IAEA Safety Standards

for protecting people and the environment

The Operating Organization for Nuclear Power Plants

Specific Safety Guide

No. SSG-72

IAEA
International Atomic Energy Agency

IAEA SAFETY STANDARDS AND RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Information on the IAEA's safety standards programme is available on the IAEA Internet site

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The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at: Vienna International Centre, PO Box 100, 1400 Vienna, Austria.

All users of IAEA safety standards are invited to inform the IAEA of experience in their use (e.g. as a basis for national regulations, for safety reviews and for training courses) for the purpose of ensuring that they continue to meet users' needs. Information may be provided via the IAEA Internet site or by post, as above, or by email to Official.Mail@iaea.org.

RELATED PUBLICATIONS

The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety in nuclear activities are issued as **Safety Reports**, which provide practical examples and detailed methods that can be used in support of the safety standards.

Other safety related IAEA publications are issued as **Emergency Preparedness and Response** publications, **Radiological Assessment Reports**, the International Nuclear Safety Group's **INSAG Reports**, **Technical Reports** and **TECDOCs**. The IAEA also issues reports on radiological accidents, training manuals and practical manuals, and other special safety related publications.

Security related publications are issued in the **IAEA Nuclear Security Series**.

The **IAEA Nuclear Energy Series** comprises informational publications to encourage and assist research on, and the development and practical application of, nuclear energy for peaceful purposes. It includes reports and guides on the status of and advances in technology, and on experience, good practices and practical examples in the areas of nuclear power, the nuclear fuel cycle, radioactive waste management and decommissioning.

THE OPERATING ORGANIZATION FOR NUCLEAR POWER PLANTS

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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''.

IAEA Safety Standards Series No. SSG-72

THE OPERATING ORGANIZATION FOR NUCLEAR POWER PLANTS

SPECIFIC SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

by Rafael Mariano Grossi
Director General

The IAEA's Statute authorizes it to "establish…standards of safety for protection of health and minimization of danger to life and property". These are standards that the IAEA must apply to its own operations, and that States can apply through their national regulations.

The IAEA started its safety standards programme in 1958 and there have been many developments since. As Director General, I am committed to ensuring that the IAEA maintains and improves upon this integrated, comprehensive and consistent set of up to date, user friendly and fit for purpose safety standards of high quality. Their proper application in the use of nuclear science and technology should offer a high level of protection for people and the environment across the world and provide the confidence necessary to allow for the ongoing use of nuclear technology for the benefit of all.

Safety is a national responsibility underpinned by a number of international conventions. The IAEA safety standards form a basis for these legal instruments and serve as a global reference to help parties meet their obligations. While safety standards are not legally binding on Member States, they are widely applied. They have become an indispensable reference point and a common denominator for the vast majority of Member States that have adopted these standards for use in national regulations to enhance safety in nuclear power generation, research reactors and fuel cycle facilities as well as in nuclear applications in medicine, industry, agriculture and research.

The IAEA safety standards are based on the practical experience of its Member States and produced through international consensus. The involvement of the members of the Safety Standards Committees, the Nuclear Security Guidance Committee and the Commission on Safety Standards is particularly important, and I am grateful to all those who contribute their knowledge and expertise to this endeavour.

The IAEA also uses these safety standards when it assists Member States through its review missions and advisory services. This helps Member States in the application of the standards and enables valuable experience and insight to be shared. Feedback from these missions and services, and lessons identified from events and experience in the use and application of the safety standards, are taken into account during their periodic revision.

I believe the IAEA safety standards and their application make an invaluable contribution to ensuring a high level of safety in the use of nuclear technology. I encourage all Member States to promote and apply these standards, and to work with the IAEA to uphold their quality now and in the future.

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 measures[1] 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 establishes 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. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. 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

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

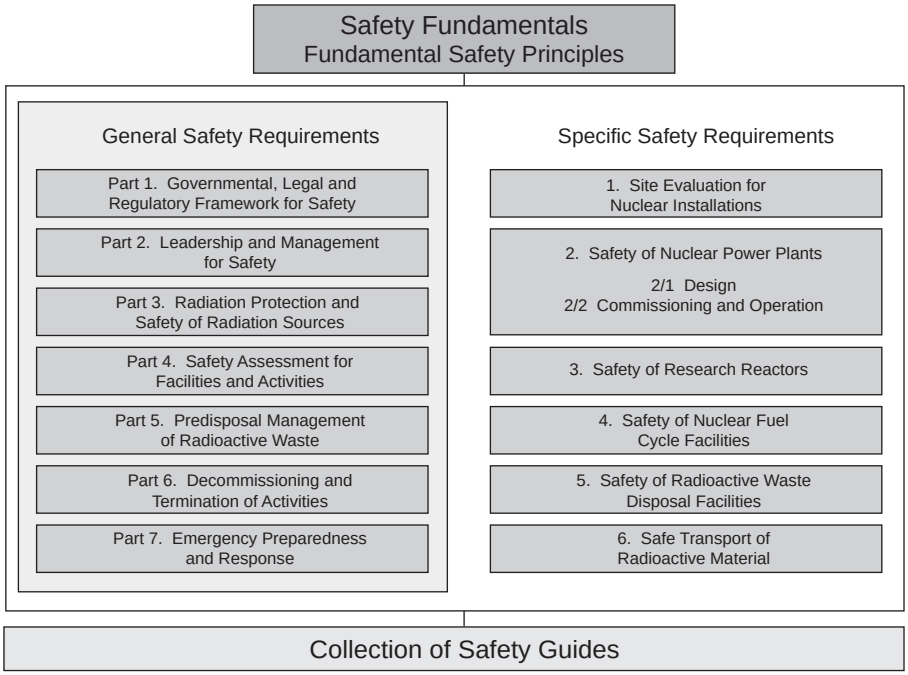

FIG. 1. The long term structure of the IAEA Safety Standards Series.

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 the development of 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 five Safety Standards Committees, for emergency preparedness and response (EPReSC) (as of 2016), 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).

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.

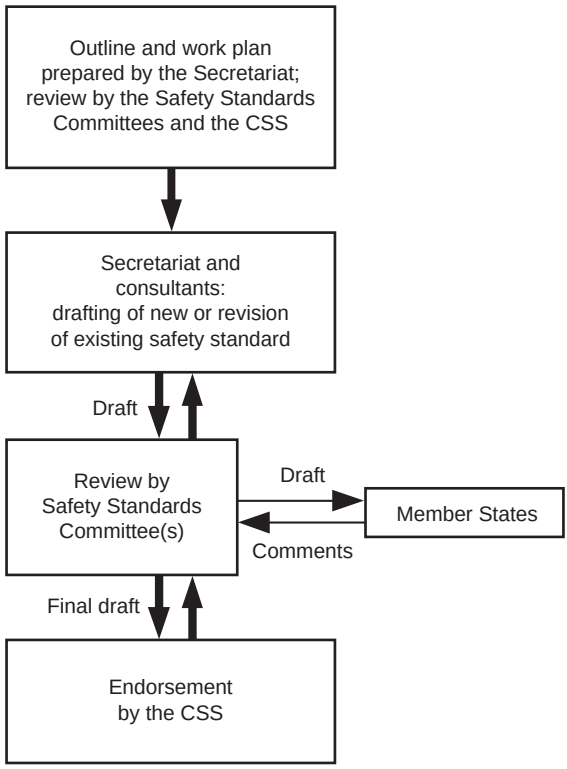

FIG. 2. The process for developing a new safety standard or revising an existing standard.

It articulates the mandate of the IAEA, the vision for 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 https://www.iaea.org/resources/safety-standards/safety-glossary). 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.

CONTENTS

1. INTRODUCTION

BACKGROUND

1.1. Requirements for the operation of nuclear power plants are established in IAEA Safety Standards Series No. SSR-2/2 (Rev. 1), Safety of Nuclear Power Plants: Commissioning and Operation [1], while requirements for the design of nuclear power plants are established in IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design [2].

1.2. Requirements for establishing, sustaining and continuously improving leadership and management for safety and for an effective management system for all facilities and activities are established in IAEA Safety Standards Series No. GSR Part 2, Leadership and Management for Safety [3].

1.3. This Safety Guide provides specific recommendations on establishing and maintaining the operating organization of nuclear power plants to ensure effective management for safety.

1.4. This Safety Guide was developed in parallel with six other Safety Guides on the operation of nuclear power plants, as follows:

- IAEA Safety Standards Series No. SSG-70, Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants [4];
- IAEA Safety Standards Series No. SSG-71, Modifications to Nuclear Power Plants [5];
- IAEA Safety Standards Series No. SSG-73, Core Management and Fuel Handling for Nuclear Power Plants [6];
- IAEA Safety Standards Series No. SSG-74, Maintenance, Testing, Surveillance and Inspection in Nuclear Power Plants [7];
- IAEA Safety Standards Series No. SSG-75, Recruitment, Qualification and Training of Personnel for Nuclear Power Plants [8];
- IAEA Safety Standards Series No. SSG-76, Conduct of Operations at Nuclear Power Plants [9].

A collective aim of this set of Safety Guides is to support the fostering of a strong safety culture in nuclear power plants.

1.5. The terms used in this Safety Guide are to be understood as defined and explained in the IAEA Safety Glossary [10].

1.6. This Safety Guide supersedes IAEA Safety Standards Series No. NS-G-2.4, The Operating Organization for Nuclear Power Plants[1].

OBJECTIVE

1.7. The purpose of this Safety Guide is to provide recommendations on establishing and maintaining the operating organization of a nuclear power plant to meet the requirements established in SSR-2/2 (Rev. 1) [1] and GSR Part 2 [3].

1.8. The recommendations provided in this Safety Guide are aimed primarily at operating organizations of nuclear power plants and regulatory bodies.

SCOPE

1.9. It is expected that this Safety Guide will be used primarily for land based stationary nuclear power plants with water cooled reactors designed for electricity generation or for other production applications (such as district heating or desalination).

1.10. In most States, the operating organization is the legal entity responsible for safety and for financial and commercial obligations, as well as for other obligations that are connected with the operation of a nuclear power plant. This Safety Guide is solely concerned with those responsibilities and obligations that are necessary to ensure the safe operation of the nuclear power plant(s) under the control of the operating organization.

1.11. This Safety Guide addresses the commissioning, operation and preparation for decommissioning stages of a nuclear power plant. The role of the operating organization in the siting, design, manufacturing and construction of a nuclear power plant is outside the scope of this Safety Guide.

STRUCTURE

1.12. Recommendations on determining the structure of the operating organization and establishing the management system are provided in Section 2. Section 3

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[1] INTERNATIONAL ATOMIC ENERGY AGENCY, The Operating Organization for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.4, IAEA, Vienna (2001).

provides recommendations on determining the functions, responsibilities, goals and objectives of the operating organization to ensure the safe operation of a nuclear power plant. Recommendations on managing the interfaces between the operating organization and external organizations are provided in Section 4. Section 5 provides recommendations relating to management for safety. Recommendations on internal and external communication and on liaison relevant to implementing an effective management system within the operating organization are provided in Section 6. Section 7 provides recommendations on the establishment of management programmes[2] by the operating organization. The Annex gives examples of tools that can be used by the operating organization to enable continuous improvement of operations at a nuclear power plant.

2. ORGANIZATIONAL STRUCTURE

THE OPERATING ORGANIZATION OF A NUCLEAR POWER PLANT

2.1. The term 'operating organization' is defined as any organization or person applying for authorization or authorized to operate an authorized facility or to conduct an authorized activity and responsible for its safety [10]. For the purposes of this Safety Guide, the term 'operating organization' is used to designate a company or utility that is authorized to operate one or more nuclear power plants.

2.2. The operating organization is required to be authorized to operate a nuclear power plant through a licensing system that has been established in accordance with the national regulatory framework. Requirements for such a framework, including the authorization and licensing of operating organizations, are established in IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [11].

MANAGEMENT SYSTEM FOR A NUCLEAR POWER PLANT

2.3. The operating organization is required to develop, implement, assess and continuously improve a management system, in accordance with the

[2] For the purposes of this Safety Guide, a 'management programme' consists of a systematic application of planning schedules, procedures, reviews and audits supported by appropriate resources to administer a specific management policy.

requirements established in GSR Part 2 [3] and with Requirement 2 of SSR-2/2 (Rev. 1) [1]. Recommendations on the management system for a nuclear power plant are provided in IAEA Safety Standards Series No. GS-G-3.5, The Management System for Nuclear Installations [12].

2.4. As part of the management system, the operating organization is required to define the various functions that are needed for safe operation of a nuclear power plant (see para. 3.2 of SSR-2/2 (Rev. 1) [1]). The operating organization should decide which functions should be performed (i) at the plant site, (ii) off the site but within the operating organization and (iii) outside the operating organization.

2.5. As part of the management system, the operating organization is required to establish policies, lines of responsibility and authority, lines of communication, and review and support activities (see para. 3.2 of SSR-2/2 (Rev. 1) [1]).

2.6. Paragraph 3.11 of SSR-2/2 (Rev. 1) [1] states that "The organization, qualifications and number of operating personnel shall be adequate for the safe and reliable operation of the plant in all operational states and in accident conditions." The staffing of the plant should be regularly reassessed and, if necessary, updated to reflect developments in safe operation.

2.7. The management system should be established well in advance so that the necessary processes (including the recruitment and training of personnel) are implemented for the commissioning stage, and to ensure that all processes are established before the commencement of operation. The management system should form the basis for the initial recruitment and training programme as well as for all such subsequent programmes.

2.8. Paragraph 6.6 of GSR Part 2 [3] states:

> "Senior management shall conduct a review of the management system at planned intervals to confirm its suitability and effectiveness, and its ability to enable the objectives of the organization to be accomplished, with account taken of new requirements and changes in the organization."

STRUCTURE OF THE OPERATING ORGANIZATION

2.9. Requirement 3 of SSR-2/2 (Rev. 1) [1] states that "**The structure of the operating organization and the functions, roles and responsibilities of its personnel shall be established and documented.**"

2.10. The factors to be considered in determining the structure of the operating organization of a nuclear power plant and its staffing requirements include the following:

(a) The need to ensure that structures, systems and components important to safety remain in accordance with the design requirements;
(b) The need for radiation protection arrangements and related provisions for medical surveillance, in accordance with the requirements established in IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [13];
(c) The need to ensure the fulfilment of fundamental safety functions in all plant states, as described in Requirement 4 of SSR-2/1 (Rev. 1) [2], that is (i) control of reactivity, (ii) removal of heat from the reactor and from the fuel store, and (iii) confinement of radioactive material, shielding against radiation and control of planned radioactive releases, as well as limitation of accidental radioactive releases;
(d) The need for design, construction, operation and plant modifications to be thoroughly analysed and reviewed, in accordance with the relevant requirements of SSR-2/1 (Rev. 1) [2] and SSR-2/2 (Rev. 1) [1];
(e) The need to be prepared for a nuclear or radiological emergency and to coordinate emergency plans with those of the regulatory body, public authorities and other response organizations, in accordance with the requirements established in IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency [14];
(f) The need to minimize and control radioactive releases and waste arisings and provide for environmental surveillance, in accordance with paras 5.11 and 5.17–5.20 of SSR-2/2 (Rev. 1) [1];
(g) The need to control access to the plant and to certain areas within the site in order to ensure protection and safety, and also for nuclear security purposes (see para. 5.1 of SSR-2/2 (Rev. 1) [1]);
(h) The need to conduct activities affecting items important to safety in accordance with the management system (see paras 2.3–2.8), including the need to verify whether such activities have been performed as specified;
(i) The need for training and retraining operating personnel and contractors to achieve and maintain an adequate level of competence, in accordance with Requirement 7 of SSR-2/2 (Rev. 1) [1];
(j) The need to consider factors that might affect human performance (see para. 4.29 of SSR-2/2 (Rev. 1) [1]), so that work can be carried out safely and satisfactorily without imposing unnecessary physical or psychological demands on operating personnel;

(k) The need to ensure that attitude towards safety is one of the selection criteria for recruiting staff, appraising staff performance and promoting managers (see para. 5.2 of GSR Part 2 [3]);
(l) The need to know and understand regulatory requirements, make proposals to meet these requirements, and implement them in a timely manner (see also para. 3.7 of SSR-2/2 (Rev. 1) [1]);
(m) The need to set up a system of formal communication with the regulatory body (see paras 3.3 and 3.7 of SSR-2/2 (Rev. 1) [1]);
(n) The need for additional personnel and facilities for activities such as maintenance, fuel management, chemistry control, surveillance, in-service inspection and monitoring, plant modifications and procurement of special items (see Refs [4–9]);
(o) The need for operating experience feedback and review (in accordance with Requirement 24 of SSR-2/2 (Rev. 1) [1]), so that appropriate actions can be taken;
(p) The need to ensure an open exchange of information both upward and downward within the organization;
(q) The need for technical services and expertise (see Requirement 13 of GSR Part 1 (Rev. 1) [11]), including for emergency preparedness and response;
(r) The need to ensure that personnel involved in the monitoring and review of safety performance have sufficient independence from costs and schedules, in accordance with para. 4.36 of SSR-2/2 (Rev. 1) [1].

2.11. The document describing the organizational structure should indicate the staffing arrangements in terms of direct operating personnel and support personnel. Clear lines of authority are required to be established to deal with matters bearing on plant safety in all plant states (see para. 3.8 of SSR-2/2 (Rev. 1) [1]). The extent to which the support functions are self-sufficient or dependent on services from outside the operating organization should be described by means of organizational charts that include personnel resource allocations and specify the duties and responsibilities of key personnel (see also para. 3.6 of SSR-2/2 (Rev. 1) [1]).

2.12. The descriptions of the structure of the operating organization, the lines of responsibility, authority and communication, as well as the functions to be performed by individual departments (and by individuals in those departments, as appropriate) should be unambiguous and should leave no scope for improvisation in any operational state or in accident conditions. Functions to be performed by external organizations or consultants should also be described, together with the related lines of communication and authority.

2.13. The response time for obtaining services from off the site should be taken into account in determining the structure of the operating organization.

2.14. Job descriptions or equivalent information should be used to supplement the organizational chart. Job descriptions should clearly define the authorities, responsibilities and competences and qualification for each job or category of job within the operating organization as a whole, and within individual departments in the plant.

2.15. Job descriptions should form the basis for defining qualification and training needs for personnel, in accordance with Requirement 7 of SSR-2/2 (Rev. 1) [1]. Further recommendations on the recruitment and selection of personnel are provided in SSG-75 [8].

2.16. Paragraph 3.9 of SSR-2/2 (Rev. 1) [1] states:

> "Proposed organizational changes to the structure and associated arrangements, which might be of importance to safety, shall be analysed in advance by the operating organization. Where so required by the State's regulations, proposals for such organizational changes shall be submitted to the regulatory body for approval."

Organizational changes are required to be part of the modification programme for a nuclear power plant, in accordance with para. 4.39 of SSR-2/2 (Rev. 1) [1]. These changes should be monitored during and after implementation to ensure that they are not detrimental to safety.

2.17. For significant organizational changes, an implementation plan should be drawn up to scrutinize their effects on safety in order to ensure that any changes in the organizational structure are properly considered in terms of safety before being implemented (see para. 4.40 of SSR-2/2 (Rev. 1) [1]). For such changes, independent internal review may also be necessary. Further recommendations on organizational changes are provided in SSG-71 [5].

2.18. When there are several operating organizations within a State, these operating organizations are required to establish arrangements for an effective exchange of operating experience (see para. 5.27 of SSR-2/2 (Rev. 1) [1]).

2.19. In developing its organizational structure, the operating organization should take into account the characteristics (e.g. central, federal, regional) of the national governmental, legal and regulatory framework.

3. FUNCTIONS AND RESPONSIBILITIES OF THE OPERATING ORGANIZATION OF A NUCLEAR POWER PLANT

FUNCTIONS OF THE OPERATING ORGANIZATION

3.1. In establishing the structure of the operating organization, consideration should be given to the functions of the management system, which is required to include activities in the following areas (see para. 3.2 of SSR-2/2 (Rev. 1) [1]):

(a) Policy making functions for all areas of safety;
(b) Allocation of responsibilities with corresponding lines of authority and communication;
(c) Operating functions;
(d) Support activities;
(e) Review activities;
(f) Design integrity.

RESPONSIBILITIES OF THE OPERATING ORGANIZATION

3.2. The operating organization has the following main responsibilities:

(a) Ensuring safe operation of the plant by implementing an integrated management system, establishing an adequate organizational structure, and allocating responsibilities and delegating authority within the organization, in accordance with Requirements 1–4 of SSR-2/2 (Rev. 1) [1].
(b) Establishing a safety policy, implementing operational policies, and developing and applying safety performance standards, in accordance with Requirement 5 of SSR-2/2 (Rev. 1) [1].
(c) Establishing and implementing a staff health policy that addresses fitness for duty and aspects such as abuse of alcohol and drugs, in accordance with para. 3.13 of SSR-2/2 (Rev. 1) [1]. This policy should apply to all employees and contractors, as well as to visitors, to the extent possible.
(d) Establishing liaison with the regulatory body and other authorities for the purposes of considering, understanding and ensuring compliance with regulatory requirements (see para. 3.7 of SSR-2/2 (Rev. 1) [1]).
(e) Maintaining liaison with design, construction, commissioning, manufacturing and other organizations involved with the nuclear power

plant(s), to ensure proper transfer and understanding of the plant design bases, requirements, assumptions and intent, as well as information and operating experience, in accordance with para. 5.32 of SSR-2/2 (Rev. 1) [1].

(f) Providing resources and support to plant management, in accordance with para. 3.8 of SSR-2/2 (Rev. 1) [1].

(g) Interacting with interested parties, in accordance with Requirement 5 of GSR Part 2 [3].

(h) Ensuring the collection, evaluation, implementation and dissemination of operating experience, in accordance with Requirement 24 of SSR-2/2 (Rev. 1) [1].

(i) Ensuring that safety is taken into account in decision making and is not compromised by any decisions taken, in accordance with para. 4.9(d) of GSR Part 2 [3].

(j) Establishing and assigning responsibilities for an accident management programme, in accordance with Requirement 19 of SSR-2/2 (Rev. 1) [1].

(k) Establishing and assigning responsibilities for an emergency plan, in accordance with Requirement 18 of SSR-2/2 (Rev. 1) [1], and ensuring an adequate level of emergency preparedness and response, in accordance with the requirements established in GSR Part 7 [14].

3.3. When the operating organization accepts control over a nuclear power plant, it becomes completely in charge of safety at the plant. Paragraph 3.1 of SSR-2/2 (Rev. 1) [1] states:

> "The prime responsibility for safety shall be assigned to the operating organization of the nuclear power plant. This prime responsibility shall cover all the activities relating to the operation directly and indirectly. It includes the responsibility for supervising the activities of all other related groups, such as designers, suppliers, manufacturers and constructors, employers and contractors, as well as the responsibility for operation of nuclear power plant(s) by the operating organization itself."

3.4. Paragraph 3.8 of SSR-2/2 (Rev. 1) [1] states that "Authority for the safe operation of the plant may be delegated to the plant management. In this case, the necessary resources and support shall be provided." Within the operating organization, the powers of authority that are delegated should be specified within the management system.

3.5. As noted in para. 3.2(b), the operating organization is required to establish safety performance standards and should effectively communicate these standards

throughout the organization. All levels of management should promote and expect consistent adherence to these performance standards.

3.6. The operating organization is responsible for providing equipment, staff, procedures, training and management programmes necessary for the safe operation of the plant, including the fostering of an environment in which individuals accept personal accountability for safety (see para. 5.2 of GSR Part 2 [3]).

RESPONSIBILITIES OF THE PLANT MANAGEMENT

3.7. The responsibilities of the plant management include implementing the safety policy of the operating organization, fostering and sustaining a strong safety culture, and controlling and verifying safety related activities. Line managers should be responsible for the safety of all operations under their control.

3.8. Requirement 9 of GSR Part 2 [3] states that "**Senior management shall determine the competences and resources necessary to carry out the activities of the organization safely and shall provide them.**"

3.9. The most senior member of the operating organization on the site is the plant manager (sometimes called the station superintendent). The plant manager is the representative of the operating organization on the site and has the overall responsibility for the safe and reliable day-to-day operation of the plant. Depending on the structure of the operating organization, the plant manager may also be responsible for the overall coordination of technical support functions, whether performed by on-site personnel or by personnel from off-site departments or external organizations. The plant manager is therefore also responsible for the qualification (including adequate initial and continuing training) of the operating personnel.

3.10. The senior management is responsible for overseeing the implementation of the operational policies of the operating organization (see Requirement 4 of GSR Part 2 [3]) and also the compliance with the regulatory requirements. The plant manager is required to ensure that appropriate interaction with interested parties takes place (see Requirement 5 of GSR Part 2 [3]) and should be involved in public information activities and in maintaining relationships with local authorities.

3.11. The senior management is accountable for ensuring that service providers meet the operating organization's expectations, including compliance with applicable safety requirements, in accordance with para. 4.36 of GSR Part 2 [3]. If services are provided outside the direct control of the plant manager, then the responsibilities of the operating organization and the service provider should be clearly defined.

3.12. Senior management should understand and support the need to develop the leadership, management and technical skills of all personnel involved in plant operations to the extent necessary to perform their assigned tasks. This support should be demonstrated through their own actions and behaviours, and by providing resources, including adequate funds, for programmes for the development of leadership, management and technical skills.

3.13. Managers should regularly conduct tours of the plant to assess and discuss the conduct of operations and compliance with management expectations and objectives.

3.14. The plant management should ensure that personnel are aware of and accept their safety responsibilities, and are aware of how these responsibilities relate to others in the organization.

GOALS AND OBJECTIVES

3.15. Since the operating organization has overall responsibility for the safe operation of its nuclear power plant(s), its management objectives for each plant should ensure the following:

(a) That the approved design enables the plant to be operated safely;
(b) That the plant is being kept in a safe state throughout its life period;
(c) That the plant is tested to demonstrate that design requirements have been met and that the plant can be operated in accordance with the operational limits and conditions, and design assumptions and intent;
(d) That the plant is operated and maintained in accordance with the operational limits and conditions, authorized operating procedures, and the design bases, requirements, assumptions and intent, by a sufficient number of competent persons who are adequately trained to cope with abnormal situations, including accident conditions;
(e) That adequate facilities, services and arrangements are available in a timely manner during normal operation and for responding to anticipated

operational occurrences, design basis accidents and design extension conditions;

(f) That appropriate provisions have been made to provide for the protection of workers and the public, and for protection of the environment, in all plant states.

3.16. Requirement 4 of GSR Part 2 [3] states that "**Senior management shall establish goals, strategies, plans and objectives for the organization that are consistent with the organization's safety policy.**" These goals and objectives should support and complement the overall goals of the operating organization, should be commensurate with the expectations of the management and should address key performance areas of the plant and areas recognized as needing improvement. Suitable goals and objectives should be established at the departmental level to support the goals and objectives for the plant. Departmental goals and objectives should be coordinated to ensure that they are consistent and mutually supportive and reflect the priorities of the plant management.

3.17. Goals and objectives should be stated in terms that allow the measurement of progress and a clear determination of achievement. These goals and objectives should be challenging yet realistic, should be focused on specific improvements in performance and should be limited in number to prevent dilution of efforts in key areas. They should be communicated, understood and supported within all parts of the operating organization that are responsible for their accomplishment.

3.18. Paragraph 4.5 of GSR Part 2 [3] states that "Senior management shall ensure that goals, strategies and plans are periodically reviewed against the safety objectives, and that actions are taken where necessary to address any deviations." Formal reviews of progress should be conducted, and results should be communicated periodically to the personnel of the operating organization.

3.19. Personnel should be held accountable for the achievement of goals and objectives assigned to them and should be recognized for the actions they take to achieve these goals and objectives.

4. INTERFACES WITH EXTERNAL ORGANIZATIONS

INTERFACE WITH THE REGULATORY BODY

4.1. The operational safety of a nuclear power plant is subject to oversight by a regulatory body that is independent of the operating organization. For the achievement of their common objective — the safe operation of the plant — there is a requirement to foster mutual understanding and respect between the regulatory body and the operating organization through a frank, open and yet formal relationship (see para. 4.24 of GSR Part 1 (Rev. 1) [11]).

4.2. Paragraph 3.7 of SSR-2/2 (Rev. 1) [1] states:

> "The operating organization, in accordance with the regulatory requirements, shall submit or make available to the regulatory body all necessary documents and information. The operating organization shall develop and implement a procedure for reporting events to the regulatory body in accordance with the established criteria and the State's regulations. The operating organization shall provide the regulatory body with all necessary assistance to enable it to perform its duties, including enabling unhindered access to the plant and providing documentation."

The procedure for reporting events will also need to be in compliance with the reporting criteria, time frames and processes stipulated by the regulatory body. If any requested access to the plant could have an adverse effect on safety, the operating organization should inform the regulatory body in advance.

INTERFACES WITH EXTERNAL SUPPORT ORGANIZATIONS

4.3. Personnel from external support organizations, including contractors, may be used to perform tasks that are of a specialized or temporary nature for which it is not feasible to use plant employees. The roles and responsibilities of external support organizations (e.g. external maintenance organizations, plant vendors, research institutes and technical support organizations) should be clearly defined and understood. The following are examples of areas where close cooperation between external support organizations and the operating organization is necessary:

(a) Training of operating personnel (see SSG-75 [8]);
(b) Commissioning of the plant (see Requirement 25 of SSR-2/2 (Rev. 1) [1]);

(c) Maintenance and in-service inspection (see SSG-74 [7]);
(d) Technical support during operation of the plant (see para. 5.32 of SSR-2/2 (Rev. 1) [1]);
(e) Preparation of operating procedures and emergency operating procedures (see SSG-70 [4]).

4.4. If external support organizations play a significant role in the operation of a plant, the management system and safety policy for the operating organization need to address their activities. Paragraph 4.3 of SSR-2/2 (Rev. 1) [1] states:

> "Key aspects of the safety policy shall be communicated to external support organizations, including contractors, so that the operating organization's requirements and expectations for the safety related activities of external support organizations, including contractors, will be understood and met."

4.5. Paragraph 3.6 of SSR-2/2 (Rev. 1) [1] states:

> "Responsibility for activities performed by external support organizations, and for their overall control and supervision, rests with the operating organization. The operating organization shall establish a system for the supervision of work performed by support organizations. It shall be the responsibility of the operating organization to ensure that the personnel of external support organizations who perform activities on structures, systems or components important to safety or activities affecting safety are qualified to perform their assigned tasks. The overall contracted activity shall be clearly specified in writing and shall be approved by the operating organization prior to its commencement."

Documented evidence should be obtained to demonstrate that contractors have the necessary qualifications before performing their assigned tasks.

4.6. The operating organization should contain an adequate number of personnel with the knowledge, training and skills necessary to supervise and evaluate the work of contractors. The personnel of the operating organization that supervise contractors or other temporary support staff should be clearly identified.

4.7. Personnel external to the operating organization who are providing a service or advice, although they may be personally or professionally responsible for the quality of the service or advice given, should have no direct authority over plant personnel unless this is specifically granted. The relevant plant management should

always be responsible for making decisions, after giving careful consideration to any specialist advice provided.

4.8. A wide range of contractual arrangements is possible between the operating organization and suppliers, from individual procurement to a turnkey contract, and the operating organization should ensure that it assigns sufficient knowledgeable personnel to manage these processes (see also Requirement 11 of GSR Part 2 [3]).

4.9. For turnkey contracts the supplier plays a more wide-ranging role in the construction and testing of the plant. However, para. 4.34 of GSR Part 2 [3] states that "The organization shall itself retain the competence to specify the scope and standard of a required product or service, and subsequently to assess whether the product or service supplied meets the applicable safety requirements."

INTERFACE WITH THE PUBLIC

4.10. Paragraph 4.1 of SSR-2/2 (Rev. 1) [1] states that "The operational policy established and implemented by the operating organization shall give safety the utmost priority, overriding the demands of production and project schedules." The operating organization should declare this in a publicly issued policy statement.

4.11. The operating organization is required to ensure that interested parties, such as the local population, are informed of radiation risks associated with the plant and that any necessary information relevant to safety is disseminated (see para. 4.7 of GSR Part 2 [3]).

4.12. The operating organization should provide information on the status of the plant to the public in a regular and timely manner. The public should be informed of any significant event on the International Nuclear and Radiological Event Scale (INES) [15] and of any corrective actions taken at the plant.

4.13. The public are required to be provided with clear, objective and understandable information during and after a nuclear or radiological emergency, in accordance with Requirement 10 of GSR Part 7 [14].

5. LEADERSHIP AND MANAGEMENT FOR SAFETY

MANAGEMENT COMMITMENT TO SAFETY

5.1. Requirement 2 of GSR Part 2 [3] states that "**Managers shall demonstrate leadership for safety and commitment to safety.**"

5.2. The starting point of leadership and management for safety is the involvement of the senior management of the operating organization. The lead in safety matters is required to come from the highest levels of management (see Requirements 1–5 of GSR Part 2 [3]).

5.3. The values, expectations and attitudes of managers should be of the highest standard and should permeate the operating organization at every level and extend to external support organizations performing delegated tasks, to ensure that there is no complacency about safety.

5.4. Managers are required to ensure that their actions help develop questioning and learning attitudes toward safety matters (see para. 3.2(c) of GSR Part 2 [3]) and should encourage the open exchange of information both upward and downward within the organization.

SAFETY POLICY

5.5. In accordance with Requirement 5 of SSR-2/2 (Rev. 1) [1], a safety policy is required to be established and implemented by the operating organization. This policy is required to give plant safety the highest priority, overriding the demands of production and project schedules.

5.6. Paragraph 4.1 of SSR-2/2 (Rev. 1) [1] states:

> "The safety policy shall promote a strong safety culture, including a questioning attitude and a commitment to excellent performance in all activities important to safety. Managers shall promote an attitude of safety consciousness among plant staff".

The safety policy should be documented and submitted or made available to the regulatory body and the public.

5.7. The safety policy should be based on maintaining adequate defence in depth during operation of the plant. The independence of each level of defence in depth and adequate reliability of each level should be maintained. Further recommendations are provided in Section 2 of SSG-76 [9].

5.8. To be effective, the safety policy needs the endorsement and active support of senior management. Paragraph 4.2 of SSR-2/2 (Rev. 1) [1] states:

> "Senior management shall communicate the provisions of the safety policy throughout the organization. Safety performance standards shall be developed for all operational activities and shall be applied by all site personnel. All personnel in the organization shall be made aware of the safety policy and of their responsibilities for ensuring safety. The safety performance standards and the expectations of the management for safety performance shall be clearly communicated to all personnel, and it shall be ensured that they are understood by all those involved in their implementation."

The operating organization should adopt or develop safety performance standards that specify expectations for the implementation of the safety policy in different operational areas, such as operation, maintenance, technical support, training and qualification.

5.9. The operating organization is required to ensure that adequate resources are available to implement the safety policy (see Requirement 9 of GSR Part 2 [3]). This includes the necessary plant equipment and tools as well as a sufficient number of competent staff (supplemented as necessary by consultants or contractors, including plant vendors). Sufficient resources should be provided to ensure that activities relating to the implementation of the safety policy can be completed in a safe manner, avoiding undue physical or mental stress on individuals.

PERFORMANCE OF SAFETY RELATED ACTIVITIES

5.10. Requirement 8 of SSR-2/2 (Rev. 1) [1] states:

> "**The operating organization shall ensure that safety related activities are adequately analysed and controlled to ensure that the risks associated with harmful effects of ionizing radiation are kept as low as reasonably achievable.**"

5.11. Safety related activities should be properly planned to ensure that they can be carried out safely and effectively. Suitable and sufficient safety assessments of the potential risks arising from such activities are required (see para. 4.25 of SSR-2/2 (Rev. 1) [1]). The nature of the safety assessment will depend on the safety significance of the proposed activity, and the assessment may be qualitative or quantitative. The purpose of the safety assessment is to identify the acceptability of the proposed activity and the appropriate control measures that are necessary to ensure that protection and safety is optimized. The results of the safety assessment should be incorporated into work instructions or control documentation associated with the activity, for example, the documentation for the permit to work system.

5.12. Appropriate arrangements should be made to ensure that safety related activities are adequately controlled. The level of control required depends on the safety significance of the task (see para. 4.25 of SSR-2/2 (Rev. 1) [1]). Activities with a high level of safety significance should be undertaken by specially authorized persons (see para. 4.16 of SSR-2/2 (Rev. 1) [1]), such as the reactor operator. In addition, certain activities, such as tests and experiments, should be authorized in advance and should involve a specific safety review, a special procedure and the use of a permit to work system. Other control measures that might be implemented include the use of hold points and verification stages during complex tasks and the control of stores items and test equipment.

5.13. All safety related activities are required to be carried out in accordance with written procedures (see para. 4.26 of SSR-2/2 (Rev. 1) [1]). These procedures should describe how the activity can be carried out safely and, where appropriate, identify the steps to be taken in the event of an abnormal situation. The procedures are required to be issued under controlled conditions (see para. 7.4 of SSR-2/2 (Rev. 1) [1]), in accordance with the management system. Further recommendations on operating procedures are provided in SSG-70 [4].

PLANT MODIFICATIONS

5.14. Any proposed plant modifications, including organizational changes, are required to be thoroughly planned (see Requirement 11 of SSR-2/2 (Rev. 1) [1]). The operating organization is required to establish a programme to ensure that modifications are characterized on the basis of their safety significance (see para. 4.39 of SSR-2/2 (Rev. 1) [1]). This programme should ensure that operational limits and conditions are observed, and that applicable codes and standards are followed. Further recommendations on the management of plant modifications are provided in SSG-71 [5].

RECOVERY FROM ABNORMAL SITUATIONS

5.15. Arrangements should be in place to manage situations that are outside normal operating conditions, for example abnormal findings from inspections or special tests. These arrangements should ensure that appropriate control is maintained, and that due consideration is given to safety. Further recommendations on recovery from abnormal situations are provided in SSG-76 [9].

5.16. Requirements on preparedness and response for a nuclear or radiological emergency are established in GSR Part 7 [14].

MONITORING, REVIEW AND CONTINUOUS IMPROVEMENT OF SAFETY PERFORMANCE

5.17. Requirement 9 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish a system for continuous monitoring and periodic review of the safety of the plant and of the performance of the operating organization.**" Senior management should create a working environment that encourages continuous improvement in performance. All personnel of the operating organization should be committed to and involved in the system for continuous monitoring and periodic review of safety. Information on tools for continuous improvement is presented in the Annex.

5.18. Paragraph 4.34 of SSR-2/2 (Rev. 1) [1] states:

> "Self-assessment by the operating organization shall be an integral part of the monitoring and review system. The operating organization shall perform systematic self-assessments to identify achievements and to address any degradation in safety performance."

Further recommendations on measurement, assessment and improvement are provided in Section 6 of GS-G-3.5 [12].

5.19. Self-assessment is an important review mechanism that the operating organization can use to improve safety in the operation of a nuclear power plant. Self-assessment should be a structured, objective and visible procedure (or set of procedures), whereby individuals, groups and managers within an operating organization evaluate the effectiveness of their own operational safety against predetermined targets, goals and other performance expectations. The

self-assessment process should only be considered complete when any corrective actions have been implemented and their adequacy has been confirmed.

5.20. A prioritized, long term plan for systematic self-assessments should be developed. At a minimum, self-assessments should be conducted with respect to programmes and activities that influence safety (including non-radiation-related safety), plant reliability and regulatory compliance.

5.21. Paragraph 4.34 of SSR-2/2 (Rev. 1) [1] states that "Where practicable, suitable objective performance indicators shall be developed and used to enable senior managers to detect and to react to shortcomings and deterioration in the management of safety."

5.22. To monitor safety performance in an effective and objective way, relevant and measurable safety performance indicators should be used. No single performance indicator provides a meaningful measure of the safety of a nuclear power plant; consequently, a range of indicators should be developed and used to provide a representative picture of the overall safety performance of the plant and any trends over time.

5.23. Paragraph 4.33 of SSR-2/2 (Rev. 1) [1] states:

> "An adequate audit and review system shall be established by the operating organization to ensure that the safety policy of the operating organization is being implemented effectively and that lessons are being learned from its own experience and from the experience of others to improve safety performance."

5.24. The operating organization should develop and effectively utilize independent oversight. The purpose of the independent oversight is to verify that the utility has the full capability to perform in a manner that achieves the safety goals through appropriate staffing, processes, activities, actions and monitoring. The independent oversight personnel should be sufficiently independent from the line organization to be capable of providing objective oversight not hindered by line reporting relationships. The independent safety oversight should pay specific attention to verifying that the plant management has taken measures with regard to changes in national regulations and international safety standards, operating experience, and new operating practices and technologies, and has implemented plant modifications as necessary. The independent safety oversight should have a direct reporting line to the senior management of the operating organization. For further guidance on independent oversight, see Ref. [16].

5.25. Senior management should provide the necessary resources to support the independent safety oversight function, and roles, responsibilities and expectations should be clearly established and documented. The effectiveness of independent safety oversight should be periodically evaluated.

5.26. Expertise from both inside and outside the operating organization should be used to support independent safety oversight activities, and individuals should have the necessary experience, training, skills and credibility to perform oversight activities.

5.27. The operating organization should establish a safety committee for the plant (and also at a corporate level, where applicable). The responsibilities, authorities and lines of reporting of the safety committee should be documented. Experts from outside the operating organization who are highly experienced in the operation of nuclear power plants should be involved in the safety committee.

5.28. Monitoring of safety performance is required to include the monitoring of personnel performance and attitudes to safety (see para. 4.35 of SSR-2/2 (Rev. 1) [1]). The plant management should monitor personnel performance and behaviours in their specific jobs or while they are in training for these jobs. Compliance with management expectations (see para. 3.13) should be monitored during these observations to ensure that a high level of safety is being achieved. Essential elements of management observations are coaching and feedback. These elements should be used to reinforce positive behaviour and to identify performance gaps and opportunities for development and improvement. The frequency and scope of management observations should be based on the importance of the equipment and activities to the safe and reliable operation of the plant and on the extent of any problems that have been identified.

5.29. Benchmarking techniques should be used to identify solutions to specific problems, performance gaps (e.g. in terms of human performance, the management system or the conduct of operations) or current industry best practice in a specific area. A system should be implemented for formally monitoring the implementation of actions resulting from such benchmarking activities.

5.30. The plant management should conduct regular performance reviews. Such reviews should involve the review and analysis of a wide variety of information and data, including the following:

(a) Information on corrective actions;
(b) The results of self-assessment and benchmarking;

(c) Data from observations by managers, operating personnel and external organizations;
(d) Data from monitoring of safety performance indicators;
(e) Data from internal reporting systems (e.g. simulator issues, occurrences of personnel contamination);
(f) Reports from independent safety oversight;
(g) Reports from other external reviews.

5.31. Any issues identified through the monitoring and review of safety performance should be evaluated in a manner that is commensurate with their significance to safety, and such issues should be analysed to determine the causes. Trends in safety performance data should be analysed to identify focus areas and to initiate further analysis.

5.32. Paragraph 4.37 of SSR-2/2 (Rev. 1) [1] states:

> "The appropriate corrective actions shall be determined and implemented as a result of the monitoring and review of safety performance. Progress in taking the corrective actions shall be monitored to ensure that actions are completed within the appropriate timescales. The completed corrective actions shall be reviewed to assess whether they have adequately addressed the issues identified in audits and reviews."

5.33. The plant management should communicate the results of the monitoring and review of safety performance to personnel.

6. COMMUNICATION AND LIAISON

COMMUNICATION

6.1. Managers at all levels in the operating organization are required to encourage and cultivate effective communication within the organization (see para. 5.2(c) of GSR Part 2 [3]). Downward communication should help to ensure that the safety policy and the expectations of managers are understood; upward communication should help encourage the reporting of problems directly to the plant management (see para. 3.2(c) of GSR Part 2 [3]). Managers should also encourage horizontal communication to support effective work coordination and collaboration.

6.2. An effective communication strategy and communication plan should be established by the operating organization to explain the safety policy, to effectively implement the management system and to encourage communication about safety throughout the organization. Communication can be either formal or informal, depending on the importance of the information provided. An effective communication strategy should be in place to reinforce teamwork, especially between shifts.

6.3. Appropriate arrangements should be established to promote feedback from individuals on safety concerns. These could include both formal mechanisms such as safety meetings and less formal mechanisms such as feedback via line managers. The operating organization should be open and responsive to constructive criticism and feedback received from operating personnel.

6.4. Good communications should be established with external organizations. In particular, there should be well defined and open routes of communication with the regulatory body and other relevant authorities (see also paras 4.1 and 4.2). Communications with external organizations should also recognize the broader social framework within which the plant operates, including the need for constructive dialogue with trade unions and other groups affected by the plant operation. The operating organization should undertake outreach activities to encourage interactions with interested parties (see Requirement 5 of GSR Part 2 [3]).

6.5. Arrangements should be made to monitor the effectiveness of internal and external communications, and to act promptly to eliminate any identified weaknesses. The communication strategy and communication plan should be periodically reviewed and updated, as necessary.

6.6. Communication with external organizations and with the public during a nuclear or radiological emergency is required to be part of the emergency plan (see paras 7.73–7.78).

6.7. Personnel with specific roles and responsibilities for communication should be suitably trained and should have access to, and ongoing interactions with, senior management.

LIAISON

6.8. Paragraph 3.3 of SSR-2/2 (Rev. 1) [1] states:

> "The operating organization shall establish liaison with the regulatory body and with relevant authorities to ensure a common understanding of, and to ensure compliance with, safety requirements and their interface with other requirements, such as those for security, protection of health or protection of the environment."

6.9. Paragraph 5.32 of SSR-2/2 (Rev. 1) [1] states:

> "The operating organization shall maintain liaison, as appropriate, with support organizations (e.g. manufacturers, research organizations and designers) involved in the design, construction, commissioning and operation of the plant in order to feed back information on operating experience and to obtain advice, if necessary, in the event of equipment failure or in other events."

6.10. This liaison should aim to lead to improvements in the operational aspects of the design of the plant, in the operating procedures and in the planning of research programmes so that they are relevant to the operational needs of the plant.

6.11. Arrangements should be made for the participation of personnel from the operating organization early in the design stage. These arrangements should enable operating organization personnel to make a contribution to improvements in the plant design by using feedback from operating experience. This should also provide an opportunity for these personnel to acquire a detailed knowledge of the plant design and a thorough understanding of the operational limits and conditions for the plant. These personnel should be given the opportunity to consider the following:

(a) The adequacy and redundancy of systems and components to meet operational limits and conditions and other operational requirements;
(b) The general layout of the plant with respect to the convenience and efficiency of operation, particularly in relation to contamination control and to keeping doses as low as reasonably achievable;
(c) Ergonomic aspects, especially to provide for rapid assessment of plant conditions, proper operator response and prevention of inadvertent actions;
(d) The extent of automatic control;

(e) Specifications for components and instrumentation for operational states and accident conditions;
(f) The provisions for handling and disposal of radioactive waste, including for post-accident conditions;
(g) The type and number of spare parts necessary, taking account of procurement times;
(h) The provision of special tooling necessary for repairs and inspection;
(i) The arrangements for maintenance, surveillance and in-service inspection, including access to and availability of equipment and facilities;
(j) The radiation protection arrangements to ensure the optimization of protection and safety as well as compliance with regulatory requirements;
(k) The assessment of on-site and off-site consequences of accident scenarios.

6.12. The operating organization should arrange for the involvement of its staff, particularly operation and maintenance personnel, in construction activities so that they receive hands-on training. This involvement also helps to detect any discrepancies between construction specifications and the methods and techniques actually used, and should also be used in the development of operating and maintenance instructions.

6.13. The operating organization should encourage the participation of operating personnel in the preparation and performance of commissioning tests and in the evaluation of test results. This participation will enable the validation of operating procedures, as required by para. 6.9 of SSR-2/2 (Rev. 1) [1]. The participation of such personnel should also be used to obtain the preliminary operating experience needed to facilitate the transfer of responsibilities from the commissioning group to the operating groups. Such participation might range from the setting up of mixed testing teams (consisting of the supplier and operating personnel) to the complete involvement of the operating organization in a given test. Detailed recommendations on the involvement of operating personnel in testing during the commissioning of the plant are provided in IAEA Safety Standards Series No. SSG-28, Commissioning for Nuclear Power Plants [17].

7. MANAGEMENT OF PLANT OPERATIONS

GENERAL

7.1. In order to undertake the functions and meet the responsibilities listed in Section 3 and to exert effective control over plant operations, the operating organization should establish appropriate documented management programmes and processes. The areas of plant operation to be covered by these management programmes and processes, in accordance with the requirements established in SSR-2/2 (Rev. 1), include the following:

— Staffing[3];
— Operational limits and conditions and operating procedures;
— Qualification and training of personnel;
— Performance of safety related activities (including human performance factors);
— Work control;
— Plant configuration control;
— Plant modifications;
— Periodic safety review;
— Equipment qualification;
— Ageing management;
— Control of records and reports;
— Programme for long term operation;
— Nuclear security and its interface with safety;
— Emergency preparedness and response;
— Accident management;
— Radiation protection;
— Management of radioactive waste;
— Fire safety;
— Non-radiation-related safety;
— Feedback of operating experience;
— Commissioning;
— Material conditions and housekeeping;
— Chemistry;
— Core management and fuel handling;
— Maintenance, testing, surveillance and inspection;

[3] Including for situations where a large number of personnel might be unavailable, such as during an epidemic or a pandemic affecting an area where personnel live.

— Outage management;
— Decommissioning.

7.2. The programmes and processes listed in para. 7.1 should address administrative as well as technical aspects of plant operation and should cover all related activities. These programmes and processes should be available sufficiently in advance to allow the corresponding plant operations to be reviewed and assessed by operating personnel before implementation.

7.3. To ensure that adequate and appropriate practices are followed in implementing the management programmes and processes, the operating organization should make arrangements for the requisite information to be available from designers, manufacturers and other organizations.

7.4. When establishing programmes and processes for the management of plant operations, consideration should be given to the following:

(a) The objectives to be achieved;
(b) The applicable regulatory requirements;
(c) The policies to be implemented;
(d) The allocation of responsibilities and delegation of authority;
(e) The qualification of personnel involved;
(f) The scheduling of activities to be performed;
(g) The services and facilities needed;
(h) The documentation and basic information needed;
(i) Feedback of operating experience;
(j) The need for audits and reviews;
(k) The need to resolve safety problems in a timely manner;
(l) The reports to be produced and the records to be kept;
(m) The information flow needed.

7.5. A prerequisite for implementing these management programmes is the establishment of a comprehensive system of instructions and procedures to cover all relevant technical and administrative aspects. These documents should be prepared by persons with suitable expertise and should be ready for implementation at the start of each programme. This represents a significant workload, which should be taken into account in the recruitment and training programmes. Input from experts in manufacturing, design and construction and from other relevant organizations should be utilized, where appropriate.

7.6. Paragraph 4.27 of SSR-2/2 (Rev. 1) [1] states:

> "If there is a need to conduct a non-routine operation or test that is not covered by existing operating procedures, a specific safety review shall be performed and a special procedure shall be developed and subject to approval in accordance with national or other relevant regulations."

Such operations and procedures should be carefully reviewed by appropriate technical personnel and should be subject to approval by the plant management. Further recommendations on the control of non-routine activities and special tests are provided in SSG-76 [9].

7.7. The operating organization is required to establish a document control system (see Requirement 15 and para. 7.4 of SSR-2/2 (Rev. 1) [1]) to ensure that all documents relevant to safety related activities are issued, distributed, updated, stored and archived in such a manner as to prevent the use of old versions or superseded documents.

STAFFING OF A NUCLEAR POWER PLANT

7.8. Requirement 4 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall be staffed with competent managers and sufficient qualified personnel for the safe operation of the plant.**"

7.9. Paragraph 3.11 of SSR-2/2 (Rev. 1) [1] states that "A long term staffing plan aligned to the long term objectives of the operating organization shall be developed in anticipation of the future needs of the operating organization for personnel and skills."

7.10. The staffing programme should be reviewed and updated periodically to ensure that it is consistent with and supports long term objectives. The staffing programme should address the development of professional and managerial skills and experience, and take into account losses of personnel and their knowledge due to retirement and other reasons. The long term staffing plan should allow sufficient time for the transfer of responsibilities to new personnel, and thereby facilitate continuity in the conduct of duties.

7.11. The staffing of the plant should be based on the functions and responsibilities of the operating organization, as described in Section 3. A detailed analysis of tasks and activities to be performed should be made to determine the staffing and

qualification needs at different levels in the organization. This analysis should also be used to determine the recruitment, training and retraining needs for the plant (see paras 7.12–7.18).

7.12. Staffing arrangements should take into account the following:

(a) The need for the operating organization to be involved in the review of activities before operation of the plant (i.e. during the design, construction and commissioning stages);
(b) The need to establish timely liaison with the regulatory body and other authorities and organizations;
(c) The minimum number of personnel necessary in all operational states and accident conditions, while ensuring that excessive loads are not placed on individual personnel;
(d) The need, particularly in the case of remotely located plants, for adequate expertise, special equipment and spare parts to be available on the site for dealing with accident conditions until such time as they are augmented from off-site sources;
(e) The national legal requirements on working conditions;
(f) The rate at which personnel are expected to be replaced in the operating organization;
(g) Long term human resource needs for future projects;
(h) The policy of the operating organization with respect to maintenance and other functions (e.g. the extent of maintenance carried out on each shift, the extent to which contractors are used, repair versus replacement of components, centralized workshops);
(i) The need for training and retraining of personnel.

7.13. The operating organization should establish the necessary arrangements to ensure the safety of personnel and the safe operation of the nuclear power plant during situations in which a large number of personnel might be unavailable, such as during an epidemic or a pandemic affecting areas in which personnel live. Such arrangements should include the following:

(a) Retaining a minimum number of qualified personnel on the site to ensure safe operation of the plant;
(b) Ensuring that a minimum number of qualified backup personnel remain available off the site;
(c) Adapting means of communication and transportation for personnel, arranging the delivery of food and water to the site, and providing for beds and essential hygiene on the site;

(d) Establishing additional measures to prevent the spread of an infection on the site, in accordance with national and international guidance (e.g. cancelling in-person meetings, adapting controls at the entrance to the site, maintaining appropriate physical distance between individuals, mandating the wearing of face masks);
(e) Enabling remote working for non-essential personnel and maintaining regular contact with those personnel who are off the site by phone or videoconference.

7.14. The operating organization should take pre-emptive action to put the plant into a stable condition if it is judged likely that insufficient personnel would be available to ensure the safety of the plant in case of anticipated operational occurrences or accident conditions. The operating organization should develop plans in anticipation of such events and should demonstrate the effectiveness of these plans.

7.15. Recruitment should start early enough to permit the establishment and proper implementation of selection methods and the timely availability of personnel for preparatory training. This should also enable relevant personnel to be involved in the commissioning stage and, if practicable, in the construction stage. Further recommendations on the recruitment and selection of plant personnel are provided in SSG-75 [8].

QUALIFICATIONS AND TRAINING OF NUCLEAR POWER PLANT PERSONNEL

7.16. Requirement 7 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall ensure that all activities that may affect safety are performed by suitably qualified and competent persons.**"

7.17. Paragraph 4.19 of SSR-2/2 (Rev. 1) [1] states:

> "A suitable training programme shall be established and maintained for the training of personnel before their assignment to safety related duties. The training programme shall include provision for periodic confirmation of the competence of personnel and for refresher training on a regular basis."

This programme should ensure that the needs of the operating organization are evaluated and that the requirements for qualification for positions in the organization are established.

7.18. Further recommendations on the establishment and implementation of a training and qualification programme for nuclear power plant personnel are provided in SSG-75 [8].

COMMISSIONING

7.19. Requirement 25 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall ensure that a commissioning programme for the plant is established and implemented.**"

7.20. Paragraph 6.1 of SSR-2/2 (Rev. 1) [1] states:

> "The commissioning programme for the plant shall cover the full range of plant conditions required in the design and the safety case. The results shall be used to demonstrate that the behaviour of the plant as built is in compliance with the design assumptions and the licence conditions."

7.21. Paragraph 6.13 of SSR-2/2 (Rev. 1) [1] states that "Authorities and responsibilities shall be clearly specified and shall be delegated to the individuals and groups performing the commissioning activities." The division of the roles and responsibilities during commissioning — in particular for plant operation while performing commissioning tests — between the commissioning organization and the operating organization should be clearly defined.

7.22. Further recommendations on the establishment and implementation of the commissioning programme are provided in SSG-28 [17].

OPERATIONAL LIMITS AND CONDITIONS AND OPERATING PROCEDURES

7.23. Requirement 6 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall ensure that the plant is operated in accordance with the set of operational limits and conditions.**"

7.24. Requirement 26 of SSR-2/2 (Rev. 1) [1] states:

> "**Operating procedures shall be developed that apply comprehensively (for the reactor and its associated facilities) for normal operation, anticipated operational occurrences and accident conditions, in**

accordance with the policy of the operating organization and the requirements of the regulatory body."

7.25. Paragraph 7.4 of SSR-2/2 (Rev. 1) [1] states:

> "Operating procedures and supporting documentation shall be issued under controlled conditions, and shall be subject to approval and periodically reviewed and revised as necessary to ensure their adequacy and effectiveness. Procedures shall be updated in a timely manner in the light of operating experience and the actual plant configuration."

In developing operating procedures, consideration should be given to the eventual decommissioning of the plant.

7.26. Further recommendations on operational limits and conditions and operating procedures are provided in SSG-70 [4].

OPERATIONS BY SHIFT TEAMS

7.27. Regardless of the extent of automation, the final decisions and responsibilities for the operation of the plant should rest with operating personnel. The operating organization is required to establish shift teams to ensure continuous safe operation of the plant (see para. 3.12 of SSR-2/2 (Rev. 1) [1]). Examples of the tasks to be performed by the shift teams include the following:

(a) Normal operation:
  (i) Maintaining the existing mode of operation of the reactor;
  (ii) Changing the mode of operation of the reactor;
  (iii) Monitoring whether plant parameters displayed in the control room are in the normal range;
  (iv) Undertaking plant walkdowns and monitoring whether there are any indications of deviations from normal operation;
  (v) Issuing work permits and preparing working conditions by isolation of structures, systems or components or modification of their configurations;
  (vi) Cancelling work permits and restoring normal plant conditions by returning structures, systems or components into service or into normal configurations;
  (vii) Keeping operational records and making reports in accordance with the management system for the plant.

(b) Anticipated operational occurrences:
    (i) Monitoring the status of the plant when any deviation from normal operation is detected, and verifying that the plant is responding to the situation as designed;
    (ii) Taking corrective actions in accordance with operating procedures if it is determined that the plant is not responding properly;
    (iii) Putting the plant in a safe state and maintaining it in this condition until a comprehensive analysis of the causes of the deviation is completed.
(c) Accident conditions:
    (i) Implementing the provisions of the accident management programme and emergency plan, as appropriate.

7.28. Further recommendations on shift teams are provided in SSG-76 [9].

MAINTENANCE AND OUTAGE MANAGEMENT

7.29. Requirement 31 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall ensure that effective programmes for maintenance, testing, surveillance and inspection are established and implemented.**"

7.30. Requirement 32 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and implement arrangements to ensure the effective performance, planning and control of work activities during outages.**"

7.31. The maintenance programme should ensure that the levels of reliability and effectiveness of all plant structures, systems and components important to safety remain in accordance with the current plant safety analysis report, and that the safety of the plant is not degraded after the commencement of operation. The results of periodic safety reviews should be incorporated into the maintenance programme.

7.32. Paragraph 8.9 of SSR-2/2 (Rev. 1) [1] states that "An adequate work control system shall be established for the protection and safety of personnel and for the protection of equipment during maintenance, testing, surveillance and inspection."

7.33. Further recommendations on the maintenance programme for nuclear power plants are provided in SSG-74 [7].

IN-SERVICE INSPECTION

7.34. In-service inspection should be used to assess whether items important to safety are in an acceptable condition for continued safe operation of the plant or whether corrective actions are necessary. Emphasis should be placed on examining important systems and components of the primary reactor coolant system because of their importance to safety and the possible severity of the consequence of failures.

7.35. The results of probabilistic safety assessment could be used to implement a risk-informed approach to in-service inspection and to support decision making. Recommendations are provided in IAEA Safety Standards Series No. SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants [18].

SURVEILLANCE

7.36. Paragraph 8.2 of SSR-2/2 (Rev. 1) [1] states:

> "The operating organization shall establish surveillance programmes for ensuring compliance with established operational limits and conditions and for detecting and correcting any abnormal condition before it can give rise to significant consequences for safety."

7.37. The surveillance programmes should ensure that items important to safety continue to perform in accordance with the valid design documentation. Such programmes should incorporate the results of probabilistic safety assessment and feedback from operating experience. The programmes should include evaluations and reviews to detect in a timely manner the degradation and ageing of structures, systems and components that could lead to unsafe conditions. These programmes should include monitoring, checks and calibrations, and testing and inspections that complement in-service inspection.

7.38. Surveillance programmes should be developed sufficiently in advance of plant commissioning to permit these programmes to be properly implemented as plant items become operational during the commissioning stage, and to ensure that the safety of the plant is not dependent on untested or unmonitored structures, systems and components. Further recommendations on the surveillance programme are provided in SSG-74 [7].

EQUIPMENT QUALIFICATION

7.39. Requirement 30 of SSR-2/1 (Rev. 1) [2] states:

> "**A qualification programme for items important to safety shall be implemented to verify that items important to safety at a nuclear power plant are capable of performing their intended functions when necessary, and in the prevailing environmental conditions, throughout their design life, with due account taken of plant conditions during maintenance and testing.**"

7.40. The equipment qualification programme should cover all aspects of the qualification process and all related activities that are necessary to establish and preserve the status of qualified equipment.

7.41. The equipment qualification programme should address all topics affecting the suitability of the system or component for its intended functions important to safety, including the following:

(a) Environmental qualification (e.g. qualification for vibration, temperature, pressure, humidity, chemical exposure, radiation, submergence, electromagnetic phenomena, ageing mechanisms);
(b) Electromagnetic qualification;
(c) Qualification for the effects of internal and external hazards.

7.42. The equipment qualification programme should be periodically reviewed to determine whether plant equipment important to safety has been properly qualified, and whether this qualification is being maintained through an adequate programme of maintenance, inspection and testing that provides confidence in the fulfilment of safety functions until at least the next review. Configuration management procedures should be applied to ensure that equipment qualification implications are appropriately considered whenever changes occur to maintenance, surveillance or in-service inspection activities.

7.43. The equipment qualification programme should take into account plant and equipment modifications, equipment repairs and refurbishment, equipment failures and replacements, any abnormal operating conditions and changes in the results of the safety analysis.

7.44. Operating experience feedback on unanticipated changes in service conditions or equipment performance, and data from the monitoring equipment

and its environment, should be used to support the ongoing qualification of installed equipment.

7.45. Further recommendations on equipment qualification programmes are provided in SSG-71 [5], SSG-74 [7] and IAEA Safety Standards Series No. SSG-69, Equipment Qualification for Nuclear Installations [19].

CORE MANAGEMENT AND FUEL HANDLING

7.46. Requirement 30 of SSR-2/2 (Rev. 1) states that "**The operating organization shall be responsible and shall make arrangements for all activities associated with core management and with on-site fuel handling.**"

7.47. The fuel management programme should address those activities that facilitate optimum reactor core operation without compromising the limits imposed by the safety design of the fuel and the plant as a whole.

7.48. Paragraphs 7.18–7.29 of SSR-2/2 (Rev. 1) [1] establish requirements for fuel manufacture and procurement, core management (including a reactivity management programme), fuel storage and the handling, movement and transport of fuel.

7.49. Further recommendations on core management and fuel handling are provided in SSG-73 [6].

CHEMISTRY PROGRAMME

7.50. Requirement 29 of SSR-2/2 (Rev. 1) states that "**The operating organization shall establish and implement a chemistry programme to provide the necessary support for chemistry and radiochemistry.**"

7.51. Paragraph 7.13 of SSR-2/2 (Rev. 1) states:

> "The chemistry programme shall provide the necessary information and assistance for chemistry and radiochemistry for ensuring safe operation, long term integrity of structures, systems and components, and minimization of radiation levels."

7.52. The chemistry programme should include monitoring, analyses, instructions for operations involving chemical processes and the evaluation of operating results. The chemical and radiochemical activities may include environmental monitoring, in particular when the activities relating to chemistry and radiation protection are performed by the same group of personnel. Further recommendations are provided in IAEA Safety Standards Series No. SSG-13, Chemistry Programme for Water Cooled Nuclear Power Plants [20].

SAFETY ASSESMENT AND PERIODIC SAFETY REVIEW

7.53. Requirement 12 of SSR-2/2 (Rev. 1) states:

> "**Systematic safety assessments of the plant, in accordance with the regulatory requirements, shall be performed by the operating organization throughout the plant's operating lifetime, with due account taken of operating experience and significant new safety related information from all relevant sources.**"

These safety assessments should be implemented by a safety review group or by independent reviewers to provide an independent evaluation of plant safety. The safety assessments might include reviews of the following:

(a) The safety performance of the plant and personnel (including the safety performance indicators; see para. 5.22);
(b) Operational limits and conditions and operating procedures (and their modifications);
(c) Maintenance, surveillance and in-service inspection programmes;
(d) Deviations from operational limits and conditions and operation outside the operational limits and conditions;
(e) Events leading to unplanned shutdown and other anticipated operational occurrences;
(f) Accidents, malfunctions and failures (and precursors);
(g) The cumulative effects on safety of equipment failures and modifications, including temporary modifications;
(h) The effects of modifications and related testing plans;
(i) Non-routine activities and special tests;
(j) The safety of outages;

(k) The effectiveness of the management system and its implementation against the best international practices, and the effects of changes to the management system, including organizational changes;
(l) The implementation of corrective actions based on audits and reviews.

7.54. Safety reviews should be conducted in sufficient depth to ensure that all issues and questions raised by the review can be satisfactorily resolved. Safety reviews should be performed by personnel who have sufficient qualifications, experience, expertise and training to perform a thorough safety assessment.

7.55. As noted in para. 7.53, periodic safety reviews are required to be performed throughout the operating lifetime of the plant. The results of periodic safety reviews should be used, for example, for the following purposes:

(a) To confirm that the nuclear power plant (or individual items within the plant) can be operated safely for a defined period of future operation;
(b) To identify and evaluate factors that could limit safe operation during the defined period;
(c) To revise the existing safety analysis report to meet current national and international codes and standards and to reflect operating experience;
(d) To provide input to long term operation studies;
(e) To support the decision making process for licence renewal and/or for long term operation.

7.56. The scope and frequency of a periodic safety review should either be specified by the regulatory body or be developed by the operating organization and agreed with the regulatory body. Further recommendations are provided in IAEA Safety Standards Series No. SSG-25, Periodic Safety Review for Nuclear Power Plants [21].

NUCLEAR SECURITY

7.57. Requirement 17 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall ensure that the implementation of safety requirements and security requirements satisfies both safety objectives and security objectives.**"

7.58. Nuclear safety measures and security measures have the common aim of protecting people, society and the environment from radiological hazards. Paragraph 5.1 of SSR-2/2 (Rev. 1) [1] states:

> "Security and safety shall be viewed as complementary, as many of the measures designed to ensure one will also serve to ensure the other. Safety and security measures shall be designed and implemented in such a manner that they do not compromise each other. The operating organization shall establish mechanisms to resolve potential conflicts and to manage safety–security interfaces."

7.59. Guidance on the nuclear security of nuclear power plants and nuclear materials is provided in the IAEA Nuclear Security Series, in particular in Refs [22–25].

RADIATION PROTECTION

7.60. Requirement 20 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and implement a radiation protection programme.**" The arrangements to be addressed by the radiation protection programme are specified in Requirement 24 of GSR Part 3 [13]. The radiation protection programme should also include arrangements for the assessment of occupational exposure, in accordance with Requirement 25 of GSR Part 3 [13].

7.61. Paragraph 5.11 of SSR-2/2 (Rev. 1) [1] states:

> "The radiation protection programme shall ensure that for all operational states, doses due to exposure to ionizing radiation at the plant or doses due to any planned radioactive releases (discharges) from the plant are kept below authorized limits and are as low as reasonably achievable."

7.62. With regard to the radiation protection programme at a nuclear power plant, appropriate independent advice should be provided on the following:

(a) The specifications for approved dosimetry service laboratories and for environmental monitoring laboratories;
(b) Radiation protection during commissioning and operation, including during accident conditions;
(c) Evaluation of operating experience from radiation protection activities;
(d) The radiation protection aspects of plant modifications;

(e) The development of techniques and equipment to reduce occupational exposure;
(f) Methods for providing evidence of compliance with regulatory requirements in relation to the discharge of radioactive effluents, the transport of radioactive material and on-site management of contaminated waste (e.g. by incineration).

7.63. If the operating organization is responsible for a number of plants and uses mobile teams of personnel for certain functions, individual occupational exposures should be recorded using a central record keeping system. Similar arrangements should be applied if contractors or personnel from other outside agencies are used extensively.

7.64. Suitable facilities should be made available so that the required medical examinations of operating personnel (see para. 5.15 of SSR-2/2 (Rev. 1) [1]) can be performed and specific medical advice can be provided. Provision should be made for additional medical facilities and support that might be necessary as a result of accident conditions.

NON-RADIATION-RELATED SAFETY

7.65. Requirement 23 of SSR-2/2 (Rev. 1) [1] states:

> "**The operating organization shall establish and implement a programme to ensure that safety related risks associated with non-radiation-related hazards to personnel involved in activities at the plant are kept as low as reasonably achievable.**"

7.66. The non-radiation-related safety programme should ensure that risks to personnel involved in plant activities are adequately controlled. The programme should include arrangements for the planning, organization, implementation, monitoring and review of appropriate preventive measures and protective measures. The operating organization should provide support, guidance and assistance for plant personnel in the area of non-radiation-related safety.

7.67. The operating organization should assign responsibilities to the personnel for implementing and supervising the non-radiation-related safety programme.

7.68. Paragraph 5.26 of SSR-2/2 (Rev. 1) [1] states:

> "All personnel, suppliers, contractors and visitors (where appropriate) shall be trained and shall possess the necessary knowledge of the non-radiation-related safety programme and its interface with the nuclear and radiation safety programme, and shall comply with its safety rules and practices."

MANAGEMENT OF RADIOACTIVE WASTE

7.69. Requirement 21 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and implement a programme for the management of radioactive waste.**"

7.70. An effluent monitoring programme is required, to ensure that planned radioactive releases (gaseous and liquid) from the nuclear power plant are satisfactorily controlled (see para. 5.19 of SSR-2/2 (Rev. 1) [1]).

7.71. Paragraph 5.17 of SSR-2/2 (Rev. 1) [1] states that "Adequate operating practices shall be implemented to ensure that the generation of radioactive waste is kept to the minimum practicable in terms of both activity and volume."

7.72. Further recommendations are provided in IAEA Safety Standards Series No. SSG-40, Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors [26].

EMERGENCY PREPAREDNESS

7.73. Requirement 18 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall prepare an emergency plan for preparedness for, and response to, a nuclear or radiological emergency.**"

7.74. Paragraph 5.3 of SSR-2/2 (Rev. 1) [1] states:

> "The operating organization shall develop an emergency plan and shall establish the necessary organizational structure, with assigned responsibilities for managing an emergency, and shall contribute to the development of off-site emergency procedures."

7.75. In accordance with GSR Part 7 [14], the emergency plan is required to include arrangements for the following:

(a) The timely identification, classification, declaration and notification of a nuclear or radiological emergency;
(b) Alerting and activation of sufficient trained and qualified personnel to manage the response, to take mitigatory actions, to assess the emergency, to protect people on the site, including emergency workers, and to provide sufficient information for an effective off-site response;
(c) Coordination between the response on the site and the response by off-site response organizations;
(d) The provision of sufficient information for an effective off-site response.

7.76. The emergency plan should also include any actions to be undertaken by the operating organization to help meet the obligations of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [27].

7.77. The roles and responsibilities of contractors who might be working at a nuclear power plant in an emergency should be defined before the commencement of fuel loading. Any contractors who might have a role and responsibilities in emergency response are required to be designated as emergency workers in advance, and appropriate arrangements for their protection, including training, are required to be provided (see Requirement 11 of GSR Part 7 [14]).

7.78. Further recommendations on emergency preparedness and response are provided in IAEA Safety Standards Series No. GS-G-2.1, Arrangements for Preparedness for a Nuclear or Radiological Emergency [28].

ACCIDENT MANAGEMENT

7.79. Requirement 19 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish, and shall periodically review and as necessary revise, an accident management programme.**"

7.80. Paragraph 5.8 of SSR-2/2 (Rev. 1) [1] states:

> "An accident management programme shall be established that covers the preparatory measures, procedures and guidelines, and equipment that are necessary for preventing the progression of accidents, including

accidents more severe than design basis accidents, and for mitigating their consequences if they do occur."

In establishing the accident management programme, the operating organization should consider the risks associated with low probability but high consequence events that could lead to core damage and/or the release and dispersion of radioactive material outside the plant.

7.81. Further recommendations are provided in IAEA Safety Standards Series No. SSG-54, Accident Management Programmes for Nuclear Power Plants [29].

FIRE SAFETY

7.82. Requirement 22 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall make arrangements for ensuring fire safety**."

7.83. Paragraph 5.21 of SSR-2/2 (Rev. 1) [1] states:

"The arrangements for ensuring fire safety made by the operating organization…shall include, but are not limited to:

(a) Application of the principle of defence in depth;
(b) Control of combustible materials and ignition sources, in particular during outages;
(c) Inspection, maintenance and testing of fire protection measures;
(d) Establishment of a manual firefighting capability;
(e) Assignment of responsibilities and training and exercising of plant personnel;
(f) Assessment of the impact of plant modifications on fire safety measures."

These arrangements should be made on the basis of the fire hazard analysis, which is required to be periodically reviewed and updated (see para. 5.22 of SSR-2/2 (Rev. 1) [1]).

7.84. Further recommendations are provided in IAEA Safety Standards Series No. SSG-77, Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants [30].

7.85. A suitable working environment should be provided and maintained so that work can be carried out safely and satisfactorily, without imposing unnecessary physical and psychological stress on personnel. Paragraph 4.29 of SSR-2/2 (Rev. 1) [1] states:

> "Aspects of the working environment that influence human performance factors (such as workload or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel."

7.86. The operating organization should establish an appropriate programme for identifying such aspects of the working environment. Examples of things that should be considered in this programme include the following:

(a) The adequacy of the resources, support and supervision provided to manage and perform the work;
(b) The adequacy of lighting, access and operator aids;
(c) The adequacy of alarms, considering factors such as their number, position, grouping, colour coding and prioritizing for audibility;
(d) The frequency and clarity of communications;
(e) The availability of suitable tools and equipment;
(f) The duration of work time for personnel;
(g) The attention needed to be given to other factors, in particular for control room staff, including well-being, psychological and attitudinal problems, shift patterns and meal breaks;
(h) The availability of procedures that take into account human factor considerations.

7.87. Human performance elements are required to be an integral part of the management system (see para. 3.5 of SSR-2/2 (Rev. 1) [1]). Managers and supervisors should actively support the programme for human performance and encourage behaviours that will reduce the likelihood of human error.

7.88. Human performance tools should assist with the following:

(a) Anticipating, preventing and recovering from errors on the job;
(b) Identifying and eliminating organizational weaknesses that might increase the likelihood of human error, by establishing and managing error defences.

7.89. Further recommendations on tools for preventing human error are provided in paras 5.70 and 5.71 of SSG-76 [9].

7.90. Initial and continuing training programmes should incorporate human performance elements and practices, and provide the necessary skills and knowledge to understand conditions that might lead to human error.

7.91. Periodic safety reviews are required to include an assessment of human factors (see Requirement 11 of IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), Safety Assessment for Facilities and Activities [31]). Further recommendations are provided in SSG-25 [21].

FEEDBACK OF OPERATING EXPERIENCE

7.92. Requirement 24 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish an operating experience programme to learn from events at the plant and events in the nuclear industry and other industries worldwide.**"

7.93. The operating experience programme should include methods to analyse both in-house events and events in the nuclear industry generally so as to identify the actions needed to prevent the occurrence of similar events. In-house events of interest to other plants are required to be shared within national and international feedback systems (see para. 5.27 of SSR-2/2 (Rev. 1) [1]).

7.94. Paragraph 5.33 of SSR-2/2 (Rev. 1) [1] states that "The operating experience programme shall be periodically evaluated to determine its effectiveness and to identify any necessary improvements."

7.95. Further recommendations on the operating experience programme are provided in IAEA Safety Standards Series No. SSG-50, Operating Experience Feedback for Nuclear Installations [32].

CONTROL OF PLANT CONFIGURATION AND PLANT MODIFICATIONS

7.96. Requirement 10 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and implement a system for plant configuration management to ensure consistency between design requirements, physical**

configuration and plant documentation." The operating organization should establish and implement this system as soon as it takes control of the plant.

7.97. The operating organization is required to maintain a formally designated entity (the 'design authority') (see para. 3.2(f) of SSR-2/2 (Rev. 1) [1]). This entity should formally approve all changes to the plant. To do this, it should have sufficient knowledge of the design and of the overall basis for safety. The design authority is required to have the necessary interfaces with the 'responsible designers' (see para. 3.5 of SSR-2/1 (Rev. 1) [2]) and is required to undertake a series of tasks and functions, as specified in para. 3.6 of SSR-2/1 (Rev. 1) [2], to ensure that the original intent of the design is maintained.

7.98. The information technology necessary to support configuration management should be planned from the design stage of the plant. The operating organization should aim to acquire and manage data that will support construction, commissioning, operation and decommissioning. Such data should be readily accessible for use during the lifetime of the plant.

7.99. Requirement 11 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and implement a programme to manage modifications.**"

7.100. Paragraph 4.39 of SSR-2/2 (Rev. 1) [1] states that "A modification programme shall be established and implemented to ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded."

7.101. Paragraph 4.43 of SSR-2/2 (Rev. 1) [1] states that "Before commissioning a modified plant or putting the plant back into operation after modifications, personnel shall be trained, as appropriate, and all relevant documents necessary for plant operation shall be updated." Any computer software affected by plant modifications should also be updated. Further recommendations on the establishment and implementation of the plant modification programme are provided in SSG-71 [5].

CONTROL OF RECORDS AND REPORTS

7.102. Requirement 15 of SSR-2/2 (Rev. 1) [1] states that "**The operating organization shall establish and maintain a system for the control of records and reports.**" The system should ensure that records and other documents

(including electronic documents) relevant to the safe and reliable operation of the plant — including design documents, commissioning documents and documents relating to the operational history of the plant — are properly managed. Such documentation should record all the changes in plant configuration.

7.103. Documentation should be controlled in a consistent, compatible manner throughout the plant and throughout the operating organization. This includes the preparation, review, revision, approval, release and distribution of documentation. It should be ensured that only correct, up to date versions of documents are available to operating personnel. Previous versions of these documents should be appropriately archived and maintained for reference purposes.

7.104. Paragraph 4.52 of SSR-2/2 (Rev. 1) [1] states (citation omitted):

> "The operating organization shall identify the types of record and report, as specified by the regulatory body, that are relevant for the safe operation of the plant. Records of operation, including maintenance and surveillance, shall be kept available from initial testing during the startup of each plant system important to safety, including relevant off-site tests. The records of operation shall be retained in proper archives for the periods required by the regulatory body. All records shall be kept readable, complete, identifiable and easily retrievable. Retention times for records and reports shall be commensurate with their level of importance for the purposes of operation and plant licensing and for future decommissioning."

7.105. The operating organization should ensure appropriate storage conditions (e.g. in terms of fire protection, security, environmental conditions, duplication of records and separate storage) for the archiving of safety related records.

MANAGEMENT OF AGEING AND LONG TERM OPERATION

7.106. Requirement 14 of SSR-2/2 (Rev. 1) [1] states:

> "**The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.**"

7.107. Requirement 16 of SSR-2/2 (Rev. 1) [1] states:

> "**Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.**"

7.108. If operation beyond the original design lifetime is being considered, the operating organization should establish policy documents, dedicated organizational structures and action plans to perform evaluations for long term operation. These should be established well before the plant enters into long term operation. The operating organization should specify what is within the scope of the evaluations for long term operation and should assess the current physical status of relevant structures, systems and components during the preparation phase for long term operation. More detailed recommendations are provided in IAEA Safety Standards Series No. SSG-48, Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants [33].

PREPARATION FOR DECOMMISSIONING

7.109. Requirement 33 of SSR-2/2 (Rev. 1) [1] states:

> "**The operating organization shall prepare a decommissioning plan and shall maintain it throughout the lifetime of the plant, unless otherwise approved by the regulatory body, to demonstrate that decommissioning can be accomplished safely and in such a way as to meet the specified end state.**"

7.110. An initial decommissioning plan is required to be prepared during the design stage of the nuclear power plant and to be submitted to the regulatory body together with the application for the operating licence (see para. 7.4 of IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities [34]). This initial plan is required to be amended, as necessary, during the operation of the plant, on the basis of operating experience and the latest developments in decommissioning techniques (see para. 7.5 of GSR Part 6 [34]).

7.111. The organizational structure should reflect any organizational changes during the preparatory period for decommissioning, including changes to the interfaces with external organizations (see Section 4), as well as changes in the roles and responsibilities of operating personnel.

7.112. The operating organization should ensure the availability of adequate resources (including financial resources, staff, equipment and time) to properly manage the transition of the plant from operation to decommissioning.

7.113. Paragraph 9.2 of SSR-2/2 (Rev. 1) [1] states:

> "A human resource programme shall be developed for ensuring that sufficient motivated and qualified personnel are available for the safe operation of the plant up to final shutdown, for conducting activities in a safe manner during the preparatory period for decommissioning and for safely carrying out the decommissioning of the plant."

7.114. Further general requirements for decommissioning are established in GSR Part 6 [34], and specific recommendations are provided in IAEA Safety Standards Series No. SSG-47, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities [35].

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Annex

TOOLS FOR ENABLING CONTINUOUS IMPROVEMENT

A–1. Operating organizations can benefit from the use of a set of tools that are aimed at enabling continuous improvement. These tools consist of a corrective action programme, self-assessment and benchmarking programmes, an operating experience feedback programme, an observation programme, performance assessment and identification of trends, and performance indicators. Independent oversight organizations, safety committees, regulatory bodies and organizations such as the IAEA and the World Association of Nuclear Operators (WANO) also provide input to continuous improvement. Collectively, these provide the means by which the operating organization can assess performance and enable continuous improvement, in accordance with Requirement 13 of IAEA Safety Standards Series No. GSR Part 2, Leadership and Management for Safety [A–1], and Requirement 9 of IAEA Safety Standards Series No. SSR-2/2 (Rev. 1), Safety of Nuclear Power Plants: Commissioning and Operation [A–2].

CORRECTIVE ACTION PROGRAMME

A–2. The general objective of the corrective action programme is to identify, document and evaluate issues in relation to performance, and to develop and implement appropriate corrective actions. A corrective action programme implements a formal rigorous and strictly defined process to ensure that important issues are thoroughly resolved.

OPERATING EXPERIENCE PROGRAMME

A–3. The operating experience programme (see Requirement 24 of SSR-2/2 (Rev. 1) [A–2]) is designed to effectively and efficiently use lessons identified from internal and external operating experience to improve plant safety and reliability through learning, training and improving the plant and the operating procedures.

OBSERVATION PROGRAMME

A–4. By making observations, managers, supervisors and individuals directly see what is happening in the plant. The quality of individual performance and supervision, the adherence to performance standards and expectations, the effectiveness of administrative processes, procedures and training, as well as leadership for safety and the safety culture of the organization, are thereby assessed through continual scrutiny. Observations also enable the effectiveness of performance improvement actions to be assessed.

SELF-ASSESSMENT PROGRAMME

A–5. The objective of the self-assessment programme is to identify achievements and to address any degradation in safety performance (see para. 4.34 of SSR-2/2 (Rev. 1) [A–2]). During self-assessments, current performance is compared with management expectations, industry best practice and regulatory requirements to identify strengths, weaknesses and opportunities for improvement.

PERFORMANCE ASSESSMENT AND IDENTIFICATION OF TRENDS

A–6. Performance assessment and the identification of trends are proactive analysis activities that lead to the advance identification of performance gaps. This enables an organization to fix a problem before it leads to a consequential event or significant organizational breakdown.

A–7. Performance assessment and the identification of trends involve the collective analysis of information obtained from the wide spectrum of performance monitoring activities. Performance assessment can be used to create or modify action plans to improve the alignment of personnel with the objectives of the organization and to ensure that these objectives are accomplished. In particular, it can focus on the most significant gaps in performance, which if addressed effectively will have the largest impact on performance.

PERFORMANCE INDICATORS

A–8. A set of measurable and objective indicators representing safety performance can enable senior managers to identify degraded performance

and/or declining trends, to analyse the situation and then act to improve performance (see para. 4.34 of SSR-2/2 (Rev. 1) [A–2]).

BENCHMARKING

A–9. Organizations can use internal and external benchmarking to identify potential improvements (see para. 3.30 of IAEA Safety Standards Series No. GS-G-3.5, The Management System for Nuclear Installations [A–3]). Benchmarking can ensure that the operating organization learns from the experience and good practices of other organizations, both within the nuclear industry and outside it.

INDEPENDENT SAFETY OVERSIGHT

A–10. Independent safety oversight assesses and reports on the management for safety through formal audits, surveillance, independent technical reviews and quality control inspections. Independent safety oversight enhances safety through its influence on the behaviour of the organization by performing the following:

(a) Verifying that safety objectives and regulatory requirements are met;
(b) Advising senior management on the status of the safety performance, on any significant trends in performance and on the principal challenges to performance;
(c) Being available at the request of the management to provide independent reviews and insights;
(d) Performing independent assessments of performance issues that are important to safety.

A–11. Information from independent safety oversight is used to provide senior managers with an independent view of performance and to identify issues for increased management attention (see paras 6.4 and 6.5 of GSR Part 2 [A–1]).

SAFETY COMMITTEE

A–12. A safety committee (see para. 5.27) provides an independent review of performance and activities that relate to the safe operation of the plant. Safety committees comprise senior managers and consultants with extensive experience of nuclear power plants or other industries.

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