

IAEA Safety Standards

for protecting people and the environment

Safety of Nuclear Fuel Cycle Facilities

Safety Requirements No. NS-R-5



IAEA

International Atomic Energy Agency

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SAFETY OF NUCLEAR FUEL CYCLE FACILITIES

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

SAFETY OF NUCLEAR FUEL CYCLE FACILITIES

SAFETY REQUIREMENTS

This Safety Requirements publication includes
a CD-ROM containing the IAEA Safety Glossary:
2007 Edition (2007) and the Fundamental Safety Principles (2006),
each in English, Arabic, Chinese, French, Russian and Spanish versions.
The CD-ROM is also available for purchase separately.
See: <http://www-pub.iaea.org/MTCD/publications/publications.asp>

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2008

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FOREWORD

by Mohamed ElBaradei
Director General

The IAEA's Statute authorizes the Agency to establish safety standards to protect health and minimize danger to life and property — standards which the IAEA must use in its own operations, and which a State can apply by means of its regulatory provisions for nuclear and radiation safety. A comprehensive body of safety standards under regular review, together with the IAEA's assistance in their application, has become a key element in a global safety regime.

In the mid-1990s, a major overhaul of the IAEA's safety standards programme was initiated, with a revised oversight committee structure and a systematic approach to updating the entire corpus of standards. The new standards that have resulted are of a high calibre and reflect best practices in Member States. With the assistance of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its safety standards.

Safety standards are only effective, however, if they are properly applied in practice. The IAEA's safety services — which range in scope from engineering safety, operational safety, and radiation, transport and waste safety to regulatory matters and safety culture in organizations — assist Member States in applying the standards and appraise their effectiveness. These safety services enable valuable insights to be shared and I continue to urge all Member States to make use of them.

Regulating nuclear and radiation safety is a national responsibility, and many Member States have decided to adopt the IAEA's safety standards for use in their national regulations. For the Contracting Parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by designers, manufacturers and operators around the world to enhance nuclear and radiation safety in power generation, medicine, industry, agriculture, research and education.

The IAEA takes seriously the enduring challenge for users and regulators everywhere: that of ensuring a high level of safety in the use of nuclear materials and radiation sources around the world. Their continuing utilization for the benefit of humankind must be managed in a safe manner, and the IAEA safety standards are designed to facilitate the achievement of that goal.

THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA 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 and to provide for their application.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures¹ have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establish the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. The safety requirements use 'shall' statements together with statements of

¹ See also publications issued in the IAEA Nuclear Security Series.

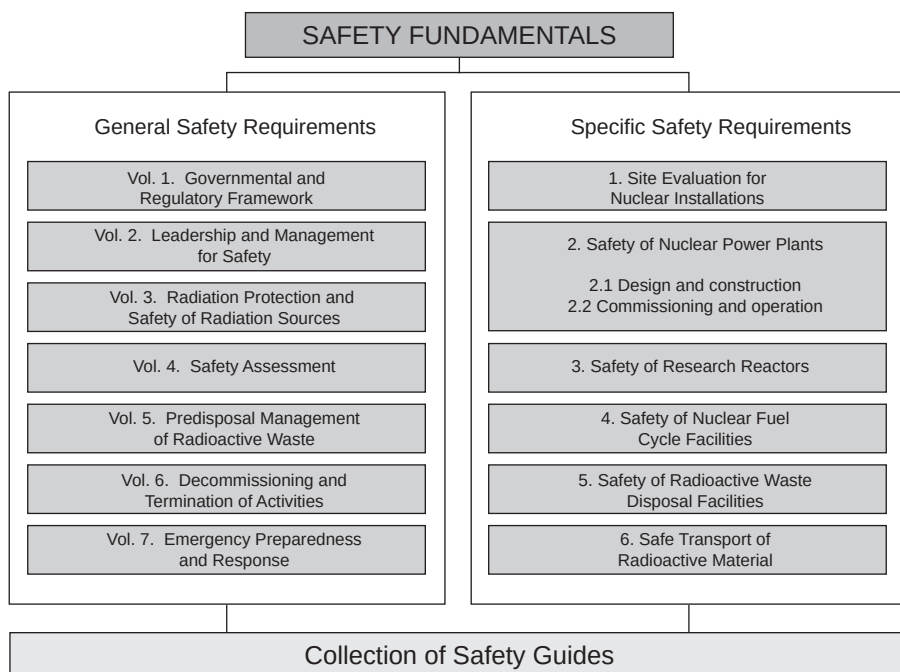


FIG. 1. The long term structure for the IAEA Safety Standards Series.

associated conditions to be met. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety

standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including developing educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and four safety standards committees for safety in the areas of nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

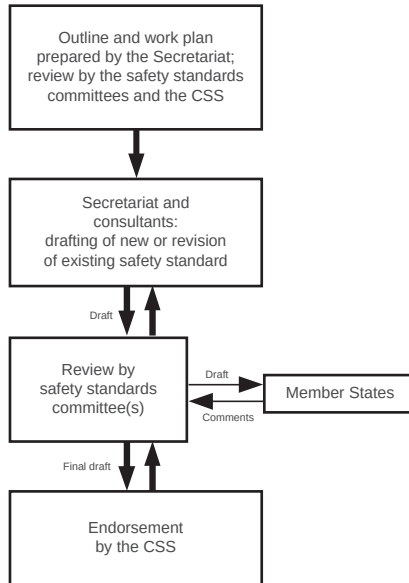


FIG. 2. The process for developing a new safety standard or revising an existing standard.

All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards. It articulates the mandate of the IAEA, the vision on the future application of the safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including

the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see <http://www-ns.iaea.org/standards/safety-glossary.htm>). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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1. INTRODUCTION

BACKGROUND

1.1. In nuclear fuel cycle facilities, nuclear material and radioactive material are used, stored and disposed of, in quantities or concentrations that pose potential hazards to workers, the public and the environment. Facilities in the nuclear fuel cycle include reactors, and facilities for mining, processing, refining, conversion, enrichment and fabrication of fuel (including mixed oxide (MOX) fuel), spent fuel storage, reprocessing, associated waste conditioning and storage, related research and development, and waste disposal. Reactors, mining facilities and waste disposal facilities are not considered here, and for the purposes of this publication the term ‘fuel cycle facility’ or ‘facility’ includes only facilities for processing, refining, conversion, enrichment and fabrication of fuel (including MOX fuel), spent fuel storage, reprocessing and associated waste conditioning and storage, and research and development.

1.2. Fuel cycle facilities employ many diverse technologies and processes. Radioactive material is often processed through a series of interconnected units and consequently can be found throughout the entire facility. The physical and chemical forms of the processed material may also vary within a single facility. Some of the processes use large quantities of hazardous chemical substances and gases, which may be toxic, corrosive, combustible, reactive (i.e. give rise to exothermic reactions) or explosive, and consequently may give rise to the need for specific safety requirements in addition to requirements for nuclear safety. A further specific feature of fuel cycle facilities is that they are often characterized by frequent changes in the mode of operation, and in equipment and processes. This can be necessitated by new production campaigns or product development, ongoing research and development, and continuous improvement. Operations at large fuel cycle facilities generally require more operator intervention than at nuclear power plants or research reactors. This may result in specific hazards to the workforce. In addition, the nature and diversity of the processes associated with the facilities result in a broad range of hazardous conditions and possible events that need to be considered in the safety analysis.

1.3. The principles that must be met to ensure safety in nuclear installations are presented in the Fundamental Safety Principles [1]. The safety requirements for fuel cycle facilities, as presented in this publication, are based on, and are established to apply, these principles.

OBJECTIVE

1.4. The objective of this publication is to establish 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.

1.5. A number of the safety requirements for fuel cycle facilities are similar to those that have been established for nuclear power plants. In view of the specificities addressed in para. 1.2, and the broad diversity of installations and operations covered, the requirements established in this publication are to be applied in a manner that is commensurate with the potential hazards for each facility, i.e. using a graded approach to ensure that the safety of the facility is adequate throughout its entire lifetime.

1.6. This Safety Requirements publication establishes the safety requirements to be met for ensuring safety. It must be used in conjunction with the IAEA Safety Guides that provide recommendations on ways of meeting the safety requirements for processing and refining, conversion and enrichment, uranium fuel fabrication, MOX fuel fabrication, spent fuel storage, reprocessing, waste conditioning and storage, and research and development facilities. In addition, some requirements that are specific to these different types of fuel cycle facility are established in the appendices of this publication (see para. 1.15).

SCOPE

1.7. This Safety Requirements publication applies to processing, refining, conversion, enrichment, fabrication of fuel (including MOX fuel), spent fuel storage, spent fuel reprocessing, waste conditioning and storage, and fuel cycle research and development facilities.

1.8. The requirements established in this publication are applicable to new fuel cycle facilities and may be applied to existing fuel cycle facilities as appropriate. The requirements might not be fully met at some facilities built to earlier standards. The way in which the requirements are to be applied to such facilities is a matter for the individual States.

1.9. The safety of fuel cycle facilities is assured by means of their proper siting, design, construction, commissioning, operation and decommissioning. In this publication, emphasis is placed on the safety aspects of design and operation.

1.10. Fuel cycle facilities generate radioactive waste that requires appropriate and systematic management arrangements. The corresponding safety principles are stated in Ref. [1] and the requirements for predisposal management are established in Ref. [2].

1.11. The safety requirements for installations for the predisposal management of radioactive waste (i.e. waste treatment and storage facilities) are addressed in Ref. [2], mainly in Sections 5 (elements of predisposal management of radioactive waste) and 7 (safety of facilities). More detailed safety requirements are presented in this publication.

1.12. The detailed requirements for emergency response are established in Ref. [3].

1.13. The requirements for the safe transport of radioactive material or fissile material arriving at, or leaving from, fuel cycle facilities are established in Ref. [4].

1.14. The implementation of the safety requirements for any fuel cycle facility shall be commensurate with its potential hazards (the ‘graded approach’). The facility type and the following facility specific attributes shall be taken into account:

- (a) The nature and the physical and chemical forms of the radioactive materials that are used, processed and stored at the facility;
- (b) The scale of operations undertaken at the facility (i.e. the ‘throughput’ of the facility) and the inventory of hazardous material, including products and waste in storage;
- (c) The processes, technologies and hazardous chemicals that are used;
- (d) The available routes for the disposal of effluents and the storage of radioactive waste.

STRUCTURE

1.15. This publication consists of ten sections, three appendices and three annexes. Section 2 covers the general safety objective and safety principles for fuel cycle facilities, with emphasis on the radiological and nuclear safety aspects. Section 3 addresses the regulatory supervision aspects. Section 4 deals with the management and verification of safety by the operating organization. Sections 5–10 contain specific requirements applicable to the stages of a fuel cycle facility, considering in turn siting, design, construction, commissioning, operation and decommissioning. Appendices I, II and III establish additional safety requirements specific to uranium fuel fabrication facilities, MOX fuel fabrication facilities, and conversion facilities and enrichment facilities, respectively. Further appendices will be added to later editions of this Safety Requirements publication when the relevant Safety Guides become available. Annex I provides a list of postulated initiating events. Annex II deals with the availability and reliability principles to be applied in fuel cycle facilities. Finally, Annex III addresses the safety approach to be applied in the design of fuel cycle facilities.

2. THE SAFETY OBJECTIVE, CONCEPTS AND SAFETY PRINCIPLES

SAFETY OBJECTIVE

2.1. The Fundamental Safety Principles [1] state that “the fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation.”

2.2. To achieve this safety objective, “measures have to be taken: (a) To control the radiation exposure of people and the release of radioactive material to the environment; (b) To restrict the likelihood of events that might lead to a loss of control over ... source[s] of radiation; [and] (c) To mitigate the consequences of such events if they were to occur” [1]. In the context of fuel cycle facilities, the control of events initiated by chemical hazards can have a significant bearing on achieving the fundamental safety objective. Events initiated by chemical hazards shall be considered in the design, commissioning and operation of the facility. Activities at fuel cycle facilities may also include

industrial processes that pose additional hazards to site personnel and the environment. Purely industrial hazards are outside the scope of this publication, but they shall be considered by the operating organization. Guidance relating to the management of specific chemical hazards may be found in the IAEA Safety Guides associated with this publication or in chemical industry standards.

SAFETY PRINCIPLES

2.3. The ten safety principles established in Ref. [1] apply to fuel cycle facilities, existing and new, throughout their entire lifetime. These principles provide the basis for the requirements for the safety of these facilities.

DEFENCE IN DEPTH

2.4. The concept of defence in depth shall be applied at the facility for the prevention and mitigation of accidents (Principle 8 of Ref. [1]). Defence in depth is the application of multiple levels of protection for all relevant safety activities, whether organizational, behavioural or equipment related [5, 6]. Application of the concept of defence in depth throughout the design and operation of a fuel cycle facility provides multilayer protection against a wide range of anticipated operational occurrences¹ and accident conditions, including those resulting from equipment failure or human error within the facility, and from events that originate outside the facility.

2.5. The strategy for defence in depth shall be twofold: first, to prevent accidents, and second, if prevention fails, to limit the potential radiological and associated chemical consequences and to prevent any evolution to more serious conditions. Defence in depth is generally structured in five different levels, as set out in Table 1, which is adapted from Ref. [5]. If one level fails, the subsequent level comes into play.

2.6. The design features, controls and arrangements necessary to implement the defence in depth concept shall be identified mainly by means of a deterministic analysis (which may be complemented by probabilistic studies) of the design and operational regime. The analysis shall be justified by the

¹ Anticipated operational occurrences: see Annex III, para. III-12.

application of sound engineering practices based on research and operational experience. This analysis, which is usually called a safety analysis, shall be carried out during the design stage to ensure that the regulatory requirements can be met.

TABLE 1. LEVELS OF DEFENCE IN DEPTH

Level	Objective	Essential means
Level 1	Prevention of abnormal operation and failures	Conservative design and high quality in construction, commissioning ² and operation (including management aspects)
Level 2	Control of abnormal operation and detection of failures	Control, limiting and protective barriers and systems and other surveillance features
Level 3	Control of accidents within the design basis	Engineered safety features and accident procedures
Level 4	Control of accident conditions beyond the design basis, including prevention of accident progression and mitigation of the consequences of such accident conditions	Complementary measures and accident management ³
Level 5	Mitigation of radiological consequences of significant releases of radioactive materials	On-site and off-site emergency response

2.7. Defence in depth shall be implemented by taking into account the graded approach as described in Section 1. The amount and type of radioactive material present, the potential for dispersion, the potential for nuclear,

² In the context of fuel cycle facilities, commissioning is the process by means of which systems and components, having been constructed, are made operational and verified to be in accordance with the design and to have met the required performance criteria. Commissioning may include both non-nuclear and/or non-radioactive and nuclear and/or radioactive testing.

³ In the context of fuel cycle facilities, accident management is the taking of a set of actions during the evolution of a beyond design basis accident: to prevent the escalation of the event into a more severe accident; to mitigate the consequences of such beyond design basis accidents; and to achieve a long term safe and stable state.

chemical or thermal reactions, and the kinetics of such events shall all be considered in determining the required number and strength of lines of defence.

2.8. The degree of application of each level of defence in depth shall be commensurate with the potential hazards of the facility and shall be established in the facility's licensing documentation.

LICENSING DOCUMENTATION

2.9. The operating organization shall establish and justify the safety of its facility through a set of documents known as the 'licensing documentation' (or 'safety case').⁴ The licensing documentation shall provide the basis for the safe siting, construction, commissioning, operation and decommissioning of the facility, including the justification for changes. The licensing documentation shall be considered in determining whether the authorizations necessary under national legislative requirements are to be granted, and thus it forms an important link between the operating organization and the regulatory body.

2.10. The content of the licensing documentation for a facility may vary between States but at least the safety analysis report and the operational limits and conditions or equivalent shall be included. Consideration of the application of the principle of optimization of protection (Principle 5 of Ref. [1]) in the design and operation of the facility shall be included in the licensing documentation.

2.11. The safety analysis report shall provide a detailed demonstration of the safety of the facility. It shall give a detailed description of those aspects having safety significance, such as information on the input feed and the products of the facility and the corresponding limits (e.g. limits on burnup and enrichment), and it shall discuss the application of the safety principles and criteria in the design for the protection of operating personnel, the public and the environment. The safety analysis report shall contain an analysis of the hazards associated with the operation of the facility and shall demonstrate compliance with the regulatory requirements and criteria. It shall also contain safety analyses of accident

⁴ In the context of fuel cycle facilities, the licensing documentation (or safety case) is 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.

sequences and of the safety features incorporated in the design for preventing accidents or minimizing the likelihood of their occurrence and for mitigating their consequences.

2.12. The safety functions and the structures, systems and components (SSCs) important to safety shall be identified in the safety analysis report to the extent appropriate and in accordance with a graded approach. The SSCs important to safety provide means for the prevention of the occurrence of postulated initiating events, the control and limitation of accident sequences and mitigation of the consequences.

2.13. The operational limits and conditions are the set of rules that establish parameter limits, the functional capability and the performance levels of equipment and personnel for the safe operation of a facility.

2.14. The licensing documentation shall also define the required intervals for periodic testing and inspection of SSCs important to safety.

2.15. The licensing documentation shall be maintained and updated during the operational lifetime of the facility on the basis of the experience and knowledge gained and in accordance with the regulatory requirements, with account taken of modifications⁵ to the facility.

3. LEGAL FRAMEWORK AND REGULATORY SUPERVISION

GENERAL

3.1. This section outlines requirements relating to general aspects of the legal and governmental infrastructure for the safety of fuel cycle facilities. Further general requirements are established in Ref. [7]. Guidance on the application

⁵ In the context of this publication, a modification is a deliberate change in or an addition to the existing facility configuration, with potential safety implications, intended for continuation of the facility's operation. It may involve safety systems, safety related items or systems, procedures, documentation or operating conditions.

of the requirements in Ref. [7] is provided in the IAEA Safety Guides associated with that publication (Refs [8–11]).

LEGAL FRAMEWORK

3.2. The government shall ensure that an adequate legal framework and regulatory basis are available for ensuring the safety of a facility and assessing its safety implications. The government shall adopt legislation that assigns the prime responsibility for safety to the operating organization. Legislation shall be enacted to provide for the establishment of a regulatory body that is effectively independent of organizations or bodies charged with the promotion of nuclear technologies or responsible for facilities or activities. The regulatory body shall be structured and resourced in a manner commensurate with the potential magnitude and nature of the hazard to be controlled. The government shall make arrangements to ensure that the regulatory body is adequately funded to fulfil the national safety requirements and legislative requirements assigned to it.

3.3. Safety, health and environment related regulatory requirements are influenced by industrial, chemical and toxic hazards in addition to the radiological hazards. The government shall ensure cooperation with and between the relevant authorities where nuclear, environmental, industrial safety and occupational health aspects are separately regulated. The construction, adjacent to a facility site, of installations that could prejudice the safety of the facility shall be monitored and controlled by means of planning requirements for land use.

REGULATORY BODY

3.4. To be effective, the regulatory body shall be provided with the legal powers and statutory authority necessary to ensure that it can discharge its responsibilities and perform its functions. Such powers normally include the authority to review and assess safety information submitted by the operating organization in the authorization process and to administer the relevant regulations, including carrying out regulatory inspections and audits for compliance with the regulations, taking enforcement actions, and providing information to other competent authorities and to the public, as appropriate.

3.5. “In order to fulfil its statutory obligations, the regulatory body shall define policies, safety principles and associated criteria as a basis for its regulatory

actions” (Ref. [7], para. 3.1). These policies, principles and criteria shall set targets and limits on the radiological consequences for the workforce, members of the public and the environment.

AUTHORIZATION PROCESS

3.6. Every project for a new fuel cycle facility shall follow an authorization process that comprehensively addresses all safety aspects.

3.7. The authorization steps and procedures may vary among States. This authorization can be a step by step process starting at the site planning and feasibility study stage and continuing up to and including the decommissioning of the facility. Alternatively, the authorization can be granted for the entire project, but conditions may need to be attached in order to apply control in subsequent stages.

3.8. An authorization from the regulatory body, which shall take the form of a licence, is required by the operating organization of any fuel cycle facility before taking into its possession or processing any radioactive substances (Ref. [12], paras 2.12 and 2.13).

3.9. Irrespective of the differences between national practices, a detailed demonstration of safety in the form of licensing documentation (see paras 2.9–2.15 of this publication) shall be submitted by the operating organization, and shall be reviewed and assessed by the regulatory body before progress of the project to the next stage is authorized. The degree of scrutiny and assessment maintained by the regulatory body shall be commensurate with its judgement of the degree of potential hazards posed by the facility.

3.10. The regulatory body shall ensure that the operating organization has made adequate arrangements for keeping the licensing documentation up to date throughout the lifetime of the facility so as to reflect the current status of the experience and knowledge gained of the facility and in accordance with the regulatory requirements. The regulatory body shall also ensure that the licensing documentation includes adequate references to supporting documents and that the operating organization maintains the reference material readily available upon request. In addition, the operating organization shall not limit or prevent adequate review and assessment by classifying the reference material.

REGULATORY INSPECTION AND ENFORCEMENT

3.11. The regulatory body shall establish a planned and systematic programme of regulatory inspection (including provisions for unannounced regulatory inspections as necessary). The scope and frequency of the regulatory inspections under this programme shall be commensurate with the potential hazards posed by the facility.

3.12. In addition to ensuring compliance with safety requirements, the programme shall take into account issues such as the safety culture of the operating organization, the adequacy of its resources (including the size of the workforce), the use of contractors and the arrangements put in place to ensure that workers are suitably qualified and experienced to perform their safety related tasks.

4. THE MANAGEMENT SYSTEM AND VERIFICATION OF SAFETY

GENERAL

4.1. To fulfil its prime responsibility for safety throughout the lifetime of a fuel cycle facility, the operating organization shall establish, implement, assess and continually improve a management system that integrates safety, health, environmental, security, quality and economic elements to ensure that safety is properly taken into account in all the activities of an organization. Requirements for the management system are established in Ref. [13].

4.2. The operating organization:

- (a) Shall establish and implement safety, health and environmental policies in accordance with national and international standards and shall ensure that these matters are given the highest priority;
- (b) Shall establish an organizational structure to enable these policies to be carried out with a clear definition of responsibilities and accountabilities, lines of authority and communication;
- (c) Shall specify and implement a management system covering all stages of the facility's lifetime;

- (d) Shall develop and maintain an effective safety culture;
- (e) Shall prepare accident management procedures and on-site emergency plans (in accordance with the hazard potential);
- (f) Shall perform a safety assessment of the facility;
- (g) Shall design and implement the physical protection of the facility.

4.3. The key aspects of each of these safety requirements are discussed in the following subsections. They are considered in terms of the main arrangements and procedures necessary for achieving and maintaining an effective organization. Arrangements specific to siting, construction, commissioning, operation and decommissioning are addressed in the corresponding sections of this publication.

4.4. The operating organization shall allocate suitable financial resources to fulfil its prime responsibility for safety and to implement these foregoing safety requirements.

4.5. The operating organization may delegate to other organizations work necessary for discharging its responsibilities, in accordance with the regulatory requirements, but the overall responsibility and control shall be retained by the operating organization.

SAFETY, HEALTH AND ENVIRONMENTAL POLICIES

4.6. An essential step in setting the necessary standards for the health and safety of operating personnel and the public and for the protection of the environment are the statements by the operating organization of its safety, health and environmental policies. These policy statements shall be provided to staff as a declaration of the organization's objectives and the public commitment of corporate management. To put these policies into effect, the operating organization shall also specify and put in place organizational structures, standards and management arrangements capable of meeting the organization's objectives and public commitments under the policy.

ORGANIZATIONAL PROVISIONS

4.7. The operating organization shall clearly specify the responsibilities and accountabilities of all staff involved in conducting or controlling operations that affect safety. The person with the responsibility for direct supervision shall

be clearly identified at all times. This applies throughout the lifetime of the facility, from its siting to its decommissioning.

4.8. The management structure shall define clear lines of communication and shall provide the necessary infrastructure for facility operations to be conducted safely.

4.9. The operating organization shall maintain the capability in terms of staffing, skills, experience and knowledge to undertake competently all activities throughout the lifetime of the facility from siting to decommissioning. Where the resources and skills necessary to fulfil any part of these undertakings are provided by an external organization, the operating organization shall nevertheless retain within its organization the capability to assess the adequacy of the external organization's capabilities for ensuring safety.

4.10. The operating organization shall specify the necessary qualifications and experience for all staff involved in activities that may affect safety. It shall also specify appropriate requirements on training and its assessment and approval. The operating organization shall additionally ensure that the qualifications and training of contractors are adequate for the activities to be performed and that adequate control and supervision are in place. Records of the training provided to staff or to contractors shall be maintained.

MANAGEMENT SYSTEM PROCESSES⁶

4.11. The operating organization shall establish and implement generic processes in a management system [13, 14] aligned with internationally recognized standards, for ensuring facility safety by providing necessary assurance that the siting, design, construction, commissioning, operational and decommissioning requirements are defined and executed in accordance with the necessary standards and degree of rigour.

⁶ The term 'management system' has been adopted in Refs [13, 14] instead of the term 'quality assurance'. The term management system includes all aspects of the management of a nuclear facility, such as a fuel cycle facility, and brings the safety, health, environment and quality assurance related requirements together in one integrated system.

4.12. From the outset, the design process shall be developed, managed and, as necessary, modified to achieve a safe design of the facility.

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

4.14. To ensure that all items and services important to safety under procurement meet established requirements and perform as specified, such items and services shall be subject to an appropriate management system. Suppliers shall be evaluated and selected by the operating organization on the basis of specified criteria. Requirements on reporting deviations from procurement specifications and on corrective actions shall be specified in the procurement documents. Evidence that purchased items and services meet procurement specifications shall be available before they are used.

4.15. The use of computer codes for the safety justification of the facility, and their verification and validation (e.g. tests and experiments), shall be subject to the management system.

4.16. Where the facility generates products, including waste products, any safety implications of these products shall also be covered by the management system.

SAFETY CULTURE⁷

4.17. Fuel cycle facilities may require special considerations to achieve high safety, health and environmental standards by virtue of their size and the number of their staff, the distribution and the movement of radioactive material and other hazardous material throughout the installation, the frequent changes in operations, and the reliance on operator action in normal operation.

⁷ “The attitudes of individuals are greatly influenced by their working environment. The key to an effective Safety Culture in individuals is found in the practices moulding the environment and fostering attitudes conducive to safety. It is the responsibility of managers to institute such practices in accordance with their organization’s safety policy and objectives” (Ref. [15], para. 35).

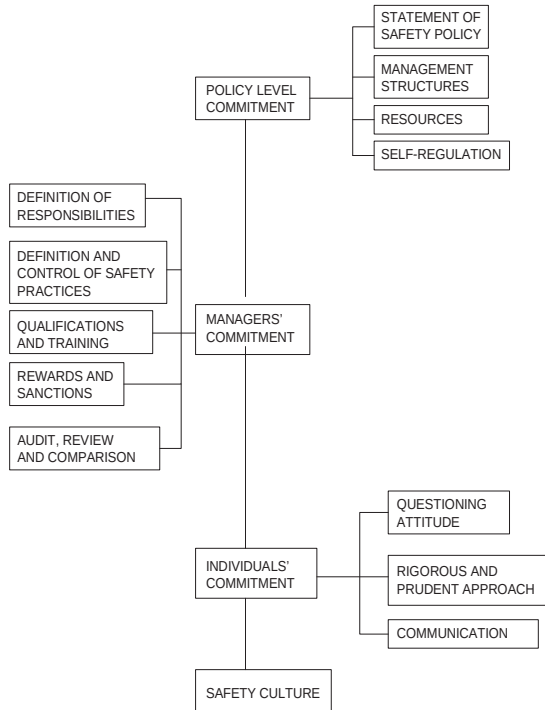


FIG. 1. Illustration of the presentation of safety culture (see Ref. [15], fig. 1; explanatory text in Ref. [14]).

The awareness by individuals of safety matters and the commitment of individuals to safety are therefore essential. The operating organization shall adopt and implement the necessary principles and processes to achieve an effective safety culture [15].

4.18. The operating organization shall address the major components of safety culture as illustrated in Fig. 1 [15].

4.19. The operating organization shall report incidents significant to safety to the regulatory body in a timely manner.

ACCIDENT MANAGEMENT AND EMERGENCY PREPAREDNESS

4.20. The prevention of accidents is the first priority for safety of the operating organization. Nevertheless, as there can be no guarantee that measures to prevent accidents will always be totally successful, the operating organization and the regulatory body have to make preparations to deal with accidents. Requirements for emergency preparedness and response are established in Ref. [3].

4.21. The operating organization shall prepare accident management procedures and on-site emergency procedures, taking into account the potential hazards of the facility, before the introduction of hazardous material. Where necessary, in accordance with the degree of the hazards, the operating organization shall prepare off-site procedures in coordination with the relevant off-site organizations and competent authorities. The off-site procedures shall be consistent with national and international practices.

4.22. Periodic exercises for on-site and off-site emergencies shall be carried out to the extent necessary to ensure the preparedness of the responsible organizations.

4.23. When necessary, the emergency procedures shall be updated on the basis of the lessons learned from these exercises.

VERIFICATION OF SAFETY

4.24. The operating organization shall be responsible for verifying the safety of the facility at all times. It shall establish or shall have access to an appropriate capability for safety analysis for ensuring that the necessary justifications are generated and maintained throughout the lifetime of the facility. It shall ensure that events that are significant to safety are reviewed in depth and that, when necessary to prevent the recurrence of accidents, equipment is modified, procedures are revised, qualifications of personnel are reassessed and training is updated and provided.

4.25. When available, information about incidents and events at other installations of the same type as the facility shall also be investigated and the lessons learned shall be considered.