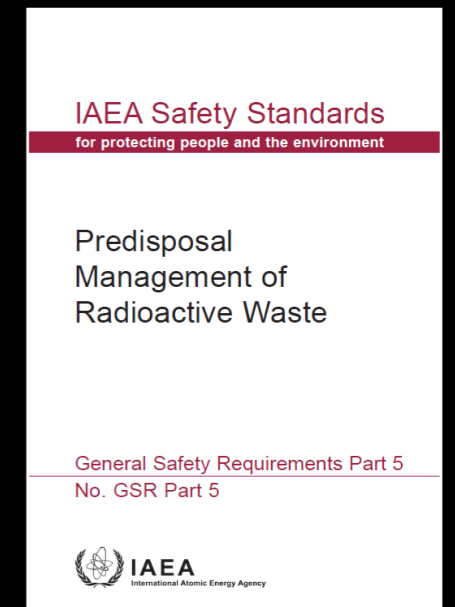
- SSR-5, Disposal of Radioactive Waste (2011)
- SSG-1, Borehole Disposal Facilities of Radioactive Waste (2006)
- SSG-14, Geological Disposal Facilities for Radioactive Waste (2011)
- SSG-23, The Safety Case and Safety Assessment for the Disposal of Radioactive Waste (2012)
- SSG-29, Near Surface Disposal Facilities for Radioactive Waste (2014)
- SSG-31, Monitoring and Surveillance of Radioactive Waste Disposal Facilities (2014)

Safety Guides for RWM

- SSR-6, Regulations for the Safe Transport of Radioactive Material, 2012 edition (2012)
- TS-G-1.1, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2008)

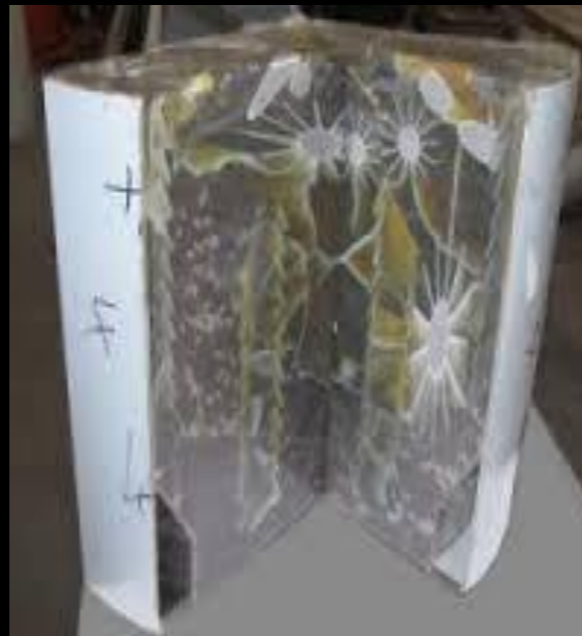
GSR Part 5 Summary

- GSR Part 5 defines Predisposal Waste Management as:
 - ***All the steps in the management of radioactive waste from its generation up to disposal, including processing (pre-treatment, treatment and conditioning), storage and transport.***
- A graded approach should be applied, depending on the hazards, the complexity of facilities and activities, and the characteristics of the waste.
- Legal, Regulatory & Policy (Requirements 1-3)
- Operator responsibilities (Requirements 4-7)
- Detailed requirements on waste generation, siting and design, safety assessment, operation and decommissioning of waste storage facilities (Requirements 8-22)



GSR Part 5 Scope

- Pre-treatment, treatment and conditioning are carried out to put the waste into a form that is compatible with transport, handling, storage or disposal requirements.



- Transport
- Storage



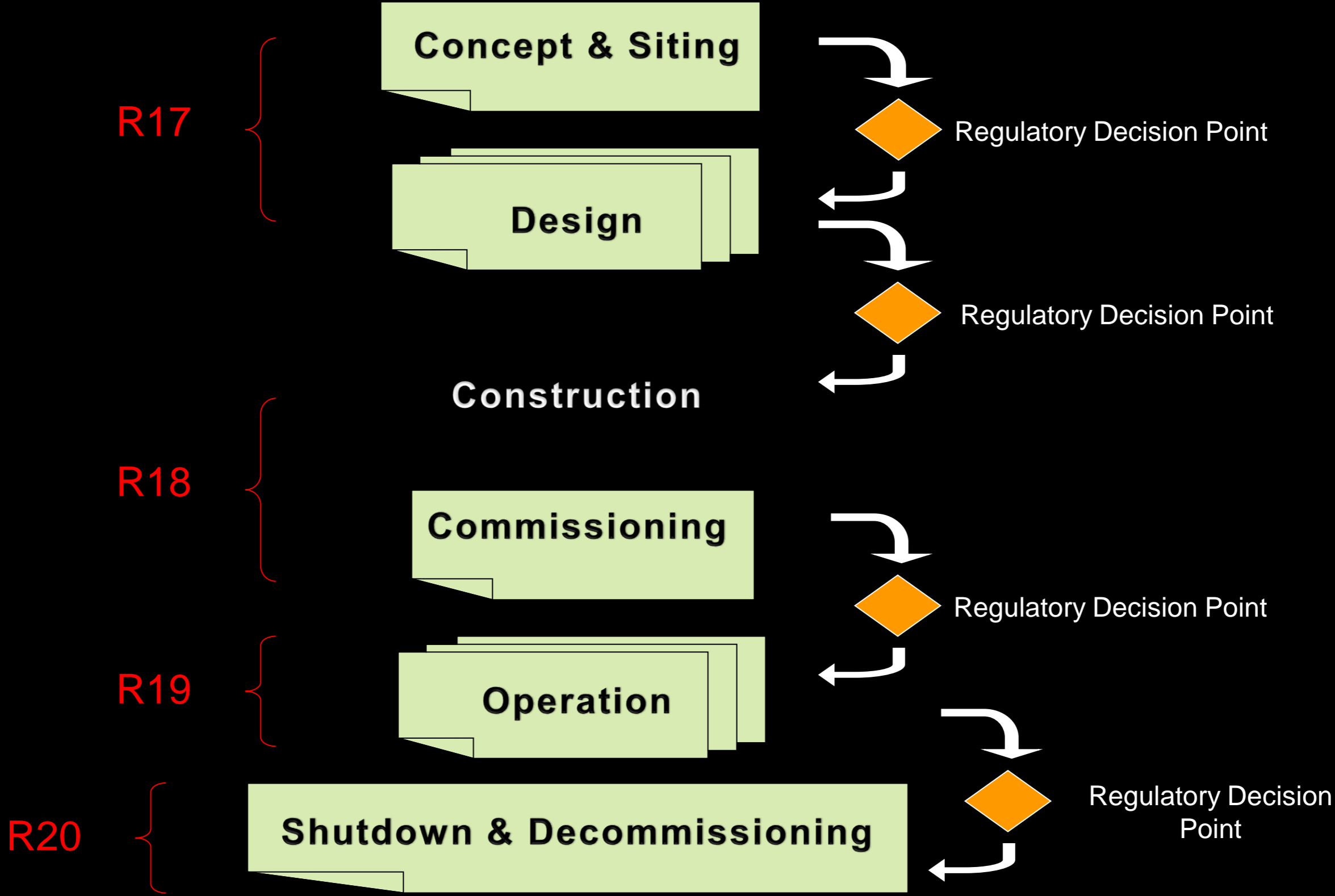
Highlights from GSR Part 5

- **Requirement 4: Responsibilities of the operator**
 - Operators shall be responsible for the safety of predisposal facilities or activities.
 - The operator shall:
 - Carry out safety assessments and develop a safety case
 - Ensure that activities for siting, design, construction, commissioning, operation, shutdown and decommissioning are carried out in compliance with legal and regulatory requirements
 - Ensure an adequate level of safety
 - Derivation of operating limits, conditions & controls
 - Implement appropriate procedures
 - Apply good engineering practice
 - Deploy trained and qualified people
 - Implement a management system
 - Maintain records
 - Provide sufficient financial support
 - Develop an emergency plan

Highlights from GSR Part 5

- Key activities relating to safety case as identified in GSR Part 5
 - Waste characterisation (Requirement 9)
 - Processing of waste (Requirement 10)
 - Storage of waste (Requirement 11)
 - Lifetime considerations
 - Passive safety features
 - Waste Acceptance Criteria (Requirement 12)
 - WAC developed based on safety case envelope
 - Requirement for operator to develop a safety case with supporting safety assessment for all aspects of scope (Requirements 13 & 14)
 - Safety case to be documented and periodically reviewed and used as basis for Regulatory approval (Requirements 15 & 16)

Facility Safety Case Lifecycle



Summary

- Safety Standards = Safety Fundamentals + Safety Requirements + Safety Guides
- 10 fundamental principles (SF-1) are the basis for the development of requirements and guides
- General Safety Requirements apply to all facilities and activities
- Collection of general and specific Safety Guides
- Safety Standards reflect a consensus on what constitutes a high level of safety

Summary

- All activities and facilities involving radiation risk require a safety case to define the safe operating envelope
- A graded approach should be applied
- GSR Part 5 should be considered in conjunction with Part 4 to ensure all safety requirements are met
- GSR Part 4 defines the requirements for safety assessment
 - Overall requirements (Requirements 1-4)
 - Specific safety assessment needs (Requirements 5-12)
 - Defence in depth and safety margins (Requirement 13)
 - Safety Analysis (Requirements 14-19)
 - Documentation and verification (Requirements 20 & 21)
 - Management and maintenance (Requirements 22-24)

Thank you for your time.
Any questions?