DS424 Draft Version

Date: 31July 2oo9

IAEA SAFETY STANDARDS

for protecting people and the environment

Status: To be submitted to Member States for a 120-day Comment Period.

Comments due by 7 December 2009.

For the cross-referencing with other safety standards currently under revision (see annexes 4 to 7), the versions used are those as of 31 July 2009. These references will be updated, as appropriate, during the next steps of the process.

Establishing a Safety Infrastructure for a National Nuclear Power Programme

DRAFT SAFETY GUIDE

DS424

CONTENTS

1. INTRODUCTION 4

Background 4

Objective 6

Scope 9

Structure 13

2. IMPLEMENTING THE IAEA GENERAL SAFETY REQUIREMENTS FOR THE ESTABLISHMENT OF THE SAFETY INFRASTRUCTURE 15

ACTIONS 1-10: National policy and strategy 15

ACTIONS 11-18: Global nuclear safety régime 21

ACTIONS 19-22: Legal framework 26

ACTIONS 23-39: Regulatory framework 32

ACTIONS 40-48: Transparency and openness 43

ACTIONS 49-59: Funding and financing 47

ACTIONS 60-72: External support organizations and contractors 51

ACTIONS 73-85: Leadership and management for safety 61

ACTIONS 86-99: Human resources development 67

ACTIONS 100-105: Research for safety and regulatory purposes 74

ACTIONS 106-117: Radiation protection 78

ACTIONS 118-122: Safety assessment 84

ACTIONS 123-134: Safety of radioactive waste, spent fuel management and decommissioning 91

ACTIONS 135-147: Emergency preparedness and response 97

3. IMPLEMENTING THE IAEA SPECIFIC SAFETY REQUIREMENTS FOR THE ESTABLISHMENT OF THE SAFETY INFRASTRUCTURE 102

ACTIONS 148-160: Operating organization 102

ACTIONS 161-170: Site survey, site selection and evaluation 114

ACTIONS 171-184: Design safety 122

ACTIONS 185-188: Preparation for commissioning 128

ACTIONS 189-192: Transport safety 131

ACTIONS 193-200: Interfaces with nuclear security 137

REFERENCES **143**

ANNEX 1. OVERVIEW OF THE ACTIONS TO BE CONDUCTED DURING EACH PHASE FOR THE ESTABLISHEMENT OF THE SAFETY INFRASTRUCTURE **144**

Phase 1 144

Phase 2 149

Phase 3 155

ANNEX 2. LIST OF THE IAEA SAFETY REQUIREMENTS AND GUIDES, AND OTHER SAFETY KEY-PUBLICATIONS TO BE CONSIDERED **162**

ANNEX 3. THE FUNDAMENTAL SAFETY PRINCIPLES **170**

ANNEX 4. REQUIREMENTS (TITLES) STATED IN GSR Part 1 (DS415, revision of GS-R-1, dated 14 July) **171**

ANNEX 5. REQUIREMENTS (TITLES) STATED IN GSR Part 3 (DS379, revision of BSS115, draft 2.0 dated 7 May) **172**

ANNEX 6. REQUIREMENTS (TITLES) STATED IN NS-R-1 (DS414, dated 28 July) **173**

ANNEX 7. REQUIREMENTS (TITLES) STATED IN NS-R-2 (DS413, dated 22 July) **175**

CONTRIBUTORS TO DRAFTING AND REVIEW **176**

1. INTRODUCTION

BACKGROUND

1.1. In recent years, the IAEA General Conference has encouraged the Secretariat to develop approaches to supporting nuclear power infrastructure in States either considering the introduction of nuclear power for the first time or expanding an existing nuclear power programme. Recognizing the long tradition of the IAEA in establishing internationally agreed safety standards, numerous States have stated the necessity for clearer and more practical guidance on how to apply the entire suite of the IAEA Safety Standards, in the most effective, and efficient manner, in the development of a national nuclear power programme.

1.2. The IAEA Safety Fundamentals [1] provides a coherent set of ten principles that constitutes the basis on which to establish safety requirements to protect people and the environment from harmful effects of ionizing radiation[1]. The application of all ten principles is essential to achieve the fundamental safety objective. At the initial stage when a State is considering embarking on a nuclear power programme, the understanding of Principle 1 “Responsibility for safety”, Principle 2 “Role of government”, Principle 3 “Leadership and management for safety” and Principle 4 “Justification of facilities and activities”, is crucial to ensure the basis for the future safe operation of a nuclear power plant.

1.3. It has been recognized by the international community that a considerable period of time is necessary to acquire competences and a strong safety culture before operating a nuclear power plant. While prime responsibility for safety must rest with the operating organization, the State has the responsibility, upon committing itself for many years to a nuclear power programme which demands significant investment, to create a robust framework for nuclear safety. This responsibility is incumbent to those who live and work inside the State and cannot be outsourced. Establishing a sustainable safety infrastructure is a long process, and it has been internationally acknowledged that a period of 15 years under optimized conditions would be generally needed between the first consideration of nuclear power as part of the national energy strategy and the operation of the first nuclear power plant.

1.4. In 2007, the IAEA published a brochure entitled “Considerations to Launch a Nuclear Power Programme” [2] and a report entitled “Milestones in the development of a national infrastructure for nuclear power” (NG-G-3.1) [3]. In 2008, a report was published by the

International Nuclear Safety Group on "Nuclear Safety Infrastructure for a National Nuclear Power Programme supported by the IAEA Fundamental Safety Principles" (INSAG-22) [4]. This report defines *nuclear safety infrastructure* as *the set of institutional, organizational and technical elements and conditions established in a State to provide a sound foundation for ensuring a sustainable high level of nuclear safety*.

1.5. In the INSAG-22 report, consistent with [2] and [3], the lifetime of a nuclear power plant is divided into five "Phases" from a nuclear safety standpoint and indicative average durations are provided for each of these Phases. Phase 1 is the "Safety infrastructure before deciding to launch a nuclear power programme" (1~3 years), Phase 2 is the "Safety infrastructure preparatory work for construction of a NPP after a policy decision has been taken" (3~7 years), Phase 3 is the "Safety infrastructure during implementation of the first NPP" (7~10 years) , Phase 4 is the "Safety infrastructure during the operation phase of a NPP" (40~60 years) and Phase 5 is the "Safety infrastructure during decommissioning and waste management phases of a NPP" (20~100+ years), as shown in Fig.1. The present Safety Guide uses the same approach and addresses Phases 1, 2 and 3.

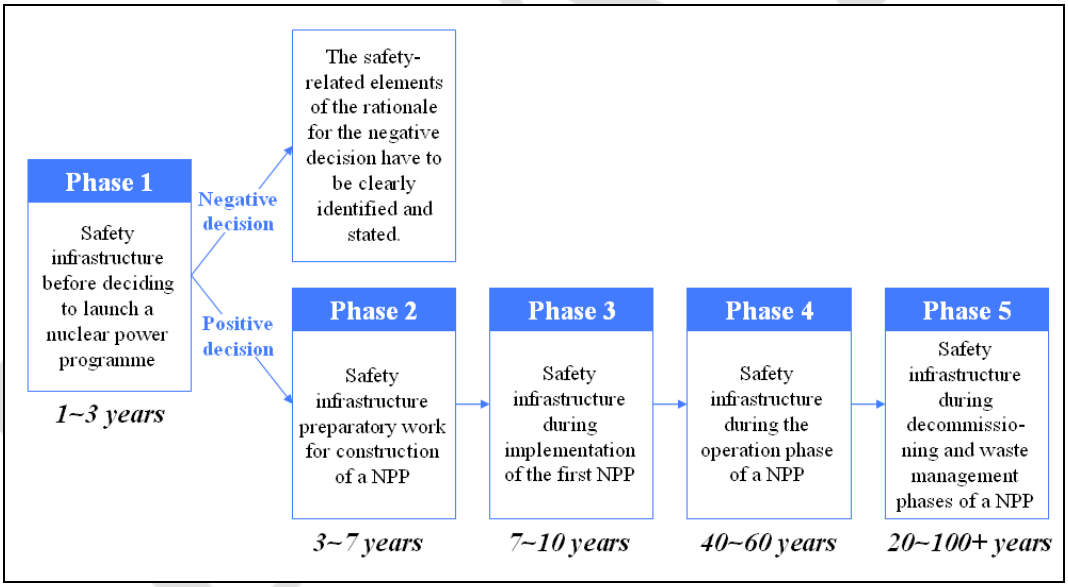

FIG. 1. Main phases of the safety infrastructure development in the lifetime of a nuclear power plant (based on INSAG-22).

1.6. In response to the IAEA General Conference's request, this Safety Guide provides a compilation of relevant IAEA safety principles and requirements to be progressively applied

[1] See annex 3 "The Fundamental Safety Principles".

during Phases 1, 2 and 3 of the safety infrastructure development (see Fig.2), presented in the form of sequential actions, for the convenience of the user.

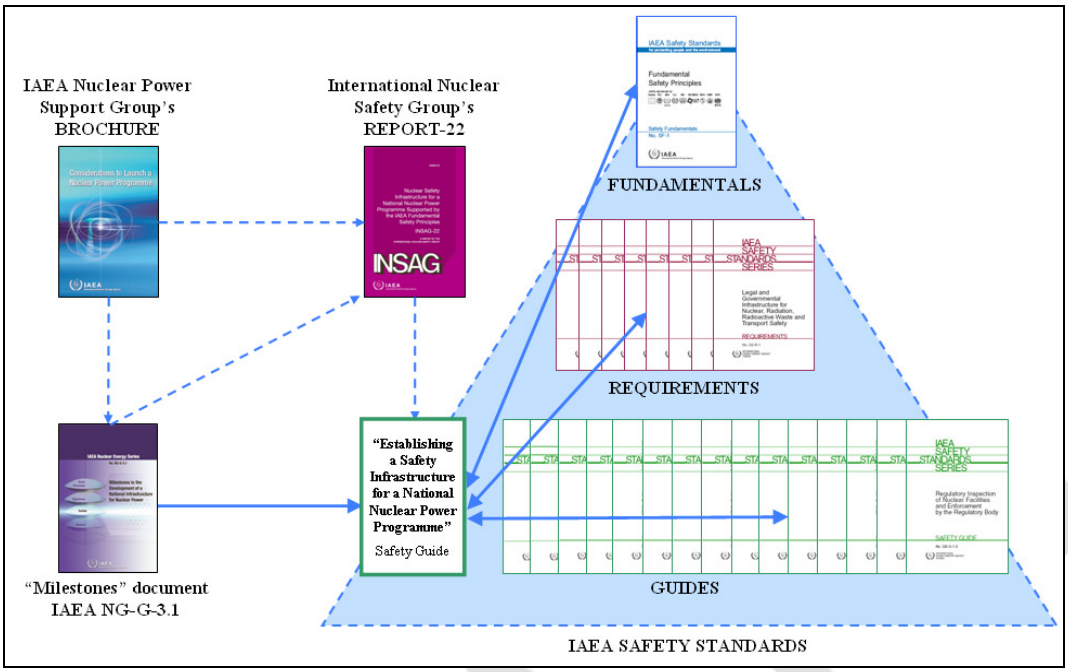

FIG.2. An umbrella document on the progressive implementation of the IAEA Safety Standards

1.7. It is important to note that the use of the IAEA safety requirements alone is not viewed as sufficient to understand or develop infrastructure needs. It is expected that the organizations or individuals using this Safety Guide will understand and use the additional information in the existing set of Safety Guides supporting the specific Safety Requirements in the respective subject areas. The IAEA provides for the application of its Safety Standards through safety review services such as the *Integrated Regulatory Review Service* (IRRS) or the *Operational Safety Review Teams* (OSART) upon request by the State, to guide and/or to peer review a self-assessment.

OBJECTIVE

1.8. The objective of this Safety Guide is to provide guidance on the establishment of a safety infrastructure in accordance with the IAEA safety standards when considering and preparing to embark on a national nuclear power programme. In this regard, it is proposed a road-map of 200 safety-related actions to be taken in the first three phases of the development of the nuclear power programme, in order to achieve a high level of safety during the entire lifetime of the nuclear power plant, including decommissioning and waste management.

1.9. This Safety Guide is intended to be applicable for States with various levels of previous experience. While some States seeking to establish a nuclear power programme would have little or no nuclear activities established, others could have extensive experience from the operation of research reactors and other applications of ionizing radiation. For the purpose of this Guide, it is assumed that the State has little or no relevant experience. In the scenario presented in this Safety Guide, the State has no regulatory body and no operating organization at the beginning of the process (Phase 1); therefore, this Safety Guide is to be used with flexibility, especially for States which are in a different initial situation. It is also to be noted that the IAEA welcomes feedback from States for continuous improvement in future revisions of this Safety Guide.

1.10. This Safety Guide is intended to contribute to the early building of a strong leadership and management for safety, safety culture and for use as guidance for a self-assessment by all interested parties involved in the safety infrastructure development.

1.11. The users of this Safety Guide are expected to be any individual or organization involved in the preparation and implementation of the national nuclear power programme. This includes:

- government officials;
- legislative bodies;
- organizations that are given an explicit governmental mandate to assess the feasibility or coordinate the development of a national nuclear power programme[2];
- regulatory bodies;
- operating organizations;
- external expert support entities, including technical support organizations;
- industrial organizations, including designers and constructors;
- radioactive waste management organizations;
- organizations involved in nuclear and radiological emergency preparedness and response;

[2] Such organizations are sometimes called “governmental project management organizations” or “nuclear energy programme implementing organizations” in other IAEA and INSAG publications. For the purpose of this Safety Guide, such organizations will always be referred to as “the government”.

- organizations involved in the transport of nuclear material;
- competent authorities involved in security matters;
- education and training organizations;
- research centres.

1.12. International organizations may use this Safety Guide to help determine the progress accomplished by a State in developing and establishing the infrastructure necessary for executing a nuclear power plant project, so that assistance can be provided in a meaningful and timely manner.

1.13. Any other relevant organization, as well as the media and the general public, may also use this Safety Guide to provide confidence that the State has established the nuclear safety infrastructure necessary to start constructing a nuclear power plant and has also started preparations to commission, operate, maintain and decommission it, as well as to manage properly the radioactive waste being generated during operation.

1.14. When identifying actions to be conducted, this Guide tries to specify as much as practicable the entity responsible for taking the action. However, since States have a number of different national structures, it is sometimes not possible or not relevant to specify which entity within the State (the government, legislative bodies, regulatory bodies, etc.) is responsible for a given action. In those cases, the generic term “State” is used. The government, in cooperation with legislative bodies, establishes national policy for safety by means of different instruments, statutes and laws. Typically, the regulatory body, as designated by the government, is charged with the implementation of policies through a regulatory programme or a strategy set forth in its regulations or standards. The government determines the specific functions of the regulatory body and the allocation of responsibilities. For example, the government in cooperation with legislative bodies establishes laws and adopts policies pertaining to safety, whereas the regulatory body develops plans and promulgates regulations in execution of such laws or policies. In addition, the government in cooperation with legislative bodies establishes laws and adopts policies specifying the responsibilities and functions of different governmental entities in respect of safety and emergency preparedness and response, whereas the regulatory body establishes a system to provide effective coordination. The guidance established in this Safety Guide is to be understood in the context of these respective functions, although some flexibility may be necessary depending on the particular national circumstances.

SCOPE

1.15. The scope of this Safety Guide covers all the relevant IAEA safety principles and requirements to be incorporated into an effective safety infrastructure for a national nuclear power programme, presented in the form of 200 sequential actions for the purpose of user-friendliness.

1.16. This Safety Guide addresses the safety infrastructure before a decision to launch a nuclear power programme (Phase 1), the safety infrastructure preparatory work for construction of a nuclear power plant (Phase 2) and the safety infrastructure during implementation of the first nuclear power plant (Phase 3).

1.17. While Fig.3 provides an indicative time frame with some steps important to safety in establishing a safety infrastructure for a national nuclear power programme, Fig.4 utilizes this time frame to provide insights on the progressive involvement of the regulatory body and the operating organization in nuclear power activities, as well as the progressive allocation of responsibilities from the government to these organizations. This also reflects the development of sufficient competent human resources to perform the necessary activities. In addition, Fig. 4 identifies, for each relevant IAEA safety requirements publication, at which stages respectively:

- awareness should be given to the requirements;
- implementation of the requirements should be started;
- requirements should be fully implemented.

1.18. Research reactors and fuel cycle facilities are not explicitly covered in this Safety Guide, which concentrates on the nuclear power programme.

1.19. IAEA Safety Fundamentals SF-1 states: “Safety measures and security measures have in common the aim of protection human life and health and the environment.” This Safety Guide briefly addresses nuclear security considerations and actions needed to be taken to progressively incorporate security elements into an effective nuclear security regime for a national nuclear power programme. This topic is more completely covered in the Nuclear Security Series publications. Specific security recommendations are for nuclear power plants are provided in Physical Protection of Nuclear Material and Nuclear Facilities recommendations publication (in preparation). Additional implementing guides are provided in the Nuclear Security Series. Consistent with the views of the International Nuclear Safety

Group, this Safety Guide recognizes the need to clarify the interfaces between nuclear safety and nuclear security. Therefore, the scope of nuclear security considerations covered by this Safety Guide focuses on the interfaces between nuclear safety and nuclear security.

1.20. It should also be noted that IAEA mandate rests with the ionizing radiations but that conventional risks (such as chemical risks) are also generated by nuclear power plants and have to be regulated by the State, although it is not within the purpose and scope of this Safety Guide.

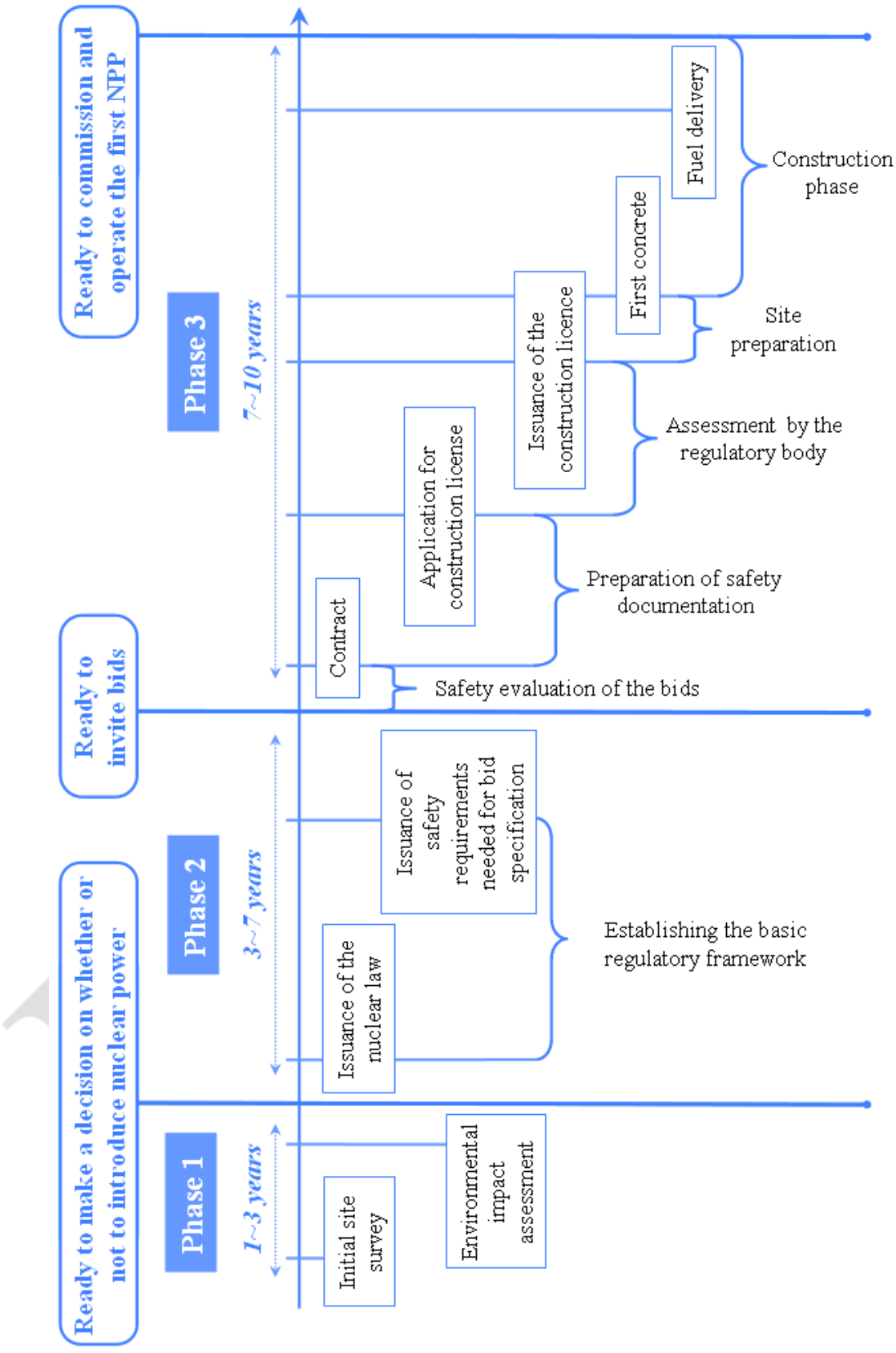

FIG.3. Some steps important to the safety infrastructure development (indicative only, to be used with flexibility)

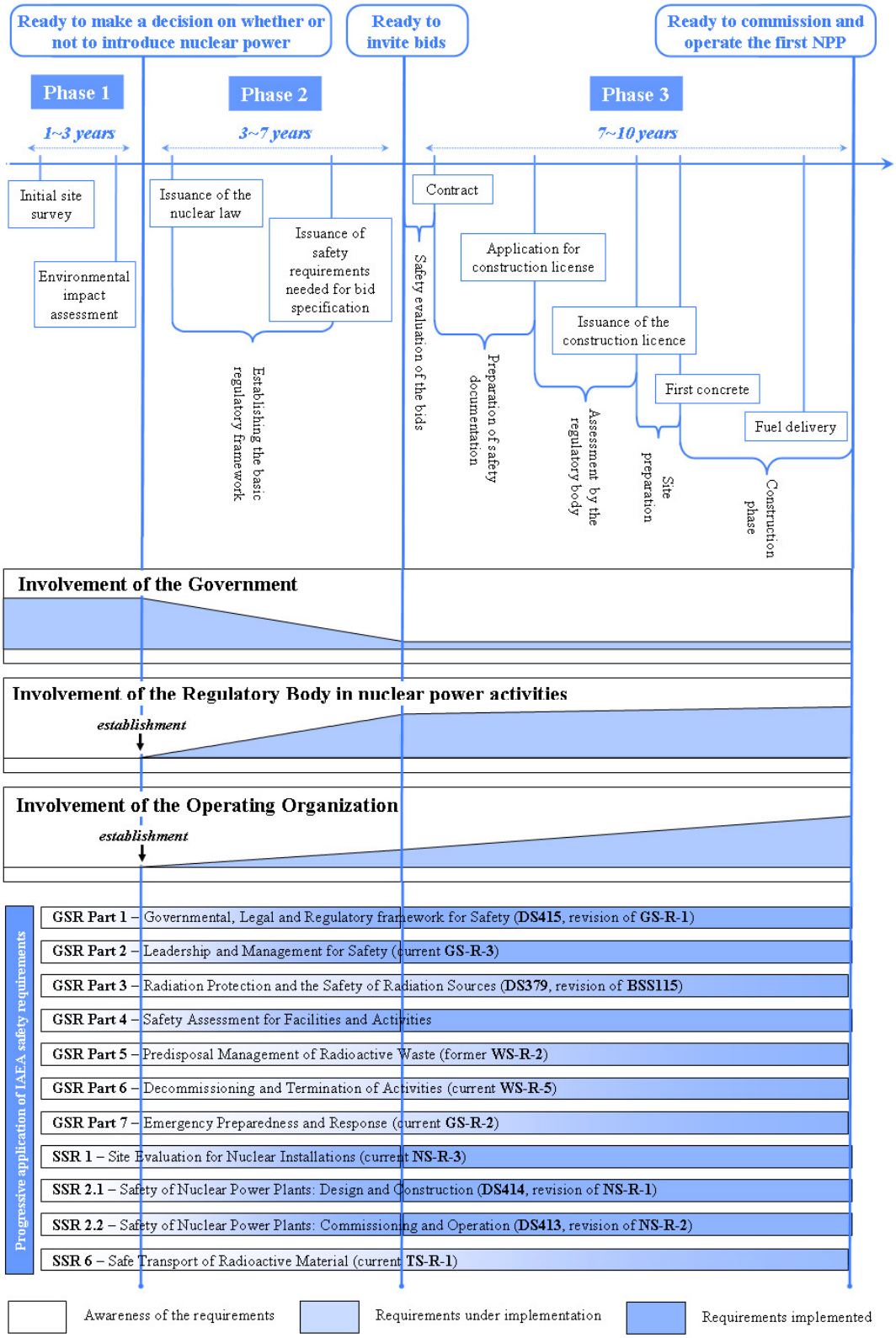

FIG.4. Progressive involvement of the main organizations in the nuclear power programme and progressive application of the IAEA safety requirements (indicative only, to be used with flexibility)

STRUCTURE

1.21. Sections 2 and 3 provide guidance on the development of a nuclear safety infrastructure in line with the IAEA Safety Standards, during Phases 1, 2 and 3. Section 2 addresses the 'general safety' elements of the infrastructure (elements 1 to 14), while Section 3 addresses the 'specific safety' elements of the infrastructure (elements 15 to 20), as defined in the new structure of the IAEA Safety Standards (see Fig.5). In each of the elements considered, this Safety Guide identifies the main actions which should be taken in Phases 1, 2 and 3 respectively, and also specifies both the IAEA Safety Requirements to be complied with and the IAEA Safety Guides to be considered, as well as other safety key-publications as necessary, such as INSAG reports.

	20 ELEMENTS OF THE SAFETY INFRASTRUCTURE	MAIN SUPPORTING IAEA SAFETY REQUIREMENTS IDENTIFIED	CORRESPONDING NUMBER IN THE LONG-TERM STRUCTURE	
SECTION 2	1 - National policy and strategy	GS-R-1 (revision, DS415)	GSR Part 1	General Safety Requirements
	2 - Global nuclear safety regime			
	3 - Legal framework			
	4 - Regulatory framework			
	5 - Transparency and openness	GS-R-1 (DS415) *and others*	GSR Part 1 *and others*	
	6 - Funding and financing			
	7 - External support organizations and contractors			
	8 - Leadership and management for safety	GS-R-3	GSR Part 2	
	9 - Human resources development	GS-R-3 *and others*	GSR Part 2 *and others*	
	10 - Research for safety and regulatory purposes			
	11 - Radiation protection	BSS115 (revision, DS379)	GSR Part 3	
	12 - Safety assessment	GSR Part 4	GSR Part 4	
	13 - Safety of radioactive waste, spent fuel management and decommissioning	GSR Part 5 (former WS-R-2) WS-R-5	GSR Part 5 GSR Part 6	
	14 - Emergency preparedness and response	GS-R-2	GSR Part 7	
SECTION 3	15 - Operating organization	NS-R-2 (revision, DS413)	SSR 2	Specific Safety Requirements
	16 - Site survey, site selection and evaluation	NS-R-3	SSR 1	
	17 - Design safety	NS-R-1 (revision, DS414)	SSR 2.1	
	18 - Preparation for commissioning	NS-R-2 (revision, DS413)	SSR 2.2	
	19 - Transport safety	TS-R-1	SSR 6	
	20 - Interfaces with nuclear security	-		

FIG .7. Structure of Sections 2 and 3 of this Safety Guide, in accordance with the structure of the IAEA Safety Standards

1.22. In the text, for each of the elements considered, a list of recommendations ("should-statements") first appears in the form of numbered actions in bold characters, and then a few paragraphs provide the user with further background on, and rationale for, these recommendations.

1.23. The actions of this Safety Guide are not intended to provide a reformulation of safety requirements; rather, as 'should' statements, they provide recommendations on when to implement the relevant requirements.

1.24. This Safety Guide specifies, in each Phase, which IAEA safety requirements serve as a basis for the actions. When requirements are mentioned for the first time, they appear in bold characters; otherwise, they appear in normal characters.

1.25. Annex 1 consists of a user-friendly summary of all the actions ("should-statements") which should be taken in Phases 1, 2 and 3 respectively, as well as the bases for these actions.

1.26. Annex 2 provides a comprehensive list of the relevant IAEA Safety Requirements and Guides, as well as other safety key-publications, such as INSAG reports.

1.27. Annex 3 provides the fundamental safety objective and the ten fundamental safety principles established in Ref. [1].

1.28. Annexes 4 to 7 provide the titles of the requirements stated in the IAEA Safety Requirements referenced in this Safety Guide which are currently under revision, respectively GSR Part 1 (DS415, revision of GS-R-1), GSR Part 3 (DS379, revision of BSS115), NS-R-1 (DS414) and NS-R-2 (DS413), *for the convenience of Member States during the 120-day Comment Period.*

1.29. The IAEA website provides an up-to-date list of current IAEA safety standards as well as information on IAEA safety standards being drafted or reviewed: http://www-ns.iaea.org/downloads/standards/status.pdf .

2. IMPLEMENTING THE IAEA GENERAL SAFETY REQUIREMENTS FOR THE ESTABLISHMENT OF THE SAFETY INFRASTRUCTURE

ACTIONS 1-10: NATIONAL POLICY AND STRATEGY

Introduction

2.1. A nuclear power programme is a major undertaking requiring careful planning, preparation and a major investment in time and human resources. While nuclear power is not unique in this respect, it is considered different because of the safety issues associated with the possession and handling of nuclear material and the long time commitment to ensuring safety after the decision to embark on a nuclear power programme has been made.

2.2. Given the wide spectrum of issues to be considered and given the implications and duration of the commitments associated with a nuclear power programme, the policy decision to embark on a nuclear power programme will come from the government. The prime importance of safety is recognized and reflected in the policy decision as well as in the strategy adopted by the government. It is also important to recognize, from the earliest phases of the safety infrastructure development, that the prime responsibility for safety will rest with the facility operating organization and that it is the role of the government to provide an effective legal and governmental framework to support a high level of safety. The responsibility for safety cannot be outsourced; it will rather be ensured by the operating organization through strong leadership, adequate financing, sufficient expert capacity and legal responsibility.

2.3. A State considering launching a nuclear power programme is likely to look for existing proven technologies rather than develop a specific new design. Nevertheless the choice will be made from among various available technologies. Such a choice may be made at different times depending on the overall policy, but in any case, the policy needs to emphasize effective transfer of safety competence into the State. If there is a strategy to establish an early partnership with a certain State, the selection can take place in Phase 1 as part of the decision process to move forward with the nuclear option, or early in Phase 2. In such a case, the partnership between the State providing the respective technology and the State embarking on a nuclear programme has to include agreements at the government level to establish the framework and objectives of such cooperation. An alternative strategy, the one described in this Safety Guide, would be to first develop a national knowledge base through a large network of international contacts during Phase 2, and then to open a bidding process.

2.4. The government decides on the level of national participation in the nuclear programme. This will have a significant impact on the time and resources needed to develop the necessary infrastructure.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1** of GSR Part 1 (DS415, revision of GS-R-1);
- **3.17 and 3.126** of GSR Part 3 (DS379, revision of BSS115);
- **2** of GSR Part 5;

necessitates that:

Action 1. The government should consider the necessary elements of a national policy and strategy for safety, in conjunction with the fundamental safety objective and principles established in the IAEA Safety Fundamentals.

Action 2. The government should ensure the coordination among the stakeholders of all the activities of the safety infrastructure development.

Action 3. The government should ensure that the status of the national safety infrastructure is assessed in relevant areas and that radiological aspects are adequately analysed in the environmental impact assessment (EIA).

Action 4. The government in cooperation with legislative bodies should take due account of the assessment of the safety infrastructure elements and the fundamental principle of justification when making a decision on whether or not to introduce nuclear power.

2.5. In a national policy and strategy for safety, due account has to be taken of:

- The fundamental safety objective and the fundamental safety principles established in the IAEA Safety Fundamentals SF-1;
- Binding international instruments and other international instruments (see also the chapter “Global nuclear safety régime”);
- The specification of the scope of the governmental, legal and regulatory framework as the elements of the necessary framework for safety (see also the chapters “Legal framework” and “Regulatory framework”);

- The need for and provisions for human and financial resources (see also the chapters “Human resources development” and “Funding and financing”);
- The provisions and framework for research and development (see also the chapter “Research for safety and regulatory purposes”);
- Adequate mechanisms for taking account of social and economic developments;
- The promotion of leadership and management for safety, including safety culture (see also the chapter “Leadership and management for safety”);
- The need for and provisions for radioactive waste management, including disposal (see also the chapter “Safety of radioactive waste, spent fuel management and decommissioning”).

2.6. Past experience shows that there are many possible ways to establish a national nuclear power programme. Countries wishing to embark on a first nuclear power plant project may be at various levels of safety capability, ranging from no experience, to experience with laboratory scale nuclear facilities and industrial applications, operation of research reactors, or handling large amounts of radioactive material. However, in this Safety Guide, for the sake of generality it is assumed that the State does not have an institution or organization that would be ready to assess the feasibility of the nuclear option as part of the national energy policy and could present its findings to the highest national decision makers.

2.7. Therefore, the first step of the safety infrastructure development is the coordination of the assessment activities across the numerous interested parties and to the preparation for a decision on whether or not to proceed with the development of a nuclear power programme.

Principle 2 of the Safety Fundamentals SF-1, “Role of government”, states the basic responsibilities the government has to discharge to fulfil all its national and international obligations.

2.8. Although the State may already be engaged in some activities with regard to the management of radioactive sources, it may identify new activities that will be started in a timely manner and the appropriate resources (human, organizational and financial) that will be made available.

3.1. In most States, major projects are subject to environmental restrictions and their promoters have the obligation to demonstrate the impacts of their project (including the different alternatives considered) through a document generally called Environmental Impact

Assessment (EIA) report. The authority to which such a report has to be submitted, typically a ministry of environment or an environmental authority, is usually different from the nuclear safety authority. For a nuclear power plant project, this report is very broad and covers areas such as chemical impacts, thermal impacts, radiological impacts, noise impacts, biophysical impacts, socio-economical impacts, etc. This Safety Guide only deals with the radiological impacts, in conformity with the mandate of the IAEA[3]. Principle 7 of the Safety Fundamentals states that "People and the environment, present and future, must be protected against radiation risks". The radiological environmental impact analysis (which constitutes one section of the EIA) is further addressed in the chapters "Radiation protection" and "Site survey, site selection and evaluation" of this Safety Guide.

2.9. The government has to ensure that an adequate assessment of the national safety infrastructure and needs is conducted in order to provide a sound basis for a knowledgeable decision regarding the introduction nuclear power. At the end of Phase 1, the government has to be fully aware that embarking on a nuclear power programme implies strong and long commitments to maintain activities that are necessary for ensuring safety.

2.10. The national position should reflect an understanding of the principles expressed in the Safety Fundamentals SF-1, in particular Principle 4, "Justification of facilities and activities", which requires that the benefits prevail over the radiation risks and a full and fair evaluation be undertaken before deciding to introduce nuclear power in the country. At this first stage, the assessment of the balance between risks and benefits may be of a general nature.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.17 and 3.126 of GSR Part 3 (DS379, revision of BSS115);
- 2 of GSR Part 5;

necessitates that:

Action 5. The government in cooperation with legislative bodies should establish a clear national policy and strategy for safety in order to achieve the

[3] Although non-radiological aspects of industrial safety and environmental protection are not explicitly considered in this Safety Guide; it is recognized that States have to fulfil their international undertakings and obligations in relation

fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals.

Action 6. The government should ensure that the development of the various elements of the safety infrastructure is adequately coordinated.

Action 7. The government in cooperation with legislative bodies should ensure identification and progressive allocation of responsibilities to the relevant organizations involved in safety infrastructure development.

2.11. If the State decides to introduce nuclear power, the implementation of activities begins in Phase 2. However, in this Phase, the gradually reduces its involvement along with the development of other organizations such as the regulatory body, the operating organization, relevant permanent structures within ministries, etc. This transition has to be carefully considered and prepared with a view to preventing any break in the effectiveness of the process and in the national commitment to nuclear safety. The crucial role of coordinating the development of the safety infrastructure among the various permanent organizations continues to be ensured by the government until all organisations and elements are in place, functioning, with a clear definition of roles and responsibilities.

2.12. It is essential that the government demonstrate a strong commitment to safety by providing its support and the necessary resources for the implementation of a strong and effective safety infrastructure.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.17 and 3.126 of GSR Part 3 (DS379, revision of BSS115);
- 2 of GSR Part 5;

necessitates that:

Action 8. The government in cooperation with legislative bodies should continue to execute the national policy and strategy for safety.

---

to these.

Action 9. The government in cooperation with legislative bodies should ensure that the regulatory body and the operating organization are fulfilling their responsibilities.

2.13. The government has to ensure that the coordination mechanisms put in place are effective and efficient and to improve them as necessary. The delineation of responsibilities within the government for nuclear security is clarified, and steps are taken to ensure that those responsibilities are being carried out. Other actions to be conducted by the government are described in the following chapters of this Safety Guide.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

Other safety key-publications

INSAG-5 The Safety of Nuclear Power

INSAG-12 Basic Safety Principles for Nuclear Power Plants

INSAG-22 Nuclear Safety Infrastructure for a National Nuclear Power Programme Supported by the IAEA Fundamental Safety Principles

ACTIONS 11-18: GLOBAL NUCLEAR SAFETY RÉGIME

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1** and **14** of GSR Part 1 (DS415, revision of GS-R-1);
- **6.3 to 6.6** of GS-R-3;

necessitates that:

Action 10. The government should prepare for active participation in the Global Nuclear Safety Régime.

Action 11. The government should begin dialogue with neighbouring States regarding its projects to establish a nuclear power programme.

Action 12. The government and other relevant organizations should establish contact with foreign and international organizations to seek advice on matters related to safety.

2.14. Past experience indicates that a nuclear power programme in any State is not to be treated in isolation. A nuclear accident anywhere has effects everywhere due to the potential trans-border effects of nuclear release and through the impact on public opinion. The nations of the world are bound to each other by the shared need for universal safe operation of nuclear facilities and conduct of activities. Therefore, the national safety policy and the strategy adopted by the government take full benefit of effective participation in the Global Nuclear Safety Regime. Global regimes are based on a wide range of national and international participants. However, the prime responsibility for safety rests within each State and in specific with the licensed users of nuclear technology.

2.15. Specific considerations are given to neighbour countries whose interests could be affected by the State's nuclear power programme both from normal operation (effluents, discharges, etc.) and in the event of an accident. The government implements a consultation mechanism that would allow neighbour countries to express their views and concerns. Such a process will be continued during all phases of the State's nuclear power programme development.

2.16. International cooperation is a unique opportunity to share and benefit from the experience of countries that have already implemented or are also in the process of

implementing a nuclear power programme. In Phase 1, countries embarking on the development of a nuclear power programme will probably find it useful to establish contact with countries with advanced nuclear power programmes and international organizations to seek advice on matters related to safety, to derive benefit from international operating and regulatory experience and from the dissemination of lessons learned. Liaising with other countries with similar nuclear energy objectives may also be considered.

2.17. The State has to prepare for involvement in the Global Nuclear Safety Regime, promoted by the IAEA based on the following elements:

- The international conventions that aim to establish robust common principles and obligations for ensuring safety in the use of radiation and nuclear energy and to provide effective coordinated response to emergencies;
- Codes of Conduct that promote good practices in the relevant operations;
- Internationally agreed IAEA safety standards that support development of harmonized national safety requirements, guides and practices;
- International peer reviews of safety that aim for mutual learning by participating Member States;
- Knowledge and expert networks;
- Multinational and bilateral safety cooperation that aims to enhance safety by harmonized approaches and increased quality and effectiveness of safety reviews and inspections.

2.18. In this phase, the government, in conjunction with legislative bodies, gives consideration to the need to become party to international conventions such as:

- the Convention on Nuclear Safety[4];
- the Convention on Early Notification of a Nuclear Accident;
- the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;

[4] The Convention on Nuclear Safety has been developed to promote and harmonize nuclear safety. This is a formal, legal binding international agreement that has now been ratified by all nuclear power countries. The convention sets up a system of national reporting and peer reviews to ensure that countries are complying with their obligations to meet recognized international safety standards and good practices.

- the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste management;
- the Convention for the Physical Protection of Nuclear Material.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1 and 14 of GSR Part 1 (DS415, revision of GS-R-1);
- 6.3 to 6.6 of GS-R-3;

necessitates that:

Action 13. All the relevant organizations should continue participation in the Global Nuclear Safety Regime

Action 14. The government in cooperation with legislative bodies should adhere to the relevant international conventions, as identified in Phase 1.

Action 15. All the relevant organizations should strengthen cooperation with countries with advanced nuclear power programmes on matters related to safety.

2.19. One important consideration in the successive decision process along a nuclear power programme is the fact that what happens with nuclear power activities in one State affects every State. Nuclear power programmes can not be treated in isolation and are only as safe and as strong as the weakest program. Therefore, the key activities in Phase 2 would be the adherence to the international agreements and conventions identified in Phase 1 which will help foster safety nationally and globally, as well as enhance international confidence and trust. The consent of a State to be bound by international instruments may be expressed by signature, ratification, acceptance, approval or accession in accordance with the provisions of the respective instrument.

2.20. Activities and participation in the Global Nuclear Safety Regime that were identified and planned during Phase 1 are progressively implemented by those interested parties who were identified to carry them out. The operating organization and the regulatory body participate in their respective international networks. An important part of international cooperation would be participation in the exchange of operating experience. The regulatory body and the operating organization actively participate although for different reasons. The

regulatory body assesses whether operating experience indicates that modifications are needed in the regulatory requirements or whether more attention will be given to certain safety issues in assessment and inspections. The operating organization participates to be alerted to experiences that may require design changes or reconsideration of operation or maintenance practices to provide continued assurance of future safe operation.

2.21. Effective participation in international activities and networks promotes the transfer of knowledge on lessons-learned and best practices from other States. It also facilitates receiving strong support from countries with advanced nuclear power programmes. Such support includes two-way long term assignments of experts: foreign consultants coaching the developing organizations and national experts sent abroad for on-the-job training.

2.22. Commitment to comply with IAEA safety requirements and the participation in international safety reviews and services based on the safety standards has to be reaffirmed. Consideration needs to be given to other international safety standards, codes of conduct that promote nuclear safety good practices, as well as INSAG publications.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1 and 14 of GSR Part 1 (DS415, revision of GS-R-1);
- 6.3 to 6.6 of GS-R-3;
- **24** of NS-R-2 (DS413);

necessitates that:

Action 16. All the relevant organizations should ensure continued participation in international activities and networks for strengthening safety.

Action 17. The operating organization should implement a strong cooperation programme with the vendor and with organization(s) operating the selected reactor, for strengthening safety.

Action 18. The regulatory body should implement a strong cooperation programme with the vendor country and with other regulatory bodies which have oversight experience with the selected reactor.

2.23. The State has to participate in the review meetings of the applicable international conventions it has become a party to.

2.24. The regulatory body, the operating organization and other relevant entities strengthen their cooperation with their respective foreign counterparts, and international networks.

2.25. In order to gain some feedback from foreign regulatory bodies, the regulatory body extends its contacts, in particular through its participation in bilateral, multinational and international cooperation on the subject of reactors.

2.26. Experience has shown that joint international inspections based on bilateral agreements, with the vendor country or with other regulatory bodies having oversight experience with the selected reactor, are considered a good practice.

2.27. The operating organization establishes professional cooperation arrangements with other States' operating organizations, as well as international operator organizations such as WANO (World Association of Nuclear Operators).

2.28. External expert support, research organisations and academic bodies also work in strong cooperation with their counterparts abroad.

2.29. Assistance from the regulatory body of the supplier country, as well as from regulatory bodies which have oversight experience with the selected reactor, can be of utmost importance. All the involved regulatory bodies issue formal cooperation agreement and exchange staff as agreed.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

Other safety key-publications

INSAG-21 Strengthening the Global Nuclear Safety Regime

IAEA Handbook on Nuclear Law

ACTIONS 19-22: LEGAL FRAMEWORK

2.30. Principle 2 of the Safety Fundamentals SF-1, "Role of government", states that "an effective legal […] framework for safety […] must be established and sustained".

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1, 2 ,3 and 4** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.12 and 2.13** of GSR Part 3 (DS379, revision of BSS115);
- **1** of GSR Part 5;
- **3.3 and 3.4** of WS-R-5;

necessitates that:

Action 19. The government in cooperation with legislative bodies should identify all necessary elements of a legal framework for the safety infrastructure, and plan how to structure and develop it.

Action 20. The government in cooperation with legislative bodies should consider the process which needs to be employed to licence nuclear power facilities in the later stages of the programme.

2.31. Establishing a nuclear programme requires dedicated legislation which usually does not exist in a State when entering Phase 1. However, some of the legislation needs may be covered due to other activities. Therefore the State performs a complete assessment of the need for legislation and regulatory framework to support safe operation and effective oversight and licensing of a nuclear power plant. This assessment is based on the items listed in GS-R-1.

2.32. Based on the assessment, the State develops a plan to enhance its existing legal and regulatory framework to incorporate all elements. The IAEA Handbook on Nuclear Law provides detailed guidance on this subject.

2.33. A nuclear law, that ensures transparency and which is clearly understandable, is prepared in Phase 1 so as to be enacted as a starting point of Phase 2. Drafters of legislation who are not nuclear energy specialists must consider the scientific validity and practicability of suggestions that other persons may make with a view to enhancing nuclear safety. The nuclear law itself need not and typically does not contain detailed technical requirements.

These will usually be promulgated by the regulatory body in the form of regulations or licence conditions. The nuclear law needs to address the following:

- Safety principles for protecting people and the environment from radiation risks, both at present and in the future (see also the chapter “Radiation protection”);
- The types of facilities and activities that need to be licensed in connection with nuclear power production, and the general legal process for licensing, in accordance with a graded approach to safety;
- The rationale for the authorization of new facilities or activities and the applicable decision making process, including provisions for the involvement of interested parties and for their input into decision making (see also the chapter “Transparency and openness”);
- Provisions for assigning legal responsibility for safety to operating organizations (see also the chapter “Operating organization”);
- The establishment of a regulatory body (see also the chapter “Regulatory framework”);
- Provisions for the review and assessment of facilities and activities, in accordance with a graded approach (see also the chapter “Safety assessment”);
- The authority and responsibility of the regulatory body to promulgate (or to prepare for the enactment of) regulations and to develop guidance for their implementation;
- Provisions for inspection and enforcement, in accordance with a graded approach;
- Provisions for appeal against regulatory decisions;
- Provisions for arrangements for preparedness for and response to a nuclear or radiological emergency (see also the chapter “Emergency preparedness and response”);
- Provisions for ensuring nuclear security, including arrangements for clear delineation of responsibilities with regard to the interfaces between safety and security aspects (see also the chapter “Interfaces with nuclear security”);
- Provisions for a system of accounting for and control of nuclear material;

- Provisions for acquiring and maintaining the necessary competence nationally for ensuring safety (see also the chapters “Human resources development” and “Research for safety and regulatory purposes”);
- The responsibilities and obligations in respect of financial provision for the management of radioactive waste and of spent fuel and for decommissioning of facilities and termination of activities (see also the chapters “Funding and financing” and “Safety of radioactive waste, spent fuel management and decommissioning”);
- The criteria for the removal of regulatory control;
- The specification of offences and the corresponding penalties;
- Provision for controls on imports and exports of nuclear material and radioactive material.

2.34. For drafters of legislation unfamiliar with nuclear law and nuclear technology, a tempting approach in preparing national nuclear legislation is merely to incorporate into it the language of safety standards or guidelines developed by international organizations (primarily the IAEA) or the text of laws adopted by States with highly developed legal frameworks. This approach could be tempting for a number of reasons. First, it reduces the amount of totally new legal texts that must be drafted. Second, it takes advantage of the technical or legal expertise of experienced organizations or States. Third, in the case of the incorporation of IAEA safety standards, it can help a State receive IAEA technical assistance to comply with the requirements of the IAEA.

2.35. However, these advantages are accompanied by difficulties that warrant careful consideration. First, there are concerns whether and how international or foreign requirements will fit into a State’s legal structure. Second, standards or guidelines prepared elsewhere may contain provisions that are inconsistent with or contradictory to important features of a State’s legal structure. Third, translation might raise other concerns, since foreign terms relating to nuclear energy that are not translated may be meaningless or confusing to persons expected to apply the national law or to comply with it. In addition, difficulties may arise from the fact that the external requirements (e.g. international instruments) may be subject to change, sometimes on a regular basis.

2.36. There is a strong relationship between the development of a national nuclear legislation and the consideration to become party to the international conventions in the field of nuclear energy; these two processes are intimately linked. Therefore, the State ensures that the national law is consistent and reflects the provisions of the relevant international instruments.

2.37. After the preparation of a reasonably detailed initial draft, many governments have found it useful to subject the draft to a review, in order to assess its adequacy and public acceptability.

So as to ensure legal consistency and to avoid conflicts and confusion on the application of law, the State also needs to identify correlated laws to be prepared or amended, both safety-related and non directly safety-related, which notably includes: environmental protection, occupational health and safety of workers, nuclear liability, criminal enforcement, land use planning, international trade and customs, scientific research, nuclear security and non-proliferation issues, as applicable.

2.38. In Phase 1, the government recognizes that effective licensing requires a sound legal and governmental infrastructure, including a regulatory body with well defined responsibilities and functions. So as to conduct licensing effectively, the general process which needs to be utilized is considered and communicated to all interested parties as early as possible in the nuclear programme development. This provides the applicant with the information that will be necessary to support licensing submittals, as well as the stages of development that will require licensing. Further information about this topic can be found in the IAEA draft Safety Guide document DS416 “Licensing process for nuclear installations” (under preparation).

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, 2 ,3 and 4 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.12 and 2.13 of GSR Part 3 (DS379, revision of BSS115);
- 1 of GSR Part 5;
- 3.3 and 3.4 of WS-R-5;

necessitates that:

Action 21. The government in cooperation with legislative bodies should enact and implement essential elements of the legal framework for the safety infrastructure.

2.39. During Phase 2, all essential national legislation identified during the assessment process of Phase 1 is enacted.

2.40. In order to ensure legal consistency, the State has also complemented or amended related laws identified in Phase 1, such as those regarding environmental protection, occupational health and safety of workers.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 2 ,3 and 4 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.12 and 2.13 of GSR Part 3 (DS379, revision of BSS115);
- 1 of GSR Part 5;
- 3.3 and 3.4 of WS-R-5;

necessitates that:

Action 22. The government in cooperation with legislative bodies should ensure that the legal framework for the safety infrastructure is fully in place and is being complied by the relevant organizations.

2.41. In Phase 3, the role of the government is to ensure that the legal framework is fully in place, and that it is implemented, complemented and amended, as appropriate.

2.42. Many States have established mechanisms for helping determine whether a law is being implemented in a manner consistent with its objectives. Legislation containing reasonable provisions for reporting on implementation can help to maintain confidence in the regulatory process. Annual reports by regulatory authorities are a common mechanism in this regard.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

Other related publications

IAEA Handbook on Nuclear Law

ACTIONS 23-39: REGULATORY FRAMEWORK

Introduction

2.43. Principle 2 of the Safety Fundamentals SF-1, "Role of government", states that "An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained".

2.44. In a National Nuclear Power Programme, the role of the regulatory body is paramount to verifying that site evaluation, design, construction and operation are performed safely. The core functions of the regulatory body, as allocated in the legislation, include the following:

- preparation of regulations and guides;
- authorization;
- review and assessment of information relevant to safety;
- inspections of facilities and activities;
- regulatory enforcement of compliance with general safety principles and specific safety regulations and standards.

2.45. The regulatory body's responsibilities also include:

- ensuring that emergency preparedness and emergency plans are in place to protect the public, workers and the environment;
- establishing appropriate means of informing interested parties in a transparent manner; and
- fostering coordination with other national and international bodies.

2.46. To be effective, the regulatory body needs adequate authority, independence, financial support, and technically competent staff. Requirements for an effective Regulatory Body can be found in GS-R-1, and the implementations of the requirements above are supported by Safety Guides GS-G-1.1 through GS-G-1.5 and INSAG-17 report "Independence in Regulatory Decision Making".

3.2. Staffing of the regulatory body and the development of its management system are respectively is addressed in the chapters "Human resources development" and "Leadership and management for safety" of this guide.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1, 3, 4,7 and 11** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.14 to 2.17** of GSR Part 3 (DS379, revision of BSS115);
- **1** of GSR Part 5;

necessitates that:

Action 23. In case the nuclear safety regulatory body is already established or identified in Phase 1 (which is not the scenario developed in this Safety Guide, where it is established at the beginning of Phase 2), it should be involved together with the government in the safety infrastructure development activities from the beginning.

Action 24. The government should recognize the need for an effectively independent and competent regulatory body, and consider the appropriate position of the regulatory body in the State's structure.

Action 25. The government should identify the prospective senior managers of the regulatory body.

Action 26. The government should consider the various alternative regulatory approaches and recognize their importance with subsequent activities.

2.47. In Phase 1, the Regulatory body may or may not already exist. In any case, emphasis is given to assessing and understanding the appropriate position of the regulatory body in the governmental structure of the State.

2.48. Due consideration is given to whether existing regulatory authorities (which might be dealing with radiation protection, transport, environment, etc.) will be expanded or whether a new regulatory authority will be created. If different authorities are to coexist, then clarity of their respective role and responsibilities is considered.

2.49. The prospective senior managers of the regulatory body are identified and a strategy to begin accumulating nuclear regulatory knowledge is considered.

2.50. It is recognized that the different regulatory approaches currently in use vary significantly from one State to another. The approaches used in States with large nuclear programme may be different from those in countries with only a few nuclear power plants.

Also the approaches in countries with a national vendor may be different from those in the countries importing nuclear power plants.

2.51. The development of the regulatory framework involves a balance between the need for flexibility and the need to include detailed requirements and standardized practices. This balance might depend upon the national legal system and philosophy. Since the approach chosen will have major influence on the resources needed by the regulatory body, and the decision on approach needs to be made in Phase 2, those expected to be in charge of the regulatory body start learning and considering various approaches in Phase 1. A strategy is envisioned to determine which regulatory approach will be chosen.

2.52. The IAEA Safety Standards publication GS-G-1.4 "Documentation for Use in Regulating Nuclear Facilities" presents some advantages and disadvantages of different regulatory approaches and provides further information on this topic.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, 3, 4, 7, 11, **16, 17, 18, 21, 22, 23, 24, 25, 26, 30 and 32** of GSR Part 1 (DS415, revision of GS-R-1);
- 2.14 to 2.17 of GSR Part 3 (DS379, revision of BSS115);
- 1 and **3** of GSR Part 5;
- **3.5 and 3.6** of WS-R-5;
- **3.7** of GS-R-3;

necessitates that:

Action 27. The government in cooperation with legislative bodies should establish an effectively independent regulatory body, if not already established, and empower it with the adequate legal authority, technical and managerial competence, and human and financial resources to fulfil its responsibilities in the nuclear power programme.

Action 28. The government in cooperation with legislative bodies should, in particular, appoint senior managers and key experts to the regulatory body and form its organizational structure.

Action 29. The regulatory body should consider adopting the IAEA Safety Standards for developing a consistent regulatory approach, possibly supported with appropriate national requirements and guides.

Action 30. The regulatory body should issue regulations or guides specifying the documentation and procedures needed in the various steps of licensing.

Action 31. The regulatory body should specify safety requirements needed for tendering process.

Action 32. The regulatory body should begin establishing suitable working relationship with the operating organization and international organizations.

2.53. The regulatory body is established and it is made effectively independent from the entities of the government which promote the development of nuclear capabilities. Positions requiring essential expertise are identified and filled in these organizations and a national process for preparing and issuing safety regulations is implemented.

2.54. A knowledgeable decision has been made on whether to expand existing regulatory authority or whether to create a new regulatory authority. If the regulatory body consists of more than one authority, there is a need for formal arrangements to ensure that regulatory responsibilities and activities are clearly defined and co-coordinated, to avoid any omissions or unnecessary duplication or conflicting requirements placed upon the operating organization.

2.55. It is essential that the regulatory body have the legal authority, technical competence and resources to fulfil its statutory obligation to regulate facilities and activities.

2.56. The organization of the regulatory body, its structure, size and technical skills of staff will change as it goes through various stages in Phase 2, starting with its early organization and preparation of its regulatory framework to the stage where it is able to specify safety regulations and make safety assessment as part of the licensing. Therefore, the regulatory body develops competences in managing growth and change.

2.57. One of the first things the regulatory body needs to duly consider before starting recruitment of its staff is the future regulatory approach. The approach to be chosen can have major impact on the needed number and qualifications of the regulatory staff. Notwithstanding the chosen approach, it is necessary to develop an approach and to recruit enough staff to cover all core competences needed for understanding all relevant safety issues

of the nuclear power programme. The regulatory approach has also implications to the need for external expert support to the regulatory body.

2.58. Main alternatives are a prescriptive approach with a large number of national regulations or performance/function/outcome oriented regulation. There are also approaches that combine features of these main alternatives. Those being in charge of the regulatory body choose an approach that best matches the State's needs, and have it approved by the government as concerns resource implications. Each of the individual regulatory approaches has benefits and difficulties associated with it.

- A prescriptive approach places a great deal of importance on the adequacy of the regulations for safety and requires detailed development. The regulations provide clear requirements and expectations for the regulator as well as the operating organization, and thus can be used to promote systematic interaction between the regulatory body and other parties. The regulations could give rather detailed technical requirements but this is not necessary. Thus they are intended to identify issues that the operating organization and its suppliers will address and present for assessment of the regulatory body. Specific technical requirements can then be taken from standards issued by generally recognized standards organizations, as agreed by the regulatory body during an early stage of the nuclear power plant authorization project. It is recognized that issuing detailed regulations places a high demand on regulatory resources for their development and update, adding to the administrative burden.
- Performance based regulatory approaches allow the operating organization more flexibility in determining how to meet the established safety goals and may require fewer and less detailed regulations. However, this approach requires the establishment of defining specific safety goals and target. Finding appropriate measures to assure safety may be difficult unless both the regulatory staff and the staff of the operating organization have the same high level of professional competence and be able to interact in a way that seeks consensus on adequate achievement of the established safe objectives under each topic.

2.59. Besides the above general alternatives, the approaches in different States vary with respect to the scope and depth of safety assessment and inspection. The scope of issues being under regulatory oversight may be limited to the most safety relevant parts of the facilities

and activities. These targets of the comprehensive and systematic regulatory oversight may be specified in a deterministic manner, based on safety classification, or they can be chosen based on probabilistic assessment of risks. Furthermore, in some States the regulatory bodies put more emphasis to the assessment and auditing of management system and operations of the operating organizations and their suppliers while in others the regulatory body prefers making comprehensive independent analysis and inspections of their own.

2.60. Once a regulatory approach has been selected, it is implemented by developing regulations, safety requirements, and guides that will be necessary to support construction, licensing and operation of the facility. The IAEA Safety Standards can be utilized as a good support for this.

2.61. The organizational structure and size of the regulatory body may be influenced by many other factors such as the number of authorities involved in the regulatory process, the legal system, the regulatory approach selected, the extent of procurement from foreign vendors, the role and capability of technical support organizations, etc.

2.62. The regulatory body's core functions and oversight practices are clearly defined as per the legislation, and as stated by GS-R-1. Specific guidance to assist the regulatory body in establishing its regulatory framework can be found in Safety Guides Series Nos. GS-G-1.1 through GS-G-1.5.

2.63. The relation between the regulatory body and the operating organization is based on mutual understanding and respect as well as a frank and open communication, bearing in mind that the prime responsibility for safety is assigned to the operating organization and the primary role of the regulatory body is to ensure that the operating organization fulfils its responsibilities.

2.64. The regulatory body has established links with other international regulatory bodies whose expertise is well established and recognized, and also with regional and international forums and networks.

2.65. Throughout Phase 2, the regulatory body has a firm strategy for prioritizing development of regulations. Regulations governing design, site evaluation, environmental assessment, construction and manufacturing are prepared early in Phase 2 as needed to provide input to the bidding process. It is recommended that, in setting its requirements, the regulatory body adopts as a reference the IAEA Safety Standards, which are vendor neutral. The regulatory body may complement these with a well established set of national

requirements and industrial standards that are in use in countries with extensive experience from nuclear power plant operation. Regulations which could have an impact on the choice of technology are established early in the process. Plan and schedule for development of other safety regulations are prepared. In developing regulations and guides, it is essential that the regulatory body take into consideration comments from interested parties and the feedback of experience.

2.66. The process to be used for licensing is identified such that applicants are aware of the requirements for licensing, including what specific activities or stages related to the nuclear programme development will require licensing, what the required content of licence applications are, and what level of interested party (including the public) involvement will be included in the process. The regulatory body will determine what level of review is necessary for each licence submittal. Typically, licensing will be required for major activities such as sitting, design, construction, commissioning and operation. Alternative licensing processes may also be implemented. Whatever process is chosen, it is established in Phase 2.

2.67. The regulatory body issues guidance on the format and content of documents to be submitted by the operating organization in support of applications for authorization.

2.68. Further information about this topic can be found in the IAEA draft Safety Guide document DS416 “Licensing process for nuclear installations” (under preparation).

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 3, 4, 7, 11, 16, 17, 18, 21, 22, 23, 24, 25, 26, **27, 28, 29,** 30, **31,** 32 and **33** of GSR Part 1 (DS415, revision of GS-R-1);
- 2.14 to 2.17 of GSR Part 3 (DS379, revision of BSS115);
- 1 and 3 of GSR Part 5;
- 3.5 and 3.6 of WS-R-5;
- 3.7 of GS-R-3;

necessitates that:

Action 33. The regulatory body should select and implement a regulatory approach in accordance with national arrangements.

Action 34. The regulatory body should maintain suitable working relationships with the operating organization.

Action 35. The regulatory body should ensure adequate planning for all the required oversight activities to be conducted during licensing, construction, commissioning and operation.

Action 36. The regulatory body should establish a consistent procedure for issuing, revising and revoking regulations and guides.

Action 37. The regulatory body should ensure that a comprehensive set of regulations and guides is fully in place to regulate construction, commissioning and operational activities at the appropriate time.

Action 38. The regulatory body should implement its inspection and enforcement programme during construction.

Action 39. The regulatory body should review and assess programmes to be implemented by the operating organization, as appropriate.

2.69. Once the vendor has been chosen through the bid evaluation process, it is worthwhile to consider co-operation with the regulatory bodies of those States where the same vendor has supplied similar plants, and especially of the home State of the vendor if such can be identified. Possibilities to benefit from the experience of other States are obvious and could influence into the earlier chosen regulatory approach.

2.70. In many cases, it is useful to accept the use of technical standards of the vendor country or of a country having oversight experience with the selected reactor. It is also useful to learn from the earlier independent analysis and safety assessment. Furthermore, the other regulators can give insights of the quality of key manufacturers and other suppliers, and this reduces the need for new auditing and evaluation of these organizations.

2.71. A common option chosen in the past, for safety regulation by the States importing their first plant, was indeed to use the regulation and standards of the supplier State. This had an obvious advantage in that the supplier knew in detail which requirements it had to meet, and it was easier for the regulatory body because of the criterion that installation was licensed in the supplier country. However this approach has a significant disadvantage too. The importing State's regulatory approach has to be aligned with the approach of the adopted regulations, and keeping abreast of all changes in these regulations is difficult. If a State subsequently

purchases a plant from a supplier with a different regulatory approach or licensing system, or if a major back-fitting programme is implemented, it would be difficult to reconcile the two systems.

2.72. If the option chosen is to use and/or further develop the own system, the State could continue basing its regulatory framework on the approach found most suitable in Phase 2 and make necessary adjustments throughout the Phase 3, based on the experience gained during implementation of the first nuclear power plant project. In addition, the IAEA Safety Standards are utilized since these are intended to be the basis for harmonized regulatory approaches. In any case, it is important that the regulatory body have a clear understanding of the basis for the regulations such that subsequent regulatory actions or changes can be fully and knowledgeably evaluated.

2.73. Experiences have shown that periodic meetings between high level officials of the regulatory body and operating organization are beneficial for both parties.

2.74. In Phase 3, the regulatory oversight may cover the following broad areas (as appropriate): construction, manufacturing of components, training and qualification, technical specifications, maintenance, surveillance testing, management of modifications, fire protection, radiation protection, emergency preparedness and management system of both the operating organization and the various suppliers involved. The regulatory body ensures a planning for all these oversight activities in Phase 3.

2.75. The regulatory body’s management system covers the activity of production of regulation and guides. A consistent procedure for establishing, revising and revoking regulations and guides has been established, in accordance with the State’s legal system. The periodic review is able to find a balance between the necessity of changes, due to events like changes in the legislation, results from research and development in fields relevant to safety, and too frequent changes, which can affect the stability of the regulatory system. Further development about revision of regulations and guides can be found in GS-G-1.4.

2.76. Licensing, a major regulatory activity in Phase 3, is based on independent regulatory review and assessment of documents which are submitted by the operating organization. During this phase, site authorization, construction licence and operation license, where applicable, have to be issued. Therefore next to the procedure for granting an authorization, a procedure for any subsequent amendment, suspension or revocation of the authorization has been issued.

2.77. As the regulatory body will have to conduct its first inspections, it ensures that it has statutory power to enforce compliance with its requirements as specified in the applicable regulations and in licence conditions, also during the construction phase.

2.78. The regulatory body develops a comprehensive inspection programme to carry out its inspection duties. Consideration is given to getting support from countries which have oversight experience with the selected reactor. The overall inspection may consist of three facets:

- routine inspections conducted by resident or non-resident inspectors;
- specific or more focused inspections conducted by inspectors with relevant expertise;
- reactive inspections conducted after abnormal events.

2.79. The extent to which the regulatory body does its own testing and measurements work independently of the operating organization has to be defined and included in the regulatory philosophy, taken into account the qualification of personnel required as well as instruments and laboratory facilities available (within the regulatory body and by external expert support). The conduct of any tests and measurements by the regulatory body or its expert support organization does not relieve the operating organization of its prime responsibility for safety.

List of main relevant IAEA safety standards

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities

GS-G-1.2 Review and Assessment of Nuclear Facilities by the Regulatory Body

GS-G-1.3 Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body

GS-G-1.4 Documentation for Use in Regulating Nuclear Facilities

DS416 Licensing Process for Nuclear Installations

GS-G-1.5 Regulatory Control of Radiation Sources

WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment

Other safety key-publications

INSAG-5 The Safety of Nuclear Power

INSAG-12 Basic Safety Principles for Nuclear Power Plants

INSAG-17 Independence in regulatory decision making

ACTIONS 40-48: TRANSPARENCY AND OPENNESS

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1** and **36** of GSR Part 1 (DS415, revision of GS-R-1);
- **3.6** and **5.26** of GS-R-3;
- **1** of GSR Part 5;

necessitates that:

Action 40. The government should establish a policy and guidance to inform general public and interested parties of the benefits and risks of nuclear power as needed to facilitate their involvement.

Action 41. The government should establish a process to ensure that the comments resulting from consultation with relevant interested parties are considered, and it should communicate about the results of these considerations to the interested parties.

2.80. Principle 4 of the Safety Fundamentals, Justification of facilities and activities, states that facilities and activities that give rise to radiation risks will yield an overall benefit. A decision to launch a nuclear programme requires a broad acceptance in the society that such programme is justified. The government establishes a clear decision making process to justify use of nuclear energy for power production and communicates about it.

2.81. Societal acceptance is a prerequisite for the implementation of a national nuclear power programme. The acceptance has to be confirmed before making major investments and organizational arrangements. For gaining true acceptance, it is necessary that the decision makers and the general public are given an opportunity to get a realistic and credible picture of the benefits as well as the safety risks involved and of the environmental impact of the nuclear power plant operation and associated activities (such as radioactive waste management and spent fuel management).

2.82. The government ensures that all interested parties have easy access to general and easily understood information on radiation and nuclear safety and there are opportunities to express opinions, based on GS-R-1. This spectrum of audiences will have a range of different concerns, levels of knowledge and experience and will therefore call for communication at

different levels of technical details, via different channels. Public opinions and comments are properly summarized and considered as part of the process that is intended to lead to a decision on launching the nuclear programme.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, **21, 34** and 36 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.6, 5.26 and **5.27** of GS-R-3;
- **2.30** and **2.33** of GSR Part 3 (DS379, revision of BSS115);
- 1 and **3** of GSR Part 5;
- **2** of NS-R-2 (DS413);

necessitates that:

Action 42. The government should inform all interested parties regarding the safety implications of the decision on the implementation of a national nuclear power programme.

Action 43. All the relevant organizations should continue informing the general public and interested parties on safety issues, including health and environmental impacts.

2.83. Various entities, such as the government, the regulatory body or the operating organization, have responsibilities in communicating risks and benefits to interested parties in a clear and transparent manner.

2.84. Requirements on transparent communication and interested parties involvement are incorporated into the nuclear legislation that is enacted during Phase 2. The legislation requires the operating organization to disseminate public information on the planned facilities and their safety features and environmental impact.

2.85. The government informs all interested parties regarding decisions on the implementation of a national nuclear power programme, which includes the public, local government, committees representing local interests, industry, media, non governmental organizations (NGOs) and neighbouring countries.

2.86. Public and interested party involvement, including hearings, consideration and resolution expressed in those hearings, is made part of the licensing process.

2.87. The regulatory body communicates its activities and role so as to assure interested parties that it is competent, independent and empowered with necessary authority. The fundamental principles on which the relationship between the regulatory body and the public at large, are expected to be based on:

- independence;
- technical competence and credibility;
- neutrality (without any biases) and balance;
- timeliness, accuracy and transparency; and
- acceptance of responsibility and accountability for promulgation and enforcement of nuclear safety regulations and requirements.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 21, 34 and 36 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.6, 5.26 and 5.27 of GS-R-3;
- 2.30 and 2.33 of GSR Part 3 (DS379, revision of BSS115);
- 1 and 3 of GSR Part 5;
- **4.53 to 4.54**, **4.82 to4.84** of GS-R-2;
- 2 of NS-R-2 (DS413);

necessitates that:

Action 44. All the relevant organizations should establish and maintain confidence and trust with the interested parties, including the public.

Action 45. All the relevant organizations should continue explaining the rationale for introducing nuclear power, including benefits and risks, and the measures taken to limit the risks.

Action 46. The regulatory body should communicate about the licensing process, the safety requirements, and the regulatory oversight to interested parties.

Action 47. The operating organization and the regulatory body should communicate about the construction progress and the commissioning programme to interested parties.

Action 48. The operating organization and the regulatory body should maintain transparency regarding problems and difficulties encountered with all the interested parties involved in the construction programme, including suppliers.

2.88. Communication is continued on a regular basis and in a structured manner.

2.89. The operating organization explains to the general public the technology being deployed in its nuclear power plant and the related environmental impact. This could be done in a permanent centre near the nuclear power plant and occasionally in other locations. The operating organization also informs the news media on the progress of construction activities, including possible problems of general interest.

2.90. Likewise, the regulatory body keeps the public and the news media informed on experiences from the construction and commissioning. When a nuclear power plant is under operation, the regulatory body has a particular function to communicate actively and without delay on abnormal events whenever they occur and also to report other safety concerns that may arise. With this regard, full understanding of the International Nuclear Event Scale (IAEA-INES) is necessary for prompt communication of safety significance.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GS-R-3 The Management System for Facilities and Activities

Other safety key-publications

INSAG-20 Stakeholder Involvement in Nuclear Issues

ACTIONS 49-59: FUNDING AND FINANCING

Introduction

2.91. An important factor in ensuring safety in the long term is sustainable financing for safety activities, which include the development and implementation of appropriate legislation, the development and implementation of the regulatory body, and the long term financing of all activities related to safety, both from an operational and a regulatory point of view.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1, 3, 10** and **11** of GSR Part 1 (DS415, revision of GS-R-1);
- **4.1** of GS-R-3;
- **1** of GSR Part 5;
- **6.1 to 6.5** of WS-R-5;
- **1, 3** and **4** of NS-R-2 (DS 413);

necessitates that:

Action 49. The government in cooperation with legislative bodies should plan funding for education and training, research centres, support activities, etc.

Action 50. The government should consider funding mechanisms for the regulatory body, and plan it.

Action 51. The government should plan funding for radioactive waste and spent fuel management, decommissioning and final disposal.

Action 52. The government should consider financing mechanisms of a nuclear power plant to ensure long term safety.

2.92. The government starts envisioning the different financing mechanisms of a nuclear power plant, giving due consideration that financial matters will never compromise safety in the later stages of the national nuclear power programme development.

2.93. The funding mechanism for the regulatory body may be direct funding from the government budget, establishment of a fund where money is collected (possibly jointly from the government and the operating organizations), or some other arrangement that ensures

adequate funding and resources. Whatever the funding mechanism, it needs to be ensured by legislation to ensure sustainability. The regulatory body funding is flexible to accommodate variations in its workload.

2.94. Financing is also planned for basic education and training on subjects relevant to safe nuclear power operation and for the safety research that is intended to provide the national knowledge base.

2.95. Funds for management and final disposal of radioactive waste, spent fuel and decommissioning, have to be collected from the beginning of operation. Funds are secured to avoid being depleted for other purposes or through inflation. In Phase 1, basic decisions on establishing such funds, on the principle mechanism for fund collection and on the organization responsible for managing the fund are made.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, 3, 10 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.1 of GS-R-3;
- 1 of GSR Part 5;
- 6.1 to 6.5 of WS-R-5;
- 1, 3 and 4 of NS-R-2 (DS 413);

necessitates that:

Action 53. The government in cooperation with legislative bodies should establish the necessary arrangements to provide assured long-term financing for education and training, research centres, support activities, etc.

Action 54. The government in cooperation with legislative bodies should be adequately implementing funding mechanism for the regulatory body.

Action 55. The operating organization should plan and ensure appropriate financing so as not to compromise safety during all the stages of the nuclear power programme

Action 56. The government in cooperation with legislative bodies should enact legislation that requires collection of funds and securing these funds for long term management of waste and decommissioning.

2.96. All the necessary arrangements are established so as to ensure that adequate resources will be allocated in a sustainable manner for developing the national knowledge base commensurate with the national participation strategy, and for the safety oversight of the nuclear facilities.

2.97. Collection of money for long term management and final disposal of radioactive waste, decommissioning and management of spent fuel, is planned taking into account that the plant may be forced to stop operation before its planned lifetime.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 3, 10 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.1 of GS-R-3;
- 1 of GSR Part 5;
- 6.1 to 6.5 of WS-R-5;
- 1, 3 and 4 of NS-R-2 (DS 413);

necessitates that:

Action 57. The government in cooperation with legislative bodies should continue providing appropriate funding for the efficient and effective conduct of the regulatory activities.

Action 58. The operating organization should ensure that financing is sufficient to sustain the safe operation of the nuclear power plant.

Action 59. The government and/or the regulatory body should ensure that a system for the funding of decommissioning and radioactive waste management is implemented.

2.98. By the end of Phase 3, the operating organization has established rates of electricity and tariffs which are commensurate with the national tariff structure. The rate fixed is such that it is sustainable for the safe operation of nuclear power plant.

2.99. Funds for decommissioning and long term spent fuel and waste disposal is established as per requirement in the legislation. Provisions are in place to ensure that that these funds are not depleted by unauthorized use or inflation. In the early stage of operation, appropriate monetary instruments are used to secure the adequacy of the funds until the full amount has been collected.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities

GS-R-3 The Management System for Facilities and Activities

GSR Part 5 Predisposal Management of Radioactive

WS-R-5 Decommissioning of Facilities Using Radioactive Material

NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)

NS-G-2.4 The Operating Organization for Nuclear Power Plants

ACTIONS 60-72: EXTERNAL SUPPORT ORGANIZATIONS AND CONTRACTORS

Introduction

2.100. The operating organization and the regulatory body are competent to make all decisions under their own responsibility. However, they may not have sufficient resources within their own organisation, in terms of number of staff or range of expertise to do this to the extent necessary. Therefore, technical or other expert professional support may be sought from external organizations or individuals to make well informed decisions. One advantage of this approach is to provide staff with easy access to various competent scientists and engineers.

2.101. As an example, the regulatory body may need services such as developing safety analysis tools, making independent safety analysis, and conducting experimental research. Also, the operating organization will have to liaise with various suppliers, both for the construction of the nuclear power plant and for its operation and maintenance. In particular, contractor personnel may be used to perform tasks that are of a specialized or temporary nature for which it is not feasible to hire or maintain a full-time plant employee.

2.102. Organizations from which the regulatory body may obtain support are of different nature and typically include:

- advisory bodies;
- dedicated technical support organisations (TSOs);
- research centres;
- academic institutions;
- specific experts or consultants, etc.

2.103. Further information about this topic can be found in the IAEA draft Safety Guide document DS429 “External expert support on safety issues” (under preparation).

2.104. Organizations or contractors with which the operating organization may have to liaise are of different nature and typically include:

- plant vendors;
- various suppliers;
- external maintenance organizations;

- dedicated technical support organisations (TSOs);
- research centres;
- academic institutions;
- specific experts or consultants, etc.

2.105. Further information about this topic can be found in the IAEA Safety Guide NS-G-2.4 “The Operating Organization for Nuclear Power Plants”.

2.106. It is essential that external experts or contractor personnel be trained and qualified for the task to be performed. It is the responsibility of the organizations obtaining external support to ensure that safety-related activities are performed by qualified personnel. For instance, documented assurance that contractor personnel have the necessary qualifications may be requested prior to involvement in these activities.

2.107. When external expertise or advice is provided, particularly to the regulatory body, it is essential to ensure that such support is independent.

2.108. The roles and responsibilities of external supporting organizations have to be clearly defined and understood. Where these supporting organizations play a significant role in the operation or regulation of a plant, the management system of the operating organization or the regulatory body needs to embrace their activities. Clear limits have to be set for the degree of control and direction over these activities.

2.109. Any support obtained by the regulatory body or the operating organization does not relieve them of their responsibilities. It is essential that the regulatory body and the operating organization have an adequate core competence to make informed decisions, which includes an adequate number of personnel, with the knowledge, training and skills necessary to supervise and evaluate the work of contractors, as well as adequate contractual arrangements.

2.110. In countries with an appropriate industrial base, it is desirable that domestic organizations participate in the construction of nuclear power plants, since independent competences within the State will support safe long term operation of the nuclear power plant.

2.111. The maturity of the national technical infrastructure is an important boundary condition to be considered for ensuring the safety of nuclear power plant operation. A nuclear power plant is not an isolated island but its safe and reliable operation needs to be supported by a number of different elements from outside. The access to these services and their

reliability throughout the whole life cycle needs to be taken into account. One vital element for a nuclear power plant is the availability of electrical power, and the reliability of the power supply that depends mostly on the reliability of the external grid.

2.112. Some technical services might be outsourced, as appropriate, such as dosimetry and environmental monitoring, in-service testing and inspection, metrological activities, some maintenance activities, etc.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **4, 11, 13** and **20** of GSR Part 1 (DS415, revision of GS-R-1);
- **3.14** and **5.23** of GS-R-3;
- **2.21** of GSR Part 3 (DS379, revision of BSS115);
- **3** of NS-R-2 (DS413);

necessitates that:

Action 60. The government should consider the availability of expertise, industrial capability, technical infrastructure and services that could support the long term national safety infrastructure.

Action 61. The government should assess the need to create or to enhance national organizations providing support to the nuclear power programme, and to improve the national technical infrastructure.

2.113. Expertise may, at the beginning of the nuclear programme, be acquired from foreign expert organizations, but subsequently the support available within the State will become of continuously increasing importance in ensuring safe long term operation of nuclear power plants.

2.114. Therefore, in Phase 1, efforts are made to identify national and international expert organizations which could serve to provide support to both the regulatory body and the operating organizations. If national organizations or capabilities need to be established or enhanced, then planning for these activities is started.

2.115. The government needs to start identifying industry that could possibly participate both in civil construction and in supplying systems, structures and components. During operation, these organizations could support maintenance of the plant and take care of the

equipment they have supplied. This would ensure domestic availability of professional and high quality maintenance during nuclear power plant lifetime.

2.116. Even though domestic industrial capability might not exist at this point, the government might adopt a strategy for national participation and decide to build and develop local industry. For coordinated development of domestic industry and for training the industry to deal with nuclear projects, it would be worthwhile to consider means for building a dedicated engineering organization that would acquire a broad knowledge in the nuclear field and subsequently support manufacturers and other industrial organizations in their nuclear projects.

2.117. As addressed in the requirement 5.67 of NS-R-1, “Interactions between the electrical power grid and the plant”, the availability of electrical power is a vital service for all nuclear power plants is, and the reliability of the power supply depends mostly on the reliability of the external grid. Consideration is given to the safety implications of the introduction of a large electrical generating station on the existing electrical grid. Also, the reliability of on-site power depends on external elements such as provision of high quality industrial products (fuel, fluids, oil, gases…). Among other factors contributing to safety are the supply chain for spare parts and consumables and the access to a skilled workforce. The reliability of the technical infrastructure has to be assessed, and compensatory measures planned as necessary.

2.118. Operation of a nuclear power plant will need technical services related to:

- Radiation protection and safety (including personal dosimetry and environmental monitoring);
- Radioactive waste management;
- In-service testing and inspection;
- Training in nuclear technology;
- Diagnosis activities;
- Metrological activities;
- IT activities;
- Maintenance activities, etc.

2.119. Technical services are not necessarily provided by governments. However, the availability of technical services, whether domestic or foreign, is considered in Phase 1 and

the gaps are identified. Tentative consideration is given to developing strategies for filling the gaps.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 4, 11, 13, **17** and 20 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.14**, 5.14**, 5.23 and **5.24** of GS-R-3;
- 2.21 and **2.38** of GSR Part 3 (DS379, revision of BSS115);
- **37** of NS-R-1 (DS414);
- 3 and **31** of NS-R-2 (DS413);

necessitates that:

Action 62. The operating organization and the government as appropriate should encourage national industrial organizations to develop their capabilities with the objective of participating in the construction of nuclear power plant and supporting safe long term operation.

Action 63. The government should establish organizations providing expertise, engineering or other technical support to the national nuclear power programme, as identified in Phase 1.

Action 64. Expertise, engineering and other technical support organizations should begin building competence and quality assurance programmes.

Action 65. The regulatory body and the operating organization should plan arrangements for overseeing the activities performed by external support organizations and contractors.

Action 66. The operating organization and the government should start to implement plans for improving national technical infrastructure, as needed to fill in previously identified gaps.

2.120. From phase 2, external expert support organizations need to be developing their technical capabilities and competencies as well as experimental and analytical tools needed for providing assurance of adequate nuclear safety.

2.121. Short-term technical support might be suitably provided by highly specialized consultants, private engineering companies, and other industrial organizations. However, it is advisable always to retain some additional alternate expertise to rely on, so as to avoid the development of technical biases over time.

2.122. The role and functions of universities and academic institutions differ from those of TSOs, as the former organizations are best used in providing basic training of engineers and scientists, specialized analysis of specific problems, longer-term confirmatory research and support in the development of longer term innovative regulatory safety philosophy or policy.

2.123. The role and functions of TSOs can include independent confirmatory analyses or research; technical assistance on resolution of specific regulatory issues; preparation and development of technical bases for promulgation, development of the technical bases for safety policy; among others. TSOs can also provide a longer-term function of serving as a technical training centre and maintaining an overall national expertise in nuclear and radiation safety. The size, scope and responsibilities of TSOs are best determined by specific needs of the supported organizations, and they need not be static and need to be flexible enough to allow changes over time, as the supported organizations' needs also evolve.

2.124. Independent regulatory advisory bodies with membership drawn from other departments, regulatory bodies of other states, scientific organizations and the industry may be established to provide long term, broad based independent advice to the regulatory body on all issues relevant to the nuclear regulatory decision making process. These may include complex technical and policy issues, specific regulatory or safety issues, and changes in regulations. Moreover, it can bring broad perspectives to bear on the formulation of regulatory policy and regulation. It is recognized that the advisory body members also need to be technically independent, highly experienced, recognized and respected (by their peers) in their respective fields. The advisory body can also be assembled with specific objectives and charges, to function for a specific period of time.

2.125. The operating organization, and the government if applicable, promote building a national network of industrial organizations that are interested in entering and staying in the nuclear business, since independent competences within the State will support safe long term operation of nuclear power plants.

2.126. In phase 2, the operating organization conducts a realistic assessment of the national and local capabilities to supply commodities, components and services for nuclear facility,

given due consideration to nuclear management system requirements in the evaluation criteria. The operating organization ensures that the providers of goods and services are following good management system practices, both as the receiver of the products and services and as the procurer of the products and services.

2.127. Strict application of quality standards for nuclear equipment and services are generally more stringent than for other industrial operations. If the national policy supports the industrial involvement in construction or support services, then a plan for development of appropriate management systems has to be prepared, so that compliance with nuclear quality assurance needs can be ensured and that the safety of the future nuclear installation is not compromised.

2.128. It is necessary that one or more engineering organizations allied with the operating organization be in the process of acquiring wide competencies in the nuclear field. These competences are used to supply engineering services directly to the operating organization or to support construction and manufacturing industries in learning specific features of the nuclear business. The engineering organizations dedicated to the nuclear field also need to get prepared to support the constructors, manufacturers and other suppliers in making bids to the vendor or to the operating organization. Due consideration is also given to the establishment of appropriate management systems (including quality control and quality assurance) in such organizations so as to meet the level of quality required for nuclear installations.

2.129. During Phase 2, plans are developed for improving national infrastructure, as feasible, and implementation of those plans is initiated. In doing so, it is ensured, inter alia, that the system will be capable of withstanding the sudden loss of the largest generating unit (and also its prolonged scheduled maintenance) without compromising safety. Necessary financing is allocated for this purpose with the objective to complete the improvements before the commissioning of the nuclear power plant.

2.130. Where the external supply of services cannot be provided with adequate reliability, compensatory measures are planned and taken into account in the bid specifications. These could involve the strengthening of certain plant systems with respect to reference plants and preparing for stockpiling under appropriate conditions of spare parts and consumables beyond the common practice.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 4, 11, 13, 17 and 20 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.14, 5.14, **5.15 to 5.20**, 5.23, 5.24 and **5.25** of GS-R-3;
- 2.21 and 2.38 of GSR Part 3 (DS379, revision of BSS115);
- 37 of NS-R-1 (DS414)
- 3 and 31 of NS-R-2 (DS413);

necessitates that:

Action 67. All the relevant organizations should ensure completion of all improvements of the required technical infrastructure and services to provide reliable and timely support.

Action 68. The regulatory body should establish, when appropriate, qualification process for the technical services that have safety implication.

Action 69. External support organizations should continue building competence and maintain sufficient suitably qualified and experienced personnel.

Action 70. All the relevant organizations should ensure clarity of the role and functions of external support organizations or individuals.

Action 71. All the relevant organizations should make appropriate arrangements to avoid conflicts of interest.

Action 72. The regulatory body and the operating organization should oversee the activities performed by external support organizations and contractors, and assess the quality of the service provided, in line with their management system.

2.131. In Phase 3, external support organizations are well established and ready to fulfil their role as determined by the applicable recipients.

2.132. External personnel providing a service or advice to the operating organization, although they may be personally or professionally responsible for the quality of the service or advice given, have no direct authority over plant personnel. As the operating organization retains the responsibility for safety of the plant, it is crucial that it be always responsible for making decisions. Knowledgeable and skilled personnel of the operating organization have to be clearly identified and assigned the supervision of contractors or other temporary support staff

2.133. Areas where close cooperation between the operating organization and the supplier is necessary include:

- training of operating staff;
- preparation of documentation;
- commissioning of the plant;
- maintenance and in-service inspections;
- technical assistance during operation;
- preparation of normal and emergency operating procedures.

2.134. Roles of different expert support organizations need to be studied carefully, to avoid conflicts of interest in case the same organization provides support to both the regulatory body and the operating organization.

2.135. Experience shows that the construction of a nuclear power plant may entail numerous contractors, and it is incumbent to the operating organization to ensure that this complex chain of contractor is adequately managed such that the end-products are acceptable from a safety standpoint. The scope and timing of the tasks performed by the operating organization depend on the option selected for the nuclear power plant supply contract, whether it is a super turnkey, turnkey or split-package contract.

2.136. The operating organization reassesses the national and local capabilities to supply commodities, components and services for nuclear facility. It gives primary importance to management system and safety culture in allocating supply of spare parts, consumable supplies, maintenance services and calibration services.

2.137. Supplier qualification requirements are issued by the operating organization and included in the contracts. The operating organization promotes a common understanding of the key aspects of safety culture and design requirements among the suppliers.

2.138. All improvements of the national technical infrastructure as identified in Phases 1 and 2 such as reliability of electrical power, diesel fuel and spare parts for the safe operation of nuclear power plant have been completed. The nuclear power plant operators have established proper coordination with the grid management organization and tested the reliability of external grid. By this time a redundant and reliable source of off-site power for nuclear power plant have been ensured.

2.139. The operator has the prime responsibility for the quality (and thus safety) of the results of the provided technical services. However, depending on the national system, the regulatory body, or some other national certifying body, might establish certification requirements for providers of technical services that have safety implications. Management systems, including safety culture, should factor into the evaluation criteria.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

DS429 External Expert Support on Safety issues

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

GS-R-3 The Management System for Facilities and Activities

GS-G-3.1 Application of the Management System for Facilities and Activities

GS-G-3.2 The Management System for Technical Services in Radiation Safety

DS349 The Management System for Nuclear Installations

NS-R-1 Safety of Nuclear Power Plants: Design (under revision, **DS414**)

NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)

NS-G-2.4 The Operating Organization for Nuclear Power Plants

Other safety key-publications

INSAG-18 Managing Change in the Nuclear Industry: the Effects on Safety

ACTIONS 73-85: LEADERSHIP AND MANAGEMENT FOR SAFETY

Introduction

2.140. Principle 3 of the Safety Fundamentals SF-1, "Leadership and Management for Safety", states that "Effective leadership and management for safety will be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks".

2.141. The International Nuclear Safety Group (INSAG) defines safety culture as "that assembly of characteristics and attitudes in organizations and individuals, which establishes that, as an overriding priority, […] safety issues receive the attention warranted by their significance."

2.142. Effective and efficient management systems constitute a cross-cutting element of the national safety infrastructure, applicable to all the organizations involved in the nuclear power programme. However, as indicated in Fig. 6, the involvement of the different organizations very much depends upon the Phases. While the government is the major player in Phase 1, the regulatory body may not be created before Phase 2, and the main Phase for the implementation of the operating organization's programmes is Phase 3.

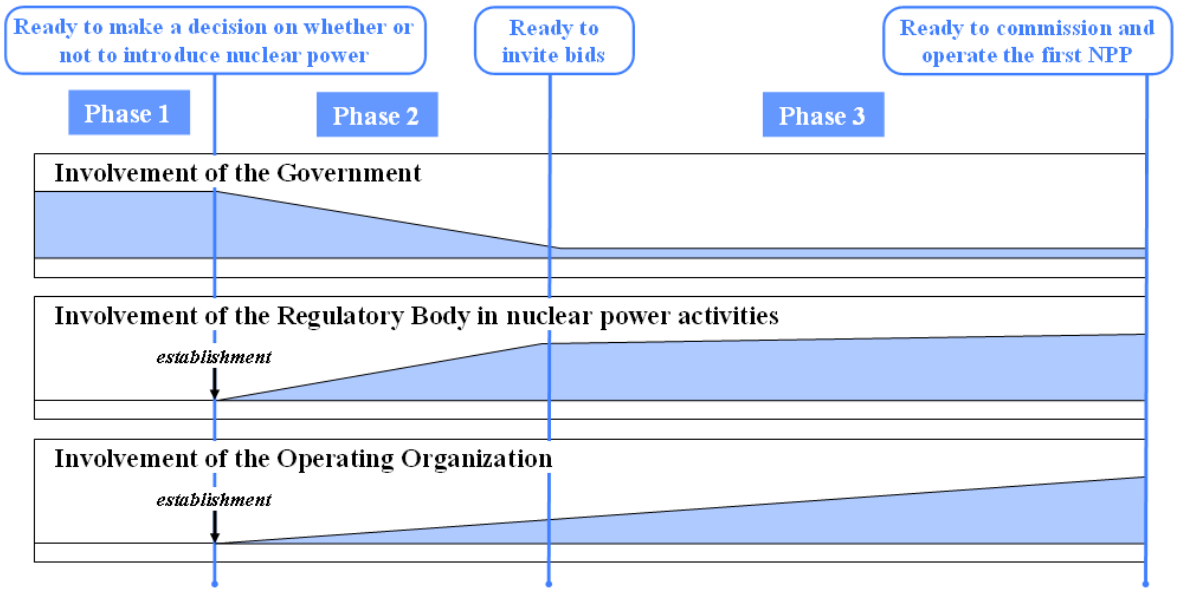

FIG.6. Progressive involvement of the main organizations in the nuclear power programme (indicative only, to be used with flexibility)

2.143. It is essential that all the actions taken by the relevant organizations be included in the framework of an effective management system. In that regard, the requirements stated in GS-

R-3 have to be the basis for the management systems which need to be established before the conduct of the actions, by the applicable organizations at the applicable Phase.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1** and **19** of GSR Part 1 (DS415, revision of GS-R-1);
- GS-R-3 **as a whole**;
- **2.43, 2.44** and **2.47** of GSR Part 3 (DS379, revision of BSS115);
- **6.1 to 6.9** of NS-R-3;

necessitates that:

Action 73. The government should recognize the essential role of safety management and leadership in order to achieve a high level of safety and to foster safety culture within organizations.

Action 74. The government should ensure that all the activities conducted in Phase 1 are included in the framework of an effective management system.

Action 75. The government should give emphasis to persons with a strong safety culture and strong leadership capabilities when identifying senior managers for the prospective organizations to be established.

2.144. In Phase 1, it is essential to recognize that the selection of the initial senior managers is of great importance in establishing effective management focused on keeping safety in a central position. The senior managers will define missions, objectives, policies and strategies of the organizations and will make decisions accordingly. It is therefore of paramount importance that, in identifying persons for top positions in the prospective operating and regulatory organizations, emphasis is given to persons with safety minded attitudes and strong leadership capabilities.

2.145. In particular, if the heads of the regulatory body are recognized as having the highest level of competence (in nuclear technology, law, public administration or some other relevant discipline), the right kind of experience and a sound character, the judgements made by the regulatory body are likely to be respected and implemented. Regulatory bodies headed by persons who are perceived as lacking competence or as holding their position for purely

political reasons will have difficulty in maintaining internal employee morale and external confidence.

2.146. Leadership in safety is necessary at the highest levels in organizations. Safety needs to be continuously achieved by means of an effective management system. An effective management system will assure, in a coherent manner, that safety cannot be compromised by other requirements or demands. Management systems (including quality control and quality assurance) have to ensure, inter alia, the promotion of a safety culture at all levels of the organization, the regular assessment of safety performance, the application of lessons learned from experience, the recognition and treatment of precursors to potential accidents, etc. Human factors also need to be taken into account with consideration of all possible interactions of individuals at all levels with technology and organizations.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, 19 and **35** of GSR Part 1 (DS415, revision of GS-R-1);
- GS-R-3 as a whole;
- 2.43, 2.44, **2.45**, 2.47, **2.48** and **2.49** of GSR Part 3 (DS379, revision of BSS115);
- **7** of GSR Part 5;
- 6.1 to 6.9 of NS-R-3;
- **2** of NS-R-2 (DS413);
- **306** of TS-R-1;

necessitates that:

Action 76. The regulatory body and the operating organization should start developing and implementing effective management systems in their respective organizations and promote a strong safety culture.

Action 77. The regulatory body and the operating organization should develop competences in managing growth and change of the organization.

Action 78. The regulatory body and the operating organization should start making appropriate arrangements for measurement, assessment (both self

assessment and independent assessment) as well as continuous improvement of their management systems.

2.147. Early in Phase 2, all top positions in the operating and regulatory organizations are filled based on criteria defined in Phase 1. A strong safety culture takes time to develop and the new leaders of both the operating and regulatory organization have to initiate, from the very beginning, programmes and practices to build strong safety culture in their respective organizations. An effective way of establishing a strong safety culture and promoting the development of leadership for safety is to implement appropriate management systems which provide structure and direction to the applicable organizations that will have responsibilities in safety, in line with GS-R-3.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 19 and 35 of GSR Part 1 (DS415, revision of GS-R-1);
- GS-R-3 as a whole;
- 2.43, 2.44, 2.45, **2.46**, 2.47, 2.48 and 2.49 of GSR Part 3 (DS379, revision of BSS115);
- 7 of GSR Part 5;
- **5.37 to 5.39** of GS-R-2;
- 6.1 to 6.9 of NS-R-3;
- **2** of NS-R-1 (DS414);
- 2, **8, 9** and **15** of NS-R-2 (DS413);
- 306 of TS-R-1;

necessitates that:

Action 79. The senior management of all the relevant organizations should provide effective leadership and effective management for safety to ensure a sustainable high level of safety.

Action 80. All the relevant organizations should continue the implementation of an integrated management system that promotes the concept that safety shall be paramount within the organization, overriding all other demands.

Action 81. The operating organization and the regulatory body should ensure that the effectiveness of their management system is monitored, measured, and that self-assessments as well as independent assessments are conducted regularly for continuous improvement.

Action 82. All the relevant organizations should ensure that appropriate arrangements for knowledge management (including record and report management) and knowledge transfer are in place.

Action 83. All the relevant organizations should ensure that leadership and succession development programme are in place to develop future leaders with strong emphasis on safety.

Action 84. The operating organization should prepare a safety management programme as well as the corresponding chapter of the SAR.

Action 85. The regulatory body should review and assess the operating organization's programme on safety management.

2.148. The act of empowering individuals and making them accountable for their work encourages individuals to take 'ownership' of their work and to seek improvement in their performance.

2.149. Managers and leaders encourage and welcome the reporting by individuals throughout the organization of potential safety concerns and respond to valid concerns promptly and in a positive manner.

2.150. It is also necessary to ensure a common understanding of the key aspects of safety culture within the organizations and promote questioning attitude at all levels of the organization.

2.151. The operating organization and the regulatory body have to establish and maintain a system for the control of the records and reports that are important to safety. Documentation has to be controlled in a consistent and compatible manner throughout its preparation, change, review, approval, release, distribution and archiving.

2.152. In order to sustain the effectiveness of a management system, it is essential that it be measured and monitored on periodic basis. Self-assessment has been identified as an important mechanism that organizations can use to improve their performance.

2.153. Self-assessment can be reinforced by independent assessment, which can be carried out by independent audit teams within the organization or by bodies that are external to the organization. In this phase, processes for self assessment have been established for continuous monitoring of the effectiveness of the operating organization as well as the regulatory body.

2.154. Senior management need to treat information as a fundamental resource. Proper transmission and continuity of knowledge is vital for long-term sustainability of safety management.

2.155. Programme and processes are in place for the development of future leaders and for the preservation and management of corporate knowledge (both explicit and tacit) of the organization.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-3 The Management System for Facilities and Activities

GS-G-3.1 Application of the Management System for Facilities and Activities

DS349 Management Systems for Nuclear Installations

GS-G-3.2 The Management System for Technical Services in Radiation Safety

GS-G-3.3 The Management System for the Processing, Handling and Storage of Radioactive Waste

GS-G-3.4 The Management System for the Disposal of Radioactive Waste

TS-G-1.4 Management System for the Safe Transport of Radioactive Material

Other safety key-publications

INSAG-4 Safety culture

INSAG-5 The Safety of Nuclear Power

INSAG-12 Basic Safety Principles for Nuclear Power Plants

INSAG-13 Management of Operational Safety in Nuclear Power Plants

INSAG-15 Key Practical Issues in Strengthening Safety Culture

ACTIONS 86-99: HUMAN RESOURCES DEVELOPMENT

Introduction

2.156. Requirement 12 of GS-R-1 states that "The government shall ensure, or provide for adequate arrangements for building the competence of the organizations and individuals that have responsibilities relating to the safety of facilities and nuclear activities". The organizations covered by this requirement include the regulatory body, the operating organization, research and technical support organizations, industrial organizations and organizations providing technical services.

2.157. Further guidance on human resources development for the regulatory body and the operating organization can respectively be found in GS-G-1.1 "Organization and Staffing of the Regulatory Body for Nuclear Facilities" and NS-G-2.8 "Recruitment, Qualification and Training of Personnel for Nuclear Power Plants".

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **1, 11** and **18** of GSR Part 1 (DS415, revision of GS-R-1);
- **4.1, 4.3** and **4.5** of GS-R-3;
- **2.19** and **2.20** of GSR Part 3 (DS379, revision of BSS115);
- 4 of NS-R-2 (DS413);

necessitates that:

Action 86. The government should consider a strategy for securing high-quality personnel.

Action 87. The government should identify competencies required in nuclear safety areas and approximate number of experts needed.

Action 88. The government should explore national and foreign institutions that could provide education and training.

Action 89. The government should identify gaps in existing training institutions and plan to start training and establish new institutions as needed.

Action 90. The government should consider sending nuclear trainees to study and work in foreign institutions.

2.158. Human resource development is a demanding task and its complexity in terms of resources (both time and money) needs to be properly addressed. Therefore, an assessment of the education and training needs to be conducted as one of the first tasks during Phase 1. Cooperation with other States and international organizations can provide insights into necessary competences and human resources required for implementing a nuclear programme.

2.159. The assessment process develops a list of expertise areas necessary to support development of legal and regulatory framework, site evaluation and design assessment, construction and regulatory oversight, along with estimates of the number of individuals needed in those functional areas. At later phases expertise will be needed for commissioning, operation, maintenance and waste management.

2.160. The assessment process also examines the current capabilities of existing academic facilities, research and development centres as well as technical training institutions to provide training for certain technical expertise areas that will be required for nuclear power plant licensing, operations and oversight. The assessment leads to conclusions on the adequacy of the current capabilities to meet the identified needs in areas such as reactor physics, thermal hydraulics, chemistry, radiation protection, material science, strength analysis, reliability technology, mechanical engineering, civil engineering, electrical engineering, I&C (instrumentation and control) engineering, human behaviours science, testing of materials, project management and organizational management.

2.161. Based on the assessment, a comprehensive plan for either upgrading existing training institutes or building new training institutes needs to be developed. Possibilities for collaboration with potential vendor countries and other countries operating nuclear power reactors regarding human resources development is explored at early stages.

2.162. Experience shows that, before domestic education and training curricula are put in place, it might be useful to utilize education in foreign institutions and to send nuclear trainees abroad, so as to start developing human resources from the earliest phase. Consideration is also given to hiring staff from other industries.

2.163. Due consideration is given to securing human resources, since loss of human capital towards other countries may jeopardize the implementation and the sustainability of the national safety infrastructure. In the light of developing countries' experience, a strategy to attract and maintain high-quality staff within the State is prepared, which could include measures such as adequate return arrangements for trainees sent abroad, sufficient salaries,

good working conditions, and career positions. Furthermore, all national organizations with safety related functions, especially the regulatory body, are provided by necessary means to attract and retain high-quality staff in potential competition with the operating and industrial organizations.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1, 11 and 18 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.1, 4.3, **4.4** and 4.5 of GS-R-3;
- 2.19, 2.20, **2.29, 2.49** and **3.103** of GSR Part 3 (DS379, revision of BSS115);
- 4 and **7** of NS-R-2 (DS413);
- **311 to 315** of TS-R-1;

necessitates that:

Action 91. All the relevant organizations should implement a strategy to attract and retain trained high-quality personnel.

Action 92. All the relevant organizations should support the training of prospective nuclear staff in foreign nuclear organizations.

Action 93. The regulatory body and the operating organization should actively recruit staff so as to ensure capability in the relevant areas in a timely manner.

Action 94. The government in cooperation with legislative bodies and other applicable organizations should establish new institutes or new curricula, as identified in Phase 1.

Action 95. All the relevant organizations should start education and training of necessary number of persons in academic and vocational institutions.

2.164. A strategy to attract and retain trained high-quality personnel needs to be vigorously implemented. As identified in Phase 1, this may include measures such as adequate return arrangements for trainees sent to foreign educational institutes, sufficient salaries, good working conditions, and career positions. The government also verifies that all organizations with crucial safety related tasks, especially the regulatory body, have been able to attract high-quality staff.

2.165. Early in Phase 2, a national policy decision is made regarding implementation of plans that were developed in Phase 1 for assuring competent technical experts. Implementation of the selected plan needs to begin early enough in Phase 2 so that sufficient numbers of individuals complete the necessary training and occupy positions in the regulatory body, the operating organization, expert support organizations and industrials organizations before the actual implementation of the first nuclear power plant starts.

2.166. In cases where the assessment in Phase 1 has shown need for new institutes or extended curricula, such new institutes and revision of curricula are established.

2.167. The staffing strategies of the regulatory body are based on the assessment and planning process conducted in Phase 1. At the beginning of Phase 2, the senior management positions are filled and the recruitment of the organization staffs the most important positions first. Throughout Phase 2, the regulatory body gradually recruits and develops its necessary expertise. The objective is to have early enough in Phase 2, a staff that is able to specify and understand the safety requirements for use by the operating organization in the bidding process and for its own use in the review of the site and the construction licence application. The staff is also able to make other safety related decisions at the time when such decisions are needed. The specific competence and training needs for Phase 3, notably for the inspectors who will have to perform inspections during construction, as well as assess compliance and achievement of safety objectives, are identified in Phase 2.

2.168. At the end of Phase 2, the operating organization has sufficient technical expertise to competently specify the safety requirements in a call for bids for a nuclear power plant and to evaluate the safety relevant parts of the bids to be received early in Phase 3. Even if international consultant support may be available for this purpose, the operating organization needs to start early enough to recruit experts with good overall understanding of the safety issues, both the site specific safety features and of the nuclear power plant designs. Recruitment also needs to be done with the goal of implementing the future stages of the programme.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1, 11 and 18 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.1, 4.3, 4.4 and 4.5 of GS-R-3;

- 2.19, 2.20, 2.29, **2.41**, 2.49 and 3.103 of GSR Part 3 (DS379, revision of BSS115);
- 4 and 7 of NS-R-2 (DS413);
- 311 to 315 of TS-R-1;

necessitates that:

Action 96. The operating organization, the regulatory body and other support organizations should ensure sufficient and competent human resources for the efficient and effective conduct of all activities at the appropriate time.

Action 97. The operating organization should prepare a human resources management programme (including staffing, qualification and training) as well as the corresponding parts of the SAR.

Action 98. The regulatory body should review and assess the operating organization's programme regarding human resources management.

Action 99. The government should continue promoting educational development in the nuclear field so as to provide a continuing flow of qualified people in the relevant areas.

2.169. A sustainable level of nuclear power technology and safety expertise has to be maintained via continuous recruitment of competent staff, and long-term generic support and analysis programmes, that provide and preserve the strength of the national nuclear power programme.

2.170. The operating organization needs to recruit and train a large amount of its staff in Phase 3 to support construction, preparation for operation, and licensing. At the beginning of the Phase 3 it is important to recruit staff with experience from project management, civil construction, equipment manufacturing, welding, non destructive testing, I&C, fire prevention and protection, management system, etc. Their main task is to verify that the plant is built to high standards of quality and maintaining high safety culture throughout the construction project in all involved organizations. The need of customer’s quality verification is not diminished even in the turn-key type project because the operating organization will have full responsibility for plant safety during operation, and this requires assurance of the quality already during construction. Also experience in various areas of design is necessary in order to assess the detailed plans for construction and manufacturing. The control room operating staff and the supervisory staff for plant operation, maintenance and specific technical areas

needs to be recruited, and their plant specific training starts before halfway of the construction. Also a full-scope training simulator for training the control room operators is acquired, or simulator training is arranged otherwise in due time before the plant commissioning.

2.171. The regulatory body continues recruiting and training staff in order to be able to provide adequate oversight of the construction and equipment manufacturing and towards the later part of Phase 3 of the plant commissioning. The inspectors need to have a strong technical background as well as a thorough knowledge and understanding of the regulations and guides. In Particular, they will have to perform the first inspections during the construction phase. Actions are taken to address the specific competence and training needs identified in Phase 2.

2.172. For the purpose of providing highly skilled experts for the operating organization, the regulatory body, and other organizations with crucial safety related tasks, educational institutions continue to offer curricula appropriate to support the needs of the national nuclear programme.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities

GS-R-3 The Management System for Facilities and Activities

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

RS-G-1.4 Building Competence in Radiation Protection and the Safe Use of Radiation Sources

NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)

NS-G-2.4 The Operating Organization for Nuclear Power Plants

NS-G-2.8 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

Other safety key-publications

INSAG-16 Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety

ACTIONS 100-105: RESEARCH FOR SAFETY AND REGULATORY PURPOSES

Introduction

2.173. Vendors can provide technical advice and support to the operating organization during the licensing stages and in early years of operation, but these in-depth competences have to be integrated in due time within the State. Long-term safety research objectives have to be established so as to reduce reliance upon vendors, which cannot be expected to exist throughout the lifetime of the nuclear power plant.

2.174. If a decision to utilize a research reactor for supporting safety research is made, then the State has to take the adequate arrangements to comply with the IAEA Safety Requirement NS-R-4 “Safety of Research Reactors”, and give due consideration to the associated Safety Guides. However, these issues are not explicitly covered in this Safety Guide, which concentrates on the safety infrastructure for nuclear power.

Phase 1

In Phase ., the progressive application of the following safety requirements:

- **1** and **11** of GSR Part 1 (DS415, revision of GS-R-1);

necessitates that:

Action 100. The government should consider areas where in-depth knowledge is necessary to assess and analyze safety aspects of a nuclear power plant and identify research centres that can start research programmes in necessary knowledge areas.

Action 101. The government should identify gaps in domestic research centres’ capabilities to meet the needs in core areas, and plan to establish new research centres for core areas as deemed needed.

2.175. It is advisable to consider and initiate national research activities as early as possible when considering launching a nuclear power programme. The areas of science and technology where research and development is of vital importance for every State operating a nuclear power plant include reactor physics, thermal and hydraulics, material sciences, strength analysis and probabilistic risk assessment. Examples of other areas where research is considered are fire safety, human performance, seismic analyses, severe accident consequence, beyond design basis events assessments and management of organizations.

2.176. The research in States starting a nuclear power programme needs to be focused on the features of the prospective plants as well as site related safety issues. It is most important to learn analytical methods through own research by developing tools (i.e., computer programmes) and models that can be used for plant specific safety analysis in later stages. The accumulated knowledge could then be used for deterministic and probabilistic safety analysis as well as assessment of the reactor behaviour during transient conditions. Experience has shown that such analysis will be needed throughout the plant operating lifetime, for independent licensing and re-licensing analysis and for planning potential power upgrades or other modifications, or for analysing operational events and considering measures to prevent their recurrence. The experimental research focuses, among other things, on understanding the properties and ageing of the reactor materials, as well as other phenomena related to ageing of structures and components. In-depth understanding of material behaviour is necessary for instance in addressing safety concerns that seem to emerge in regular intervals when indications of cracks are found in pressure retaining components and piping.

2.177. In addition to gaining increased understanding of the key characteristics of the prospective nuclear power plant and safety issues related to them, the research would serve general development of in-depth knowledge and competence in the State. Indeed, national research and development is necessary to build domestic competences in certain areas, and it constitutes a good training or rehearsal for all interested parties of what is to come with the nuclear power plant project.

2.178. In establishing new research programmes, there is a consideration on whether the research can be best conducted within the existing institutions where the structures, scientist and academic networks are already in place, or whether a new institution is needed. Both approaches have been used by the States in the past.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 1 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- **3** of GSR Part 5;

necessitates that:

Action 102. The operating organization and the regulatory body should be involved in the definition of safety research areas.

Action 103. The government in cooperation with legislative bodies should implement plans to establish new research institutes, as identified in Phase 1.

Action 104. Research centres should begin conducting safety research in core areas in which in-depth knowledge is essential to support safe long term operation.

2.179. In the development of a national nuclear power programme, it is important that the operating organization and the regulatory body contribute to identify areas in which safety research is necessary to fill in gaps. An integrated research plan has to be developed which consolidates all the current and planned activities to identify long-term knowledge gaps and research needs.

2.180. The national knowledge base is strengthened by research groups established in vital safety areas. These groups participate in international networks in their respective areas and some group members are temporarily assigned for on-the-job training in foreign research organizations. The research in vital areas aims to create an independent knowledge base within the State, which will be needed to support the contracting and licensing process and later on to support safe operation and regulatory safety oversight.

2.181. If vital nuclear safety research cannot be conducted within the existing research organizations, a dedicated nuclear research organization is established.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 1 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- 3 of GSR Part 5;

necessitates that:

Action 105. Research centres and other applicable organizations should focus the research on the actual features and the safety aspects of the nuclear power plant that will be constructed, including the actual site.

2.182. As soon as the contract on a new nuclear power plant has been signed and the plant type is known, the national research community starts to develop a comprehensive set of tools tailored for its safety analysis. Plant specific models are incorporated into the generic tools. Comprehensive analysis is conducted to understand the safety margins, the impact of model changes to the results of the safety analysis, and potential cliff effects. The aim of such

research is the capability to provide fast and reliable support to the operating organization and the regulatory body in their safety assessments, and to understand the safety consequences of any abnormal event.

2.183. Arrangements to maintain close contacts with academic research and educational establishments are ensured, which could include participation in conducting specialized training and confirmatory research projects. A healthy and vibrant nuclear power programme requires highly-skilled and innovative pool of expertise that can only be maintained through an active national commitment to education and to safety research.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GS-R-3 The Management System for Facilities and Activities

GSR Part 5 Predisposal Management of Radioactive

NS-R-4 Safety of Research Reactors

Other safety key-publications

INSAG-16 Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety

ACTIONS 106-117: RADIATION PROTECTION

Introduction

2.184. Humans have always been exposed to natural ionizing radiation (background radiation), because of the exposure of the Earth's surface to cosmic rays and the radioactivity contained in rocks that form the continental crust. The fundamental safety objective stated in SF-1 is to protect people and the environment from harmful effects of ionizing radiation.

2.185. The general principles of radiation protection are not specific to nuclear power plants but are broadly applicable to all nuclear related activities and to all facilities at which ionizing radiation is produced.

2.186. Radiation protection arrangements have the fundamental role to ensure that human activities which give rise to ionizing radiations are 'justified': that they produce sufficient benefit for the exposed individuals and for society to offset the radiation detriment that they may cause (principle 4 of the Safety Fundamentals SF-1, "Justification of facilities and activities"). It is also essential to ensure that doses, the number of people exposed and the likelihood of incurring exposure are at all times kept as low as reasonably achievable (principle 5 of the Safety Fundamentals SF-1, "Optimization of the protection"). Finally, it is necessary to impose restrictions on the dose that an individual may incur (dose limits), so that no person is subject to an unacceptable risk attributable to radiation exposure (principle 6 of the Safety Fundamentals SF-1, "Limitation of risks to individuals").

2.187. This Safety Guide addresses the radiation protection of both the people and the environment, as stated in the Safety Fundamentals SF-1. "People" include workers and the public (patients are not in the scope of this Safety Guide).

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **7** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.12** and **4.2** of GSR Part 3 (DS379, revision of BSS115);
- **4.1 to 4.15** of NS-R-3;

necessitates that:

Action 106. The government should consider the additional radiation hazards and special needs presented by nuclear power plant operation.

Action 107. The government should ensure that a radiological environmental impact analysis[5] is conducted.

Action 108. The government in cooperation with legislative bodies should recognize the need for integrating radiation protection and new nuclear power plant safety regulations.

2.188. It could be expected that the State is already engaged in activities involving radioactive sources (e.g. research reactors, industrial or medical applications of ionizing radiation) which require the establishment of legislation and other provisions for radiation protection. However, the implementation of a nuclear power programme might give rise to additional hazards resulting from the expansion of activities, which necessitate amending or complementing the existing national framework.

2.189. The preparation of a radiological environmental impact analysis is a key component in the process to demonstrate the radiological protection of the environment. The process, which is part of a more general Environmental Impact Assessment (EIA), as addressed in the "National policy and strategy" of this Safety Guide, is based on a graded approach, to ensure that resources devoted to safety are commensurate to the magnitude of the radiation risks in accordance with Principle 5 of the Safety Fundamentals. The IAEA Draft Safety Guide DS427 "Radiological Environmental Impact Analysis for the verification of Radiological Protection" aims at providing guidance on how to produce such a radiological environmental impact analysis.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 7 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.12, **2.26 to 2.38, 3.5 to 3.138,** 4.2, **4.3 to 4.21, Schedule III** and **Schedule IV** of GSR Part 3 (DS379, revision of BSS115);
- 4.1 to 4.15 of NS-R-3;
- **78** and **79** of NS-R-1 (DS414);

---

[5] The radiological environmental impact analysis is part of both the Environmental Impact Assessment (EIA) mentioned in the chapter "National policy and strategy" of this Safety Guide and the Site Evaluation Report (SER) addressed in the chapter "Site survey, site selection and evaluation" of this Safety Guide.

- **301 to 303** of TS-R-1;

necessitates that:

Action 109. The regulatory body and/or the government in cooperation with legislative bodies should amend the national legislation and/or regulations as appropriate for radiation protection.

Action 110. The regulatory body should establish the radiological criteria regarding workers, the public and the environment, both for normal operation and for accidental conditions of a nuclear power plant.

Action 111. The operating organization should update the radiological environmental impact analysis for the selected site, as appropriate.

Action 112. The regulatory body should review and assess the radiological environmental impact analysis for the selected site, as appropriate.

Action 113. The operating organization should use all the appropriate safety and regulatory information regarding radiation protection to prepare the bid specifications for the nuclear power plant.

2.190. The State has to adapt its radiation protection arrangements to include specific needs for power reactor commissioning, operation, fuel transport, waste management and storage and decommissioning. This covers radiation monitoring and radiation protection of workers, the public and the environment. To determine dose limits (sometimes in nuclear laws, but more commonly in the accompanying regulations), the regulatory body and/or the government as appropriate have to give consideration to the IAEA Basic Safety Standards 115 “Protection against Ionizing Radiation and for the Safety of Radiation Sources”, which states the requirements to be fulfilled.

2.191. The regulatory body and the operating organization also need to give consideration to WS-G-2.3 “Regulatory Control of Radioactive Discharges to the Environment” and NS-G-1.13 “Radiation Protection Aspects of Design for Nuclear Power Plants” for the issuance of regulations and for the preparation of bid specifications.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 7 of GSR Part 1 (DS415, revision of GS-R-1);

- 2.12, 2.26 to 2.38, **2.39 to 2.42**, 3.5 to 3.138, 4.2, 4.3 to 4.21, Schedule III and Schedule IV of GSR Part 3 (DS379, revision of BSS115);
- 4.1 to 4.15 of NS-R-3;
- 78 and 79 of NS-R-1 (DS414);
- **21** of NS-R-2 (DS413);
- 301 to 303 of TS-R-1;

necessitates that:

Action 114. The operating organization should establish a radiation protection management programme as well as the corresponding chapter of the SAR.

Action 115. The operating organization should establish an environmental radiological monitoring programme as well as the corresponding chapter of the SAR.

Action 116. The regulatory body should review and assess the operating organization's programmes regarding radiation protection and relevant environmental aspects, and verify compliance with the regulatory requirements.

Action 117. The regulatory body should ensure that arrangements are in place for confirmatory monitoring of all releases from the nuclear power plant to the environment.

2.192. The radiation protection programme established by the operating organization needs to include arrangements for monitoring and dose assessment and to ensure that doses to individuals remain within the prescribed limits; its objective being that individual and collective doses are kept as low as reasonably achievable. Due consideration also needs to be given to the appropriate equipment and systems which will be necessary for ensuring these functions.

2.193. The environmental monitoring programme has to ensure that solid, liquid and gaseous radioactive releases from the operation of the nuclear power plant are satisfactorily controlled and monitored so that authorized discharge limits are complied with, and kept as low as reasonably achievable. Non radiological impacts may be addressed in separate documentation and be submitted to a separate authority, as appropriate.

3.3. The estimates for the releases of radioactive material in normal operating conditions as well as in accidental conditions need to be confirmed.

2.194. IAEA Safety Guides NS-G-2.7 “Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants”, RS-G-1.1 “Occupational Radiation Protection” and RS-G-1.8 “Environmental and Sources Monitoring for Purposes of Radiation Protection” provide further guidance on these programmes.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

RS-G-1.1 Occupational Radiation Protection

RS-G-1.2 Assessment of Occupational Exposure due to Intakes of Radionuclides

RS-G-1.3 Assessment of Occupational Exposure due to External Sources of Radiation

RS-G-1.4 Building Competence in Radiation Protection and the Safe Use of Radiation Sources

RS-G-1.7 Application of the Concepts of Exclusion, Exemption and Clearance

RS-G-1.8 Environmental and Sources Monitoring for Purposes of Radiation Protection

RS-G-1.9 Categorization of Radioactive Sources

DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection

WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment

NS-G-3.2 Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants

NS-G-1.13 Radiation Protection Aspects of Design for Nuclear Power Plants

NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants

Other safety key-publications

INSAG-9 Potential Exposure in Nuclear Safety

ACTIONS 118-122: SAFETY ASSESSMENT

Introduction

2.195. Safety assessment is carried out for a nuclear power plant to determine whether an adequate level of safety has been achieved for the proposed design of the plant and whether the basic safety objectives and safety criteria defined by the plant designer, the operating organisation and the regulatory body have been met.

2.196. This is a systematic process carried out throughout the lifetime of the plant to identify all the radiation risks that arise for workers, the public and the environment during normal operation, anticipated operational occurrences and accident conditions (including severe accidents beyond design basis events) to determine whether adequate measures have been taken to control (prevention and mitigation) these risks to an acceptable level. The scope and level of details of the safety assessment increases as the design develops and the way that the plant will be operated is defined. The requirements for carrying out a safety assessment are given in GS-R-4 “Safety Assessment for Facilities and Activities”.

2.197. The operating organisation has the prime responsibility for carrying out the safety assessment and is responsible for the way that the assessment is performed and the quality of the results.

2.198. A general understanding of safety features of nuclear power plants is required to make a knowledgeable decision as whether to embark on nuclear power programme. Then, a comprehensive safety assessment is required to support decisions by the plant operators on the design and operation of the plant. This is also required by the regulatory body for issuing the authorisations for the construction and commissioning of the plant.

2.199. The safety assessment covers all the scientific and technical issues that relate to the safety of the plant and the radiation risks that arise from it. This includes the safety analysis, which consists of a set of different analyses for evaluating and assessing challenges to safety in various operational states, anticipated operational occurrences and accident conditions, as well as severe accidents and beyond design-basis events. The safety assessment includes both deterministic and probabilistic methods.

- The aim of the deterministic approach is to specify and apply a set of conservative deterministic rules and requirements for the design and operation of facilities or for the planning and conduct of activities. When these rules and requirements are met,

they are expected to provide a high degree of confidence that the level of radiation risks to workers and members of the public arising from the facility or activity will be acceptably low. This conservative approach provides a way of compensating for uncertainties in the performance of equipment and the performance of personnel, by providing a large safety margin.

- The objectives of a probabilistic safety analysis are to determine all significant contributing factors to the radiation risks arising from a facility or activity, and to evaluate the extent to which the overall design is well balanced and meets probabilistic safety criteria where these have been defined. In the area of reactor safety, probabilistic safety analysis uses a comprehensive, structured approach to identify failure scenarios. It constitutes a conceptual and mathematical tool for deriving numerical estimates of risk. The probabilistic approach uses realistic assumptions whenever possible and provides a framework for addressing many of the uncertainties explicitly. Probabilistic approaches may provide insights into system performance reliability, interactions and weaknesses in the design, the application of defence in depth, and risks, that it may not be possible to derive from a deterministic analysis.

2.200. The safety assessment is carried out by suitably qualified and experienced people who are knowledgeable in all the areas of science and technology and all aspects of safety assessment and analysis required for the particular type of nuclear power plant to be built.

2.201. The safety assessment may be supported by a programme of research and development. Another chapter of the Safety Guide is devoted to “Research for safety and regulatory purposes”.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **5, 6** and **8** of GSR Part 4;

necessitates that:

Action 118. The government should consider the safety goals and principles that are to be applied to the development of the national nuclear power programme.

2.202. The government needs to consider the safety principles that will be applied in making decisions about future nuclear options.

2.203. The State has to recognize the need to develop in-house expertise in nuclear safety and safety assessment and, possibly, to take advice on the level of safety that can be achieved from technical support organisations, advisory bodies, research organisations, academic institutions and specific experts or consultants – both national and international.

2.204. The government needs to engage a dialogue with other governmental organisations in other countries so as to take account of global developments in nuclear safety and safety assessment.

2.205. The government needs to consider the safety assessment that may have been already carried out by designers, other operating organizations and by international organisations, so as to be satisfied that the benefits from the introduction of a nuclear power programme exceed the radiation risks to workers, the public and the environment.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- **24, 25** and **26** of GSR Part 1 (DS415, revision of GS-R-1);
- **3.28 to 3.34** of GSR Part 3 (DS379, revision of BSS115);
- **1, 2, 3, 4**, 5, 6, 8, **14, 15, 16** of GSR Part 4;

necessitates that:

Action 119. The operating organisation, the regulatory body and external expert support organizations as appropriate should develop the expertise to prepare for the conduct or the review of safety assessments.

2.206. Safety assessment plays an important role throughout the lifetime of a nuclear power plant whenever decisions on safety issues are made by the plant designers, the operating organisation or the regulatory body. At this stage in the process, the decisions that need to be made typically include the type of nuclear power plant to be built, the specification of any additional features[6] that need to be incorporated in the design and the choice of the site on which the plant will be built.

[6] These enhanced safety features could include the requirement to incorporate passive safety systems, the inclusion of specific features to provide protection in the event of a severe accident or for the plant structures to be strengthened so that they can withstand the effects of beyond design basis events such as an aircraft impact.

2.207. The development and use of the safety assessment provides the framework for the production of the necessary information to demonstrate compliance with the relevant safety requirements. In addition, the radiological environmental impact analysis carried out at this time to support the site and plant selection will be based on information from the safety assessment on the releases of radioactive material from the plant that occur during normal operation and following accidents as well as beyond design basis events.

2.208. The operating organisation has the primary responsibility for safety and hence for preparing the Safety Analysis Report in Phase 3 to demonstrate that the safety criteria that have been defined for the plant have been met and that an adequate level of safety has been achieved. Hence the operating organisation needs to have the personnel with the necessary skills and expertise to carry out the safety assessment and provide them with any necessary training. This will need to cover all the aspect of safety assessment applicable to the option chosen for the national nuclear power programme.

2.209. The operating organisation and the regulatory body may need to be supported by external expert organisations or individuals that have the specialist skills in particular areas to support the safety assessment. External expert support is addressed in the chapter "External support" of this Safety Guide.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 24, 25 and 26 of GSR Part 1 (DS415, revision of GS-R-1);
- 3.28 to 3.34 of GSR Part 3 (DS379, revision of BSS115);
- 1, 2, 3, 4, 5, 6, **7,** 8, **9, 10, 11, 12, 13**, 14, 15, 16, **17, 18, 19, 20, 21, 22, 23** and **24** of GSR Part 4;
- **5** and **39** of NS-R-1 (DS414);
- **12** of NS-R-2 (DS413);

necessitates that:

Action 120. The operating organisation should perform comprehensive safety assessments of the nuclear power plant and produce SARs to demonstrate that all the relevant safety requirements have been met.

Action 121. The regulatory body should carry out comprehensive review of the SARs performed by the operating organisation to verify compliance with the regulatory requirements.

Action 122. External expert organizations or individuals should be providing support to the operating organisation and/or the regulatory body for performing or reviewing safety assessments, as needed.

2.210. The operating organisation needs to carry out a comprehensive safety assessment of the proposed design and operation of the plant, as part of the preparation of the Safety Analysis Report. This needs to address all the radiation risks to workers, the public and the environment from the operation of the nuclear power plant, and demonstrate that these risks have been controlled and reduced to a level that is as low as reasonably practicable. The assessment also needs to demonstrate that the structures, systems, components and barriers incorporated in the design fulfil the safety functions required of them, and that adequate defence in depth and safety margins have been incorporated. Where weaknesses have been identified in the design or operation, improvements have been made to remedy them. The safety assessment needs to incorporate both deterministic and probabilistic approaches.

2.211. The operating organisation needs to produce a plan for carrying out the safety assessment that identifies all the activities required, the tools required, the management system to be applied to the assessment, the way that the assessment is to be documented in the form of a Safety Assessment Report for submission to the regulatory body and the independent verification that is to be carried out. This plan needs to identify all the inputs that will be required from other organisations and specialists.

2.212. The results of the safety assessment need to be used as part of a risk informed process for making decisions on the safety of the plant and determining the need to make improvements which compares the reduction in the risk from making the improvement with the costs involved.

2.213. The regulatory body needs to carry out a comprehensive review of the Safety Analysis Report to determine whether the regulatory requirements have been met. This needs to be done to allow the authorisations required for the construction and commissioning of the plant to proceed beyond the defined hold points in the licensing process to be issued.

2.214. During the design and construction phase, the contacts established between the vendor, the operating organization and the regulatory body with other organisations in the nuclear community need to be used to identify any safety improvements that are being made to other plants, improvements in the tools available to carry out the safety assessment, relevant research activities and emerging nuclear safety issues to determine which of them are applicable to the plant being built.

2.215. Throughout the lifetime of the nuclear power plant, safety reviews will have to be performed at regular intervals ("periodic safety reviews") to deal with cumulative effects of plant ageing and plant modifications, operating experience, current standards, technical developments, organizational and management issues as well as site-related aspects and aimed at ensuring high level of safety.

2.216. Example of the format and content of the safety analysis report can be found in GS-G-4.1.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

GSR Part 4 Safety Assessment for Facilities and Activities

GS-G-4.1 Format and Content of the Safety Analysis Report for Nuclear Power Plants

DS365 Risk-Informed Decision Making

GS-G-1.2 Review and Assessment of Nuclear Facilities by the Regulatory Body

NS-G-1.2 Safety Assessment and Verification for Nuclear Power Plants

DS393 Performance and Application of Level 2 PSA for Nuclear Power Plants

DS394 Performance and Application of Level 1 PSA for Nuclear Reactors

DS395 Deterministic Safety Analyses and their Application for Nuclear Power Plants

NS-G-2.10 Periodic Safety Review of Nuclear Power Plants

DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection

Other safety key-publications

INSAG-6 Probabilistic Safety Assessment

ACTIONS 123-134: SAFETY OF RADIOACTIVE WASTE, SPENT FUEL MANAGEMENT AND DECOMMISSIONING

Introduction

2.217. The principle 7 of the Safety Fundamentals SF-1, "Protection of present and future generations", calls for radioactive waste to be managed in such a way as to avoid imposing an undue burden on future generations; that is, the generations that produce the waste have to seek and apply safe, practicable and environmentally acceptable solutions for its long term management.

2.218. Radioactive waste includes waste designated as low, intermediate or high level. High level radioactive waste includes spent fuel for which no future use is foreseen.

2.219. Spent fuel management includes all activities relating to the handling and storage of spent fuel, whether or not it has been designated as waste. The designation will depend on whether the chosen fuel cycle is closed or open, i.e. requiring reprocessing or disposal of the spent fuel. In either case storage of the spent fuel will be required, which can vary from a few months to several decades. The time period for storage will be a significant factor in determining the required safety provisions.

2.220. The scope of this Safety Guide does not include fuel cycle facilities. However, if such facilities form part of the national nuclear power programme, the safety requirements of NS-R-5 and the supporting Safety Guides would apply.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **7** and **10** of GSR Part 1;
- **2.22** of GSR Part 3 (DS379, revision of BSS115);
- **1** and **2** of GSR Part 5;
- **2.1, 3.1 to 3.4**, **6.1 to 6.5** of WS-R-5;

necessitates that:

Action 123. The government should consider a range of options for radioactive waste management (including disposal), spent fuel management and decommissioning, based on a comprehensive long term strategy.

Action 124. The government should recognize long term safety requirements and cost implications of radioactive waste management (including disposal), spent fuel management and decommissioning.

Action 125. The government should plan to establish, or expand as appropriate, a national organization responsible for radioactive waste management.

2.221. It could be expected that the State is already engaged in activities involving radioactive sources (e.g. research reactors, industrial or medical applications of ionizing radiation) which require arrangements for the management and disposal of low and intermediate level radioactive waste.

2.222. Implementation of a nuclear power programme will generate high level radioactive waste that has to be safely managed. Long term safety requirements and the uncertainty of costs of radioactive waste and spent fuel management are clearly understood and considered when making a decision on launching a nuclear power programme. An activity to be conducted during Phase 1 is to study the feasibility of various options, including interim and final waste storage.

An important issue to be considered in making a decision on the nuclear waste management approach is the choice of fuel cycle option. The question is whether to have an open fuel cycle with direct disposal of spent fuel or a closed cycle where the spent fuel is reprocessed and the high level waste arising from reprocessing is to be disposed of. The alternative to be chosen has implications to waste disposal approach, costs of the spent fuel management and in the longer term to the sustainability of nuclear power as an energy source. Today there is no easy answer to the question on which alternative is the best for each State. The decision to select a particular alternative rests on many factors, some cost-based and others are of a technical nature or matters of policy. Regardless, cost estimates for final waste disposal are needed to assess the economics of nuclear power production and to be able to put sufficient funds aside for nuclear waste management.

2.223. Furthermore, radiological impacts and costs of decommissioning a nuclear power plant are also factored into the consideration on whether or not to implement a nuclear power programme. In addition to the type of waste being generated during operation, large amounts of low specific activity solid waste are produced during decommissioning activities. Specific requirements for decommissioning are addressed in the Safety Standard WS-R-5.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 7 and 10 of GSR Part 1;
- 2.22 and **3.125** of GSR Part 3 (DS379, revision of BSS115);
- 1, 2, **3, 4, 5, 6, 7, 8, 9, 10, 11, 12** and **17** of GSR Part 5;
- 2.1, **2.2, 2.3, 2.5**, 3.1 to 3.4, **3.5 to 3.8, 4.1 to 4.8**, 6.1 to 6.5 of WS-R-5;
- **22** of NS-R-2 (DS413);
- **35, 36** and **38** of NS-R-1 (DS414);

necessitates that:

Action 126. The government in cooperation with legislative bodies should establish the radioactive waste management organization, as necessary.

Action 127. The government in cooperation with legislative bodies, the radioactive waste management organization and the regulatory body should establish the national strategy for radioactive waste and spent fuel management and decommissioning, and set the goals for its implementation in appropriate schedule, including site investigations for radioactive waste disposal.

Action 128. The regulatory body should issue the necessary regulatory requirements on waste and spent fuel management and decommissioning, as appropriate.

Action 129. The operating organization shall consider the necessary arrangements for ensuring safe management of radioactive waste, spent fuel and decommissioning, and for minimizing the generation of radioactive waste.

2.224. An activity to be conducted during Phase 2 is to study alternative interim storage and disposal strategies for low, intermediate and high level radioactive and nuclear waste and for spent fuel. The studies focus both on safety, feasibility and costs of alternative strategies. As concerns the low and intermediate level waste disposal, one important question to be answered is whether the operating organization wants to do it by itself on site or whether there will be a national approach with a central final repository, and possibly a dedicated organization to operate such facility. This needs to be decided early enough so that the treatment and interim storage facilities for low and intermediate level waste can be taken into

account in the design of the nuclear power plant, ensuring optimum arrangement for waste volume reduction.

2.225. For managing the long lived radioactive waste and the high level nuclear waste and spent fuel, the government and the waste management organization have to assess whether final disposal can be provided through national solutions or whether foreign assistance is necessary. In general, national solutions are feasible in an open fuel cycle with direct disposal of spent fuel, while choosing a closed cycle in a small nuclear programme requires services from a foreign reprocessing organization.

2.226. Although the disposal solutions with respect to low, intermediate and high level waste have probably not been selected, the government ensures that the funding mechanisms are defined and the costs are estimated as accurately as possible. This would be essential for an informed decision on the amount of money to be deposited annually to the nuclear waste fund.

2.227. Detailed regulations governing the back end of the fuel cycle are not needed by the end of Phase 2 but work is started to establish the policy and regulations governing such areas as transportation and interim storage.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 7 and 10 of GSR Part 1;
- 2.22 and 3.125 of GSR Part 3 (DS379, revision of BSS115);
- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, **13, 14, 15, 16**, 17, **18, 19** and **20** of GSR Part 5;
- 2.1, 2.2, 2.3, **2.4**, 2.5, 3.1 to 3.4, 3.5 to 3.8, 4.1 to 4.8, **5.1 to 5.14**, 6.1 to 6.5 of WS-R-5;
- 22 and **33** of NS-R-2 (DS413);
- 35, 36 and 38 of NS-R-1 (DS414);

necessitates that:

Action 130. The regulatory body should fully implement its regulatory oversight programme for radioactive waste and spent fuel management facilities and activities, as appropriate.

Action 131. The operating organization should prepare a waste and spent fuel management programme as well as a decommissioning management programme, in complete coherence with the national strategy, and prepare the corresponding chapters of the SAR.

Action 132. The regulatory body should review and assess the operating organization's programme on waste and spent fuel management and decommissioning, and verify compliance with the regulatory requirements.

Action 133. The operating organization and the radioactive waste management organization should make interim storage facilities fully operational and ready to receive radioactive waste and spent fuel from the nuclear power plant.

Action 134. The government and the radioactive waste management organization should follow international efforts and progress toward disposal of radioactive waste.

2.228. Work is done by the operating organization and the national waste management organization to identify and evaluate the arrangements and sites that would be viable for final disposal of low level radioactive waste.

2.229. The treatment facilities for low and intermediate level waste are incorporated into the nuclear power plant ensuring arrangement for waste volume reduction packing and transport. The facilities are fully operational at the time of the first reactor start-up.

2.230. Most countries will build only a single geological disposal facility. The development of a geological disposal facility will take place over several decades and will require specialized research and development programmes. Countries that have similar host geologies, for example, can benefit from knowledge and cost sharing through collaborative efforts in underground research laboratories and rock characterization facilities.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

GSR Part 5 Predisposal Management of Radioactive

111-G-1.1 Classification of Radioactive Waste

→ **DS390** Classification of Radioactive Waste

WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment

WS-G-2.5 Predisposal Management of Low and Intermediate Level Radioactive Waste

WS-G-2.6 Predisposal Management of High Level Radioactive Waste

WS-G-6.1 Storage of Radioactive Waste

DS284 Safety Assessment for Radioactive Waste Predisposal Facilities and Activities

WS-R-5 Decommissioning of Facilities Using Radioactive Material

WS-G-2.1 Decommissioning of Nuclear Power Plants and Research Reactors

→ **DS402** Decommissioning of Nuclear Power Plants and Research Reactors

DS354 Disposal of Radioactive Waste (to become **SSR 5**)

NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants

GS-G-3.3 The Management System for the Processing, Handling and Storage of Radioactive Waste

NS-R-5 Safety of Nuclear Fuel Cycle Facilities

DS371 Storage of Spent Fuel

ACTIONS 135-147: EMERGENCY PREPAREDNESS AND RESPONSE

Introduction

2.231. Good design features and safety culture, as well as competent operation make the probability of radiation release from a plant extremely low. However, the probability is not zero. Previous accidents have demonstrated that emergency planning for the protection of plant personnel, emergency workers and the public beyond the site boundary is a necessary element of overall plant safety, as stated in the principle 9 of the Safety Fundamentals SF-1, "Emergency preparedness and response".

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **7** and **8** of GSR Part 1 (DS415, revision of GS-R-1);
- **4.2** of GSR Part 3 (DS379, revision of BSS115);
- **2.1 to 2.6** of GS-R-2;

necessitates that:

Action 135. The government should recognize the need for early establishment of emergency plans.

Action 136. The government should identify national institutions and new arrangements to support Emergency Preparedness and Response (EPR).

2.232. An appreciation of the need for emergency planning needs to be developed with involvement of local authorities and national organizations. Appropriate local and national organisations in the State need to be aware that emergency arrangements require involvement of many organizations and complex interactions between the organizations, largely outside the nuclear arena. During Phase 1, the need for an agreement on allocation of responsibilities in developing arrangements for emergency preparedness and response has to be recognized. A close examination of emergency planning option and costs also has to be considered at this stage.

2.233. Due considerations is given to the steps at the national level that a State becomes a party and ratifies the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 7 and 8 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.2, **4.3 to 4.21** and **Schedule IV** of GSR Part 3 (DS379, revision of BSS115);
- 2.1 to 2.6, **3.1 to 3.20, 5.2 to 5.30** of GS-R-2;
- **18** of NS-R-2 (DS413);
- **304 and 305** of TS-R-1;

necessitates that:

Action 137. The government should define the national institutions with responsibilities for EPR.

Action 138. The government should define the general approach based on the severity of the emergency situations.

Action 139. The government should start implementing new arrangements as identified in Phase 1 for strengthening the emergency infrastructure.

Action 140. The regulatory body should develop basic regulations on emergency planning.

Action 141. The operating organization should start developing a general nuclear power plant emergency preparedness programme.

2.234. During the Phase 2, while implementation details do not need to be in place, implementation of the general approach for emergency planning needs to be started, which covers, inter alia:

- Basic legislation and regulations for emergency planning;
- Threat assessments;
- Emergency response plans, procedures and concept of operations;
- Procedures for protecting emergency workers;
- Demographic characteristics of the selected site or sites;
- Procedures for provisions for public notification, information and instructions;
- Procedures for implementation of urgent protective actions;
- Procedures for medical response;

- Procedures for implementation of longer term protective actions;
- Procedures for dealing with non-radiological consequences.

2.235. In Phase 2, the gaps identified in existing national institutions and communication networks identified in Phase 1 are being filled or integrated into an action plan to be implemented later in Phase 3.

2.236. The establishment of an emergency organisation, of interaction with neighbouring countries and of the associated provisions or procedures can be very long. Therefore, independently of the elements needed or useful for site evaluations and for the bid specifications, it is recommended to start those actions in Phase 2.

2.237. The operating organization and the regulatory body give due consideration to the requirements applicable to EPR for a nuclear or radiological emergency, stated in GS-R-2.

2.238. National activities towards ratification 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 have to continue.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 7 and 8 of GSR Part 1 (DS415, revision of GS-R-1);
- 4.2, 4.3 to 4.21 and Schedule IV of GSR Part 3 (DS379, revision of BSS115);
- 2.1 to 2.6, 3.1 to 3.20, **4.1 to 4.100**, 5.2 to 5.30, **5.31-5.39** of GS-R-2;
- 18 of NS-R-2 (DS413);
- 304 and 305 of TS-R-1;

necessitates that:

Action 142. The regulatory body should establish specific regulations on emergency planning.

Action 143. The operating organization should develop and implement nuclear power plant emergency preparedness programme, plans and procedures, and prepare the corresponding chapter of the SAR.

Action 144. The government and the regulatory body should develop and implement local, national, and international emergency preparedness programmes.

Action 145. The government and the regulatory body should establish arrangements for coordination between the nuclear power plant emergency response plan and the plans of the relevant national institutions involved in emergency response.

Action 146. The regulatory body should review and assess the nuclear power plant emergency programme, plans and procedures, and verify compliance with the regulatory requirements.

Action 147. The operating organization, the regulatory body and the government should demonstrate emergency response capabilities by conducting appropriate exercises, involving local communities and authorities.

2.239. At the Phase 3, by the time the first nuclear fuel arrives on site, the development of emergency arrangements has to be completed and testing/exercising of them with local and national organizations and demonstration to the regulatory body need to be performed.

2.240. International, national, local and nuclear power plant emergency preparedness programmes, plans and procedures related to nuclear or radiological emergencies are implemented. Emergency notification systems are in place and thoroughly tested. The State is responsible to establish arrangements for coordination between the nuclear power plant emergency response plan, the plans of the relevant national institutions involved in emergency response, and other States, as necessary.

2.241. The procedures for communication channels and protocols for chain of commands between various emergency centres of the operating organization, local and national authorities and regulatory body have been developed and are in place and tested.

2.242. At this stage, it is important that the regulatory body has reviewed and, if required, approved the emergency response plans and also verified the adequacy of these plans during the emergency drills and exercises conducted with the participation of local, national and, if appropriate, foreign or international organizations involved in response during all phases of the emergency.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

GS-R-2 Preparedness and Response for a Nuclear or Radiological Emergency

GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency

SS109 Intervention Criteria in a Nuclear or Radiation Emergency

→ **DS44** Criteria for Use in Planning Response to Nuclear and Radiological Emergencies

TS-G-1.2 Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material

3. IMPLEMENTING THE IAEA SPECIFIC SAFETY REQUIREMENTS FOR THE ESTABLISHMENT OF THE SAFETY INFRASTRUCTURE

ACTIONS 148-160: OPERATING ORGANIZATION

Introduction

3.4. In a National Nuclear Power Programme, the responsibilities of the operating organization for safety are:

- Ensuring safe operation of the plant by implementing an adequate organizational structure, allocating responsibilities and delegating authority within the organization with a view to achieving proper management and minimizing interface problems including interfaces among safety, security, maintenance, operations, etc.;
- Establishing safety policies and implementing management programmes for safe operation, and verifying their effectiveness;
- Establishing and implementing an appropriate policy on an individual's suitability for duty, addressing adequate physical and mental fitness for all employees, contractors and visitors, as applicable;
- Establishing liaison with public authorities and the regulatory body for the purposes of considering, understanding and ensuring compliance with regulatory requirements;
- Establishing liaison with design, construction, commissioning, manufacturing and other organizations involved with the nuclear power programme to ensure proper understanding and transfer of information and experience;
- Providing resources, services and facilities to plant management;
- Providing adequate information for the purposes of liaison and public relations;
- Ensuring the collection, evaluation, implementation and dissemination of operational experience; and
- Ensuring that the decision making process gives adequate consideration to the selection of priorities and the organization of activities.

3.5. As stated in the principle 1 of the Safety Fundamentals SF-1, "Responsibility for safety", the prime responsibility for the safety of the nuclear power plant rests with the operating organization, which means that it has to meet fundamental safety objective:

"Protecting people and the environment from harmful effects of ionizing radiation", by taking the following measures:

- controlling the radiation exposure of people and the release of radioactive material to the environment;
- restricting 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;
- mitigating the consequences of such events if they were to occur.

3.6. It is incumbent to the operating organization to specify safety criteria and to assure itself that the design, construction and operation of nuclear power plants meet the applicable safety criteria. In addition, it is responsible for the establishment of procedures and arrangements to ensure the safe control of nuclear power plants under all conditions, for the establishment and maintenance of a competent staff with a strong safety culture and for the control of the fissile and radioactive materials utilized or generated. These responsibilities have to be discharged in accordance with applicable safety objectives and requirements established or approved by the regulatory body.

3.7. The IAEA Safety Requirement NS-R-2 "Safety of Nuclear Power Plants: Operation" and Guide NS-G-2.4 "The Operating Organization for Nuclear Power Plants" provide useful guidance on how to set up an operating organization with a strong safety culture so that to achieve good performance in terms of safety.

3.8. Staffing of the operating organization and the development of its management system are respectively is addressed in the chapters "Human resources development" and "Leadership and management for safety" of this guide.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **5, 6** and **11** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.36** of GSR Part 3 (DS279, revision of BSS115);
- **1** and **4** of NS-R-2 (DS413);

necessitates that:

Action 148. In case the operating organization is already established or identified in Phase 1 (which is not the scenario developed in this Safety Guide, where it is established at the beginning of Phase 2), it should be involved together with the government in the safety infrastructure development activities from the beginning.

Action 149. The government should consider the financial strength and the necessary competencies and staffing that are expected from an organization operating a nuclear power plant so as to ensure long term safety.

Action 150. The government should prepare a plan to define or establish, as necessary, the operating organization.

3.9. In Phase 1, the prospective operating organization may not yet be identified or established, and even if it exists, it is not expected to start activities on a broad basis. It is nevertheless important that a vision of the operating organization that is going to implement a future project be defined, and that potential forms of ownership be envisioned. In order to ensure that the future operating organization can carry its responsibility for safety, it is necessary that a core group of the prospective organization be established and start early to plan and implement progressively all the provisions, structures and procedures needed. The first goal is preparations for the bidding process at the end of Phase 2. An appropriate human resource development programme for achieving this goal, and to continue further with preparations for construction, needs to be planned in Phase 1.

3.10. Considerations in Phase 1 include topics such as

- capabilities and resources of existing electric power producing companies to enter the nuclear field;
- safety implications of various nuclear power plant contract options, such as turnkey[7], super turnkey[8], split-package[9] or multi-contract[10] approaches;

---

[7] A single contractor or a consortium of contractors takes the overall technical responsibility for the whole works.

[8] A single contract is placed covering the whole nuclear power plant. It also implies that the prime technical responsibility for the success of the project and, therefore, also for the design of the plant, is placed upon the contractor.

[9] The overall technical responsibility is divided between a relatively small number of contractors, each building a large section of the works.

- possibilities of joint ventures with foreign operating organizations to strengthen its safety capabilities;
- possibilities of foreign ownership;
- the legal implications of the former two issues;
- design authority function (see chapter on “Design safety”);
- environmental impact analysis (both radiological and non-radiological).

3.11. These topics are assessed along with financial strength, staff number and competences expected from the operating organization during all stages of construction project preparation and implementation, as well as during operation, to provide for long term safety.

3.12. In planning to establish the general structure of the operating organization, consideration has to be given to four kinds of management functions, as described below:

- Policy making functions, such as setting management objectives, establishing a policy for nuclear safety and for quality, allocating resources, approving the contents of management programmes, setting policies on fitness for duty, etc.;
- Operating functions, which include executive decision making and actions for the operation of a plant, both in operational states and in accident conditions;
- Supporting functions, which include obtaining from both on-site and off-site organizations the technical and administrative services and facilities necessary to perform the operating functions;
- Reviewing functions, which include critical monitoring of the performance of the operating and supporting functions, and review of the design.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 5, 6 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.36 of GSR Part 3 (DS279, revision of BSS115);
- 1, **2, 3**, 4 and **5** of NS-R-2 (DS413);

---

[10] The owner or his architect-engineer assumes overall responsibility for engineering the station, issuing a large number of contracts.

necessitates that:

Action 151. The operating organization should be established, if not already established, and recognize that it has prime responsibility for safety.

Action 152. The operating organization should appoint managers and key experts, and define its organizational structure.

Action 153. The operating organization should establish a suitable working relationship with the regulatory body and with relevant national and international organizations.

Action 154. The operating organization should establish the bid evaluation process, giving due consideration to safety aspects.

3.13. The operating organization has to recognize its primary responsibility for safety. Key management positions of the operating organization, or a separate nuclear power plant project organization within an existing electrical power company, have to be filled. The organizational structure and the staffing strategy of the operating organization are the outcome of the assessment performed in Phase 1.

3.14. The operating organization ensures, during Phase 2, that it has a clear understanding of all relevant safety requirements (either IAEA safety requirements or national requirements if already issued) and will have capabilities to:

- implement the project management on its own;
- specify the site characteristics, including the external events and the features of the local infrastructure that need to be taken into account in plant design;
- understand in-depth the objective of all safety requirements and to incorporate them properly into the call for bids;
- define bids evaluation process, giving due importance to safety criteria;
- assess, with help of its expert support organizations, the safety features of the plants being offered by vendors, and explain the conclusions of safety assessment to the regulatory body;
- verify the capabilities of the potential vendor organizations, including the vendor's management system, in-house competences, practice and contractual arrangements

in using subcontractors for major tasks and equipment supplies, and experience in managing large construction projects;

- verify the potential vendors' preparedness to implement the project, including maturity of the detailed design;
- develop its own effective and efficient management system, including quality control, for construction and manufacturing, based on good knowledge of national and international standards and requirements;
- consider spent fuel and nuclear waste management approach.

3.15. For detailed requirements see IAEA Safety Standard Series NS-R-1 and NS-R-2.

3.16. Cooperation among the main entities involved in the programme, as well as international organizations is of paramount importance to the success of the national nuclear power programme. Their efforts need to be coordinated and the operating organization is likely to have the lead role in co-ordinating between the main partners.

3.17. It is recognised that in some countries, the operating organization may not be the eventual legal owner of the nuclear power plant. Where this is the case, clarity of role and functions of each organization is ensured. However, the prime responsibility for safety rests with the authorized party.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 5, 6 and 11 of GSR Part 1 (DS415, revision of GS-R-1);
- **3.7** of GS-R-3;
- 2.36 and **2.42** of GSR Part 3 (DS279, revision of BSS115);
- **1** of NS-R-1 (DS414);
- 1, 2, 3, 4, 5, **6, 8, 19, 20, 23, 24, 26, 27, 28, 29, 30, 31** and **32** of NS-R-2 (DS413);
- **9.4, 9.49 to 9.53** of NS-R-5;

necessitates that:

Action 155. The operating organization should implement a safety policy that gives safety matters the highest priority, as part of its management system[11].

Action 156. The operating organization should develop goals and objectives to be accomplished in terms of safety.

Action 157. The operating organization should give due consideration to safety aspects during the evaluation of bids.

Action 158. The operating organization should prepare all safety documentation required by the licensing process, such as the SARs, in accordance with the national regulatory requirements.

Action 159. The operating organization should develop all necessary operation management programmes (including operations and maintenance) and submit them to the regulatory body as appropriate.

Action 160. The operating organization should ensure the completion of construction of the nuclear power plant in accordance with design bases and with due consideration given to safety aspects.

3.18. The scope and timing of the tasks specified below to be performed by the operating organization depend on the option selected for the nuclear power plant supply contract, whether it is a super turnkey, turnkey or split-package contract.

3.19. A clear safety policy needs to be developed by the operating organization and then communicated to, and implemented by, all the relevant personnel. The safety policy demonstrates the organization's commitment to high safety performance and is supported by reference to safety standards, the development of targets and provision of the resources necessary to achieve these targets. This policy has to give plant safety the utmost priority, overriding, if necessary, the demands of production and project schedules.

3.20. It is essential that the operating organization develop safety goals and objectives. The management needs to periodically review progress towards the accomplishment of these goals and objectives, and the results are communicated periodically to the personnel of the operating organization. This will apply not only to the operational Phase (Phase 4), but also during construction and commissioning.

---

[11] See the chapter "Leadership and management for safety" for further information.

3.21. Progressively in Phase 3, the operating organization necessarily will have to grow larger in size and complexity, changing the group dynamics. The organization plans for rapid change in its size as well as in its functions, responsibilities, organization and management techniques. The growth and change needs to be achieved while continuing to develop the safety culture throughout the organization. The organization will transition from a construction oriented focus to an operation oriented focus during Phase 3.

3.22. The description of the structure and of the functions to be performed by the individual departments in the operating organization, on and off the site, and by the individual persons in each department, as well as the lines of responsibility, authority and communication, have to be unambiguous so as to leave no scope for improvisation in either operational states or accident conditions.

3.23. During the evaluation of bids, the operating organization needs to ensure that the proposed designs comply with the national safety requirements. Many factors may be considered during bid evaluation, but safety aspects are of paramount importance and override all other demands.

3.24. In the context of the implementation of its management system, the operating organization controls in a systematic manner all the safety features involved in the plant, and verify the quality of structures, systems and components (SSCs).

3.25. The operating organization prepares all required documentation to obtain the necessary licences in accordance with the regulatory requirements, which may cover, depending on the national licensing process:

- Safety analysis reports, “SAR” (see the chapter “Safety assessment” for further information on this report);
- Operational limits and conditions, “OLCs” (might be included in the SAR):
  The operation of the nuclear power plant has to be controlled in accordance with a set of operational limits and conditions (OLCs), derived from the safety analysis, which identify safe boundaries of operation. The application of these OLCs prevents situations which could lead to accidents; and limits the consequences of any such accidents, if they do occur. OLCs are developed as part of ensuring that the plant is operated in accordance with the design assumptions and intent as well as its license conditions.

- Probabilistic safety analyses, “PSA” (might be included in the SAR, see the chapter “Safety assessment” for further information on these analyses).

It is the responsibility of the operating organization to develop operation management programmes important to safety and submit them to the regulatory body according to the regulatory framework. ‘Operation management programmes’ consist of a systematic application of planning schedules, procedures, reviews and audits supported by appropriate resources to administer management policy. As described in NS-R-2 and NS-G-2.4, the areas to be covered by various management programmes for the safe operation of plant have to include, but are not limited to, the following:

- Plant operations (in conjunction with the OLCs),
- Staffing (see the chapter “Human resources development”),
- Qualification and training (see the chapter “Human resources development”),
- Commissioning (see the chapter “Preparation for commissioning”),
- Maintenance:

  The maintenance programme for a nuclear power plant needs to cover all preventive and remedial measures, both administrative and technical, that are necessary to detect and mitigate degradation of a functioning SSC or to restore to an acceptable level the performance of design functions of a failed SSC. The purpose of maintenance activity is also to enhance the reliability of equipment.
- In-service inspection:

  In-service inspection is necessary to assess against possible deterioration whether the structures, systems and components important to safety are in an acceptable condition for continued safe operation or whether remedial measures are necessary.
- Surveillance:

  The objectives of the surveillance programme are to maintain and improve equipment availability, to confirm compliance with operational limits and conditions, and to detect and correct any abnormal condition before it can give rise to significant consequences for safety.
- Core management:

  The core management programme needs to address those activities that are needed in order to allow optimum reactor core operation without compromising the limits

imposed by the design safety considerations relating to the nuclear fuel and the plant as a whole.

- Fuel handling:

  A fuel handling programme has to address the safety of fuel on the site including the safe movement of the fuel in and out of the core. The programme needs to ensure the safety of both fresh and irradiated fuel during receipt, all handling operations, storage and dispatch from the site, as appropriate. Specific attention has to be given to ensuring criticality safety. The programme needs to ensure that all operations associated with the fuel handling programme are performed in accordance with approved written procedures with the objective of preventing a criticality accident.

- Chemistry:

  The chemistry programme has to provide the necessary chemical and radiochemical assistance to ensure safe operation, the long term integrity of systems and components, and control and reduction of radiation levels in working areas.

- Periodic safety review (see the chapter “Safety assessment”)

- Physical protection (see the chapter “Interfaces with nuclear security”),

- Radiation protection (see the chapter “Radiation protection”),

- Industrial safety:

  An industrial safety programme has to be established and implemented to ensure that all risks to personnel involved in plant activities.

- Radioactive waste management (see the chapter “Safety of radioactive waste, spent fuel management and decommissioning”),

- Environmental monitoring (see chapters “Radiation protection” and “Site survey, Site selection and evaluation”),

- Emergency preparedness (see the chapter “Emergency preparedness and response”),

- Accident management:

  The accident management programme covers the preparatory measures and guidelines that are necessary to deal with beyond design basis accidents. It includes the instructions for the utilization of the available equipment, both safety related and conventional

- Fire prevention and protection:
  The operating organization has to make arrangements for ensuring fire safety on the basis of a fire hazard analysis which should be periodically updated.
- Quality assurance (see chapters “Leadership and management for safety” and “External support organizations and contractors”),
- Human factors:
  Suitable working environment has to be provided and maintained so that work can be carried out safely and satisfactorily, without imposing unnecessary physical and psychological stress on personnel. Human factors which influence the working environment and the effectiveness and fitness of personnel for duty have to be identified and addressed.
- Feedback of operational experience:
  An effective programme for the review of operating experience has to be established to provide methods to analyse both in-house events and events in the nuclear industry worldwide so as to identify plant specific actions needed to prevent the occurrence of similar events.
- Management of modifications (see the chapter “Design safety”),
- Records and reports (see the chapter “Leadership and management for safety”),
- Decommissioning (see the chapter “Safety of radioactive waste, spent fuel management and decommissioning”).

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)

NS-G-2.1 Fire Safety in Operation of Nuclear Power Plants

NS-G-2.2 Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants

NS-G-2.3 Modifications to Nuclear Power Plants

NS-G-2.4 The Operating Organization for Nuclear Power Plants

NS-G-2.5 Core Management and Fuel Handling for Nuclear

NS-G-2.6 Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants

NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants

NS-G-2.8 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

NS-G-2.9 Commissioning for Nuclear Power Plants

NS-G-2.10 Periodic Safety Review of Nuclear Power Plants

NS-G-2.11 A System for the Feedback of Experience from Events in Nuclear Installations

NS-G-2.12 Ageing Management for Nuclear Power Plants

NS-G-2.14 Conduct of Operations at Nuclear Power Plants

DS385 Severe Accident Management Programme for Nuclear Power Plants

DS388 Chemistry Programme for Water Cooled Nuclear Power Plants

GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

→ **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

Other safety key-publications

INSAG-5 The Safety of Nuclear Power

INSAG-12 Basic Safety Principles for Nuclear Power Plants

INSAG-13 Management of Operational Safety in Nuclear Power Plants

INSAG-18 Managing Change in the Nuclear Industry: the Effects on Safety

INSAG-23 Improving the International System for Operating Experience Feedback

ACTIONS 161-170: SITE SURVEY, SITE SELECTION AND EVALUATION

Introduction

3.26. Principle 8 of the Safety Fundamentals SF-1, "Prevention of accidents", has to be complied with from the very beginning, which indicates that prevention of accidents is achieved through a combination of means, one of which is the selection of an adequate site.

3.27. The site selection process, also called "siting", is divided in two stages. The first stage, called "site survey" considers potential sites based on existing data (Phase 1). The second stage is the actual selection of the site and may be considered part of the "site evaluation" which aims to confirm the acceptability of the final selected site[12] and to establish the parameters needed for the design of the nuclear power plant (Phase 2). Site evaluation continues throughout the entire life of the nuclear power plant (Phases 3, 4 and 5) to take into account the changes of the site characteristics, evaluation methodologies and safety standards (see FIG.7).

3.28. After the site selection stage, the confirmation of site acceptability and a complete site characterization are performed during the site assessment stage. This process leads to the preparation of the Site Evaluation Report (SER) which will be used as a basis for the preparation of the Chapter on site evaluation of the SAR. All the site related activities after the approval of the SER by the regulatory body and which involve confirmatory and monitoring work are in the pre-operational stage. With the approval of the SAR the open ended operational stage for site evaluation starts. This includes all confirmatory, monitoring and re-evaluation work throughout operation and especially during periodic safety reviews.

3.29. The emphasis needed for safety aspects during the site survey stage evolves with time. As the process progresses to screen out more and more sites (and therefore retain only a few sites), the importance of safety aspects become more pronounced. The data collected and the methods used for these few sites need to be treated with similar care and scrutiny as for the finally selected site, because for this site (i.e. the preferred candidate site), these data will be used in the following stages of the licensing process.

---

[12] For the purpose of this Safety Guide, it is assumed that only one site is required (to locate the number of reactor units under consideration). However, the methodology is fully applicable to any number of sites.

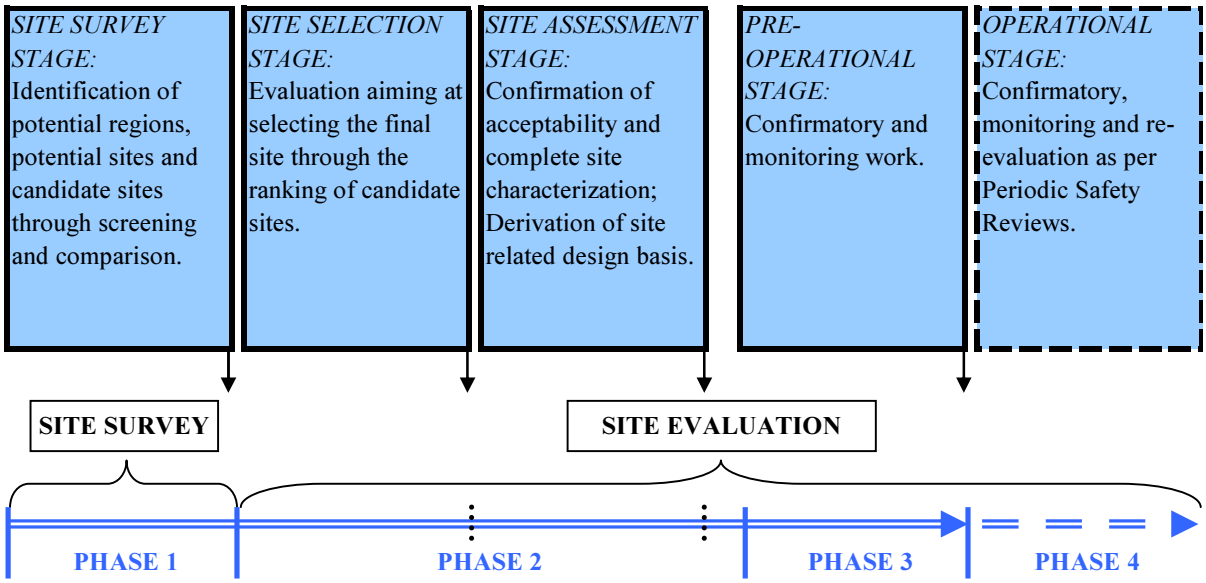

FIG. 7. The consecutive stages of site survey, site selection and evaluation

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **3.126** of GSR Part 3 (DS379, revision of BSS115);
- **2.1 to 2.29**, **3.1 to 3.55**, **4.1 to 4.15, 6.1 to 6.9** of NS-R-3;

necessitates that:

Action 161. The government should ensure that potential sites are identified and candidate sites are selected on the basis of a set of defined criteria, at a regional scale and using available data[13].

3.30. In accordance with Principle 8 of the Safety Fundamentals SF-1, and in order to be able to make a knowledgeable policy decision on whether or not to introduce nuclear power at the end of Phase 1, it needs to be evaluated that suitable sites are available for locating a nuclear power plant. A general survey at the national and regional scale performed on the basis of already available data, information and documentation, needs to be conducted to determine the availability and acceptability of such sites. The objectives of this Phase cannot be fulfilled if no suitable sites are available on basis of established safety criteria.

[13] In case the operating organization is already established or identified in Phase 1 (which is not the scenario developed in this Safety Guide, where it is established at the beginning of Phase 2), it should be involved in the site survey.

3.31. A set of criteria needs to be identified from the beginning of Phase 1, related to acceptability and comparison of sites, taking into account safety-related and non safety-related aspects. It is important to properly address both due to the interface between them. This will provide for a smooth development of the site selection and evaluation process during the following phases, with no need for coming back to earlier steps due to the lack of suitable available sites.

3.32. While “acceptability” (or exclusion) criteria are well defined in accordance with IAEA safety standards (NS-R-3) and are not modifiable, the criteria for “comparison” of the candidate sites may change from country to country and from one phase to the other on the basis of the results obtained and the iterative nature of the process.

3.33. These criteria provide for a consistent set of boundary conditions from different inter-disciplinary fields (e.g. safety vs. development and social needs, safety vs. security, safety vs. historical or archaeological conditions, etc.) that will exclude unacceptable sites in the early stages of the programme and will leave for further consideration those sites that fulfil the acceptability conditions.

3.34. Regarding safety related conditions, the requirements and recommendations established in the respective IAEA safety standards (see list at the end of this sub-section) are applicable. As stated in NS-R-3, three main aspects are considered:

- The effects on the nuclear power plant of external events occurring in the region of the site, i.e. external hazards from natural and human induced origins;
- The characteristics of the site and its environment that could influence the transfer to people and the environment of released radioactive material;
- The population density and population distribution, as well as other characteristics of the external zone that may affect the possibility of implementing emergency measures including the need to evaluate the risks to individuals and the population.

3.35. Each site has specific characteristics that will have to be taken into account in adapting the design of the nuclear power plant. These characteristics, which may represent risks for the plant, include natural hazards such as earthquakes and surface faulting, meteorological events, flooding, geotechnical hazards and also human induced hazards due to nearby industrial activities or transport routes. Also the risks of malevolent activities may be to some extent site

dependent, i.e. some site features might provide enhanced protection against malevolent actions.

3.36. The impact of the plant on the public and the environment is considered to estimate the consequences of normal operating discharges and releases resulting from potential accidents. This requires a preliminary analysis of the dispersion of radioactive material through atmospheric phenomena, through surface water and through groundwater. It is also necessary to analyse the prospective population distribution, to characterize dietary habits as well as the uses of land and water in the region. This is to be done as part of the radiological environmental impact analysis addressed in the chapter "Radiation protection" of this Safety Guide.

3.37. Regarding the non directly safety-related conditions, the criteria to be established include national and local specific needs in all the involved aspects (e.g. legal aspects, archaeological and historical aspects, economic and social developments, land use, energy distribution networks, accessibility and availability of local infrastructure, public acceptability, proximity to industrial and military centres, etc.).

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 3.126 of GSR Part 3 (DS379, revision of BSS115);
- 2.1 to 2.29, 3.1 to 3.55, 4.1 to 4.15, 6.1 to 6.9 of NS-R-3;

necessitates that:

Action 162. The regulatory body should establish specific safety requirements for site evaluation, including the process for authorizing the selected site, in compliance with applicable IAEA Safety Standards.

Action 163. The operating organization should complete the investigations related to the suitability of the candidate sites and select the preferred candidate site for the first nuclear power plant, using specific site data, information, studies and assessments conducted with the full temporal and spatial scales of investigations.

Action 164. The operating organization should prepare the Site Evaluation Report (SER) and submit it to the regulatory body, based on a full assessment of the

selected site and including the confirmation of site acceptability and the characterization of the site for the definition of the site related design basis parameters.

Action 165. The regulatory body should review and assess the SER, and make a regulatory decision regarding the acceptability of the selected site and the site related design bases.

Action 166. The operating organization should use all the appropriate safety and regulatory information related and derived from the site assessment to prepare the bid specifications for the nuclear power plant.

Action 167. The operating organization should start the site and environmental monitoring programme as described in the SER.

3.38. The licensing process by the regulatory body needs to be well defined to provide the operating organization with a clear road map on the stages and requirements of the regulatory body's intervention (e.g. review and approval process of the SER, issuance of Site Permit, etc.).

3.39. Two main stages are implemented which are driven by a different 'focus' and the depth of the substantiation process, during Phase 2:

- Comparison and ranking studies of the candidate sites, focussing in a number of sites as identified, selected and preliminary ranked in Phase 1;
- Detailed evaluation and assessment of the selected site, focussing on the selected site and making use of specific data, studies and assessments conducted on the full scale of the temporal (e.g. pre-historical, historical and instrumental time period) and spatial (e.g. regional, near regional, site vicinity and site area) scales of investigations.

3.40. In order to be ready for inviting bids for the first nuclear power plant during Phase 2, the assessment of the candidate sites –which were identified, screening out and compared in previous Phase– needs to be completed through a specific evaluation for ranking them and selecting the preferred candidate site as result of the Site Selection stage. This site selection stage is followed by the site assessment stage during which a full, specific, and detailed evaluation of the selected site in a manner so as to confirm the acceptability of it, to derive the

site related design basis and to prepare the radiological environmental impact analysis[14], as well as the non-radiological impact analysis (e.g. thermal discharges, chemical discharges, etc.) according to the national regulatory framework. This is done through detailed evaluation studies and investigations which are specific to the site and commensurate to the objectives of the Phase 2 of being ready for inviting bids.

3.41. The operating organization needs to define the maximum nuclear capacity to be installed at the site in the early stages of the site selection process.

3.42. In accordance with NS-R-3 safety requirements and regarding the potential radiological impact on the region for operational states and accident conditions leading to emergency measures, an estimate is made of expected radioactive releases of radioactive material[15]. Considering that in Phase 2 the design of the installation and its safety features may not be known, the potential releases are first estimated using generic values and later updated when the design and safety features are known in Phase 3.

3.43. During Phase 2 all site evaluation tasks are conducted according to the requirements and recommendations of the IAEA site related safety standards which are fully applicable (see list of references).

3.44. The site assessment process leads to the preparation by the operating organization of the Site Evaluation Report which includes the confirmation of site acceptability and the complete site characterization. This will be used as the basis for the preparation of the chapter on site evaluation of the SAR in Phase 3.

3.45. The operating organization identifies necessary improvements to the site to be built in Phase 3 which are important to safety, such as site protection measures against external hazards (e.g. against external floods, groundwater level and hydro-geological conditions, etc.), ultimate heat sink, road access, communications, water supplies, etc., which may also have an impact of emergency plans.

3.46. This step will give rise to intensive interactions with the public at large, in particular with local population, organizations and authorities. Further information is provided on this issue in the chapter “Transparency and openness” of this Safety Guide.

---

[14] See the chapter “Radiation protection” for further guidance.

[15] This issue is further detailed in the radiological environmental impact analysis mentioned in the chapter “Radiation protection” of this guide.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 3.126 of GSR Part 3 (DS379, revision of BSS115);
- 2.1 to 2.29, 3.1 to 3.55, 4.1 to 4.15, **5.1**, 6.1 to 6.9 of NS-R-3;

necessitates that:

Action 168. The operating organization should prepare the chapter on site evaluation of the SAR, and then update it taking into account the specificities of the chosen reactor and the data and information gathered during the pre-operational stage.

Action 169. The operating organization should implement necessary safety improvements to the site, if required, regarding the site protection measures defined as a result of the external hazard assessment tasks.

Action 170. The operating organization should continue to implement the environmental and site monitoring programme.

3.47. The characteristics of natural and human induced hazards as well as the demographics, meteorological and hydrological conditions of relevance to nuclear installations have to be monitored over the life time of the plant.

3.48. An environmental survey programme around the power plant site is started well before commissioning of the plant, in order to get reference data on the radioactive isotopes found in the environment before the plant starts to operate. This data can then be used to identify the radioactive isotopes that may be released from the nuclear power plant.

3.49. The activities regarding radiological environmental impact or monitoring are addressed in the chapter “Radiation protection” of this Safety Guide.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

→ **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)

NS-R-3 Site Evaluation for Nuclear Installations

NS-G-3.1 External Human Induced Events in Site Evaluation for Nuclear Power Plants

NS-G-3.2 Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants

NS-G-3.3 Evaluation of Seismic Hazard for Nuclear Power Plants

→ **DS422** Evaluation of Seismic Hazard for Nuclear Installations

NS-G-3.4 Meteorological Events in Site Evaluation for Nuclear Power Plants

NS-G-3.5 Flood Hazard for Nuclear Power Plants on Coastal and River Sites

→ → **DS417** Hydrological and Meteorological Hazards in Site Evaluation of Nuclear Installations (to combine **NS-G 3.4** and **NS-G 3.5**)

NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plant

50-SG-S9 Site survey for Nuclear Power Plants (under update and revision process)

DS405 Volcanic hazards for nuclear installations

DS416 Licensing Process for Nuclear Installations

RS-G-1.8 Environmental and Sources Monitoring for Purposes of Radiation Protection

DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection

ACTIONS 171-184: DESIGN SAFETY

3.50. Principle 8 of the Safety Fundamentals SF-1, "Prevention of accidents", states that "All practical efforts must be made to prevent and mitigate nuclear or radiation accidents. […] The primary means of preventing and mitigating the consequences of accidents is defence in depth".

Phase 1

In Phase 1, the progressive application of NS-R-1 (DS414) necessitates that:

Action 171. The government should understand the objectives of nuclear safety, and why and how nuclear safety impacts the design of a nuclear power plant.

Action 172. The government should consider the various designs available from vendors and understand the most important safety features.

3.51. Individuals to be involved in the nuclear power programme start acquiring knowledge in the major aspects of the IAEA safety standard NS-R-1 "Safety of Nuclear Power Plants: Design, as well as the features of the various nuclear reactor technologies. It is not intended to go into too many technical details in this phase, but the main design safety features and principles are understood.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- **2.48, 3.36 to 3.45** and **3.117** of GSR Part 3 (DS379, revision of BSS115);
- NS-R-1 as a whole;
- **6.43 to 6.51** of NS-R-5;

necessitates that:

Action 173. All the relevant organizations should obtain an in-depth understanding of safety principles and requirements applicable to the design of nuclear power plants.

Action 174. The operating organization should conduct a thorough market survey on the available nuclear power technologies and investigate their safety features.

Action 175. The regulatory body should prepare and enact national safety regulations on design necessary for bid specification.

Action 176. The operating organization and/or the regulatory body, in referencing the IAEA Safety Standards, should specify the codes and standards which provide acceptable reference for design and construction of the plant.

Action 177. The operating organization should include in the bid specification all the safety and regulatory aspects, as necessary for design considerations.

3.52. The regulatory body, the operating organization and other supporting organizations have to develop an in-depth understanding of the design principles applicable to nuclear power plants, such as:

- the concept of multiple barriers and defence in depth;
- the single failure criterion;
- prevention and mitigation of accidents;
- the concept of postulated initiating events, design basis and beyond design basis accidents;
- internal and external hazards considered in the design;
- the application of probabilistic analyses;
- the minimization of the plant's sensitivity to postulated initiating events;
- the utilization of proven safety-related codes and standards;
- the systematic consideration to human factors, including the human-machine interface;
- active and passive safety;
- different operational stages;
- items (SSCs) important to safety and safety classification.

3.53. Other factors to consider in the design include optimisation of personnel exposure, minimization of radioactive waste production and the need for decommissioning activities. The IAEA Safety Standards publication NS-R-1 "Safety of Nuclear Power Plants: Design" states the requirements to be fulfilled by the nuclear power plant.

3.54. In the preparation of bid specifications, the operating organization has to take into account all the information identified during the various assessments conducted in other parts o f this Safety Guide, such as "Site survey, site selection and evaluation" or "External support".

3.55. Codes, standards, regulations and guides for the design of equipment important to safety play key roles in ensuring the safety of nuclear power plants, especially those governing the design of:

- the reactor core;
- shutdown system(s);
- the reactor coolant system;
- the containment system;
- instrumentation and control systems;
- the emergency control centre;
- the emergency power supply;
- effluent and waste treatment systems;
- fuel (both fresh and irradiated) handling and storage systems.

3.56. Codes and standards which will be accepted for the design and construction of the plant are specified in Phase 2 before the call for bids. Regulations governing design which are needed for bid specification are also enacted in Phase 2.

3.57. The interfaces between nuclear safety and nuclear security are adequately considered as concerns design features. They are approached in such a way that the impacts of each on the other are considered and an appropriate balance is achieved. From a security perspective, it is essential to recognize that security design features have to be appropriate for the State's national threat.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 2.48, 3.36 to 3.45 and 3.117 of GSR Part 3 (DS379, revision of BSS115);
- NS-R-1 as a whole;
- **10** and **11** of NS-R-2 (DS413);
- 6.43 to 6.51 of NS-R-5;

necessitates that:

Action 178. The operating organization should establish a 'design entity' which will maintain the knowledge of the design and its configuration management during the lifetime of the plant.

Action 179. The operating organization should ensure adequate safety review of the designs proposed by the vendors in the submitted bids.

Action 180. The operating organization should establish proper interaction with the vendor for the preparation of the safety documents.

Action 181. The operating organization should prepare and provide the safety documents requested in the licensing process, such as the SARs.

Action 182. The regulatory body should review and assess the safety documentation such as the SARs, and verify compliance with regulatory requirements.

Action 183. The operating organization and the regulatory body should ensure adequate validation and verification of the design of the nuclear power plant and SSCs.

Action 184. The operating organization and the regulatory body should implement a process to address modifications in the design during construction and afterwards.

3.58. When evaluating bids, the operating organization verifies that the proposed designs satisfy the national safety requirements.

3.59. Although design review before the bid is not a part of formal regulatory process in many countries, the operating organization might ensure an independent design verification of the submitted bid so as to get a confidence that their design follows the code and standards which provide acceptable reference for design and construction, as specified by the regulatory body.

3.60. Once the bid is accepted, finalization of design and preparation of a Safety Analysis Report (SAR) starts early in this Phase. The SAR is prepared in accordance with the format and content as specified in national regulations or agreed upon with the regulatory body.

3.61. Early in this Phase the operating organization submits the SAR to the regulatory body along with the application for construction. Simultaneously is usually submitted an

environmental impact analysis. The construction activities on site cannot start until a construction licence is granted.

3.62. The regulatory body in this phase has to review the SAR to verify that design requirements as laid down in the national regulations are met for the safe operation of the nuclear power plant and for preventing or mitigating the consequences of events that could jeopardize safety. The review of SAR might take significant time and it is advisable that its schedule is discussed and agreed upon between the regulators and operating organization to the extent possible. The process of review and assessment is dealt in other sections of this guide.

3.63. Once the construction licence is issued, the construction work starts in this phase including the manufacture of important safety (related) systems and components. The construction proceeds in a manner that ensures quality and safe operation. In this phase, the operating organization, and the regulatory body as applicable, continuously monitors the construction of safety related structures, systems and components both at the site and at manufacturing facilities to ensure that the construction is done as per the approved design.

3.64. It is important at this stage to define a process which can address the changes in design during the construction, including involvement of the regulatory body where appropriate. The operating organization has to establish a procedure to ensure the proper design, review, control and implementation of all permanent and temporary modifications, if any. This procedure needs to ensure that the plant's design basis is maintained, limits and conditions are observed, and applicable codes and standards are met

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

NS-R-1 Safety of Nuclear Power Plants: Design (under revision, **DS414**)

NS-G-1.1 Software for Computer Based Systems Important to Safety in Nuclear Power Plants

NS-G-1.2 Safety Assessment and Verification for Nuclear Power Plants

NS-G-1.3 Instrumentation and Control Systems Important to Safety in Nuclear Power Plants

NS-G-1.4 Design of Fuel Handling and Storage Systems for Nuclear Power Plants

NS-G-1.5 External Events Excluding Earthquakes in the Design of Nuclear Power Plants

NS-G-1.6 Seismic Design and Qualification for Nuclear Power Plants

NS-G-1.7 Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants

NS-G-1.8 Design of Emergency Power Systems for Nuclear Power Plants

NS-G-1.9 Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants

NS-G-1.10 Design of Reactor Containment Systems for Nuclear Power Plants

NS-G-1.11 Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants

NS-G-1.12 Design of the Reactor Core for Nuclear Power Plants

NS-G-1.13 Radiation Protection Aspects of Design for Nuclear Power Plants

DS367 Safety Classification of Structures, Systems and Components in Nuclear Power Plants

DS393 Development and Application of Level 2 PSA for Nuclear Power Plant

DS394 Development and Application of Level 1 PSA for Nuclear Reactors

DS395 Deterministic Safety Analyses and their Application for Nuclear Power Plants

NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants

NS-G-2.10 Periodic Safety Review of Nuclear Power Plants

NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plant

SS79 Design of Radioactive Waste Management Systems at Nuclear Power Plants

GSR Part 4 Safety Assessment for Facilities and Activities

GS-G-4.1 Format and Content of the Safety Analysis Report for Nuclear Power Plants

DS416 Licensing Process for Nuclear Installations

Other safety key-publications

INSAG-6 Probabilistic Safety Assessment

INSAG-10 Defence in Depth in Nuclear Safety

ACTIONS 185-188: PREPARATION FOR COMMISSIONING

Introduction

3.65. Commissioning activities per se are beyond the scope of this guide since Phase 3 ends just before the beginning of commissioning tests. However, some activities in preparation for commissioning are necessary in Phase 3.

3.66. The IAEA Safety Guide NS-G-2.9 "Commissioning for Nuclear Power Plants" provides useful guidance on all steps of the commissioning stage.

Phase 3

In Phase 3, the progressive application of the requirement **25** of NS-R-2 (DS413) necessitates that:

Action 185. The regulatory body should issue requirements on commissioning.

Action 186. The operating organization should establish a comprehensive commissioning programme, prepare the corresponding chapter of the SAR as appropriate and ensure sufficient number of operating staff to be involved in commissioning activities.

Action 187. The operating organization should establish mechanisms for transfer of responsibilities with the constructor at the end of Phase 3.

Action 188. The regulatory body should review and assess the commissioning programme, and verify compliance with requirements and prepare a programme to oversee the commissioning of systems important to safety in the next Phase.

3.67. The regulatory body issues requirements regarding commissioning, which may include the establishment of hold points, such as:

- overall cold and hot hydraulic tests;
- fuel loading;
- first criticality and zero power tests;
- power tests on different levels;
- trial operation; and
- commercial operation.

3.68. The operating organization develops a commissioning programme so as to provide evidence that the installation as constructed meets the design intent and complies with the safety requirements. Operating procedures have to be validated to the extent practicable as part of the commissioning programme, with the participation of the future operating personnel. Active tests are performed with nuclear fuel in core and consist of fuel loading, first criticality, zero power level tests, power escalation tests at different power levels and trial operation.

3.69. In view of its role in the subsequent operating phase of the plant, the operating organization has to verify that the commissioning programme checks as exhaustively as possible the characteristics of the plant. In particular, the commissioning programme needs to:

- confirm that the plant as built is consistent with the provisions of the safety analysis report and record baseline data on SSC performance to be later used as reference data;
- ensure that the plant meets the requirements of the regulatory body;
- demonstrate the validity of operating instructions and procedures and provide an opportunity for operating personnel to improve their competence; and
- supply information and data necessary to verify the adequacy of provisions made for implementing the management programmes.

3.70. Even if commissioning activities are performed by the supplier or other groups, the operating organization has to make the necessary arrangements to review and approve these activities at all stages as responsibility for safety rests with the operating organization.

3.71. The operational phase of the plant is generally considered to begin when fuel is loaded into the reactor. This will overlap with plant commissioning activities. All essential elements for safe operation of the nuclear power plant needs to be in place prior to initiated fuel load. This will consist of many factors, both organizational and technical, as addressed in the IAEA Safety Standard Requirements NS-R-2 “Safety of Nuclear Power Plants: Operation”.

3.72. Specific approval by the regulatory body is required before the start of normal operation. Such approval will be granted on the basis of an appropriate safety analysis report and a commissioning programme.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)

NS-G-2.9 Commissioning for Nuclear Power Plants

ACTIONS 189-192: TRANSPORT SAFETY

Introduction

3.73. A special feature of the transport of radioactive material is the mobility of the risk source into the public domain. Unlike the situation in a stationary facility, the environment of the material being transported is subject to change. The two main technical means of protecting against hazards due to the transport of radioactive material are the containment of the material and the control of external radiation levels of the package. Criticality and damage caused by heat must also be taken into consideration in the transport of fissile material and material which generates large decay heat, such as spent nuclear fuel elements.

3.74. Like all nuclear related activities, the transport of certain radioactive material requires a prior approval of the package design or the shipment by a competent authority.

3.75. A comprehensive corpus of rules has been developed in the IAEA Safety Requirement publication TS-R-1 “Regulations for the Safe Transport of Radioactive Material” with a view to ensuring safety during the transport of radioactive material. A well structured domestic legal system that incorporates the aforementioned rules creates the legal certainty necessary for protection against risk and for increased safety during the transport of radioactive material.

3.76. An adequate legal framework is needed to implement international regulations for transport of dangerous goods such as the Technical Instructions for the Safe Transport of Dangerous goods by Air from the International Civil Aviation Organization (ICAO) and the International Maritime Dangerous Good (IMDG) Code from the International Maritime Organization (IMO) should be established.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **7** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.23** of GSR Part 3 (DS379, revision of BSS115);
- TS-R-1 **as a whole**;

necessitates that:

Action 189. The government should consider the impact on the legal and regulatory framework by the transport of nuclear fuel and nuclear waste, beyond the existing transport of radioactive material.

3.77. It is expected that the State is already engaged in activities involving radioactive sources (e.g. research reactors, industrial or medical applications of ionizing radiation) which require the establishment of regulations regarding the transport of radioactive material. In most cases there will be some existing regulations in place which cover not only the materials currently being transported, but also all materials relevant to a national nuclear power programme, where international conventions apply (air and sea, and in some States land). A regulatory authority in charge of the oversight of nuclear transport safety might also exist. However, the regulatory system is likely to be "dormant" in some areas in countries without a nuclear power programme. The implementation of a nuclear power programme might necessitate transporting new kinds of radioactive materials, with specific characteristics, which require amending or complementing the existing national framework.

3.78. The IAEA Safety publication DS387 "Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material" sets out the different materials by UN number. There are essentially two sets of UN numbers, one set (fissile) relates closely to the delivery of a national nuclear power programme. Considering the difference between the fissile and non-fissile UN numbers gives an indication of the additional controls required in transport. The regulatory body will need to be competent in assuring that the appropriate controls are in place. The transport of spent nuclear fuel is an especially demanding task that most likely requires new type of arrangements.

3.79. While a nuclear programme will typically only result in a small percentage increases in the number of shipments, it will typically increase the total quantity of radioactive material transported by several orders of magnitude. The degree of protection offered by this small number of packages needs to be significantly higher than that offered by the majority of packages being transported.

3.80. A crucial aspect for transport is to ensure the new regimes are cognisant of the existing regulatory regimes. No specific actions are needed in Phase 1 beyond getting information on the expected new tasks and taking into account any appropriate existing modal regulatory regime.

3.81. The key functions of a transport regulator are set out in TS-G-1.5 "Compliance Assurance for the Safe Transport of Radioactive Material". An important part of information gathering is to examine each of these functions and assess the resources and skills available. It may be that some functions are initially carried out in other States, but the aim has to be for a

transport regulator in a State with nuclear power to develop domestic competence in all areas. The following paragraphs provide a summary of the issues in each area.

- Design assessment:
  In many cases, this function will be limited until a nuclear programme is established (limited in scope and resource). It may not exist.
- Witnessing of testing:
  The level of testing related to a nuclear power programme is significantly different to that for the majority of shipments of radioactive material. This may involve skills that are not present in the regulatory body.
- Witnessing of manufacture:
  It is possible that many transport regulators do not need to witness any manufacture until a nuclear programme is established. Though it is the responsibility of the packaging owner to witness manufacture, it may be recommended to the regulatory body to also witness manufacture of packaging from time to time as a part of compliance assurance.
- Examination of maintenance and servicing arrangements:
  The complexity of packages, types of materials, hostile environments and length of operating life of components introduce issues peculiar to transport in a nuclear power setting. In some cases all packages used in a country will be serviced and maintained in another State until a nuclear power programme is established.
- Monitoring of transport operations:
  Because the number of shipments remains reasonably constant this is unlikely to be of concern, either in terms of competence or resource.
- Enforcement actions and investigations of incidents:
  Most States will have adequate capability in this area.
- Interdepartmental liaison/co-operation:
  The key issue here is that any new regulatory body proposed needs to fit into the existing regulatory framework without overlap or gap.
- Issuance of approvals:
  Although issuing approvals is likely to be a new process for the regulator it is likely

that an approval system exists somewhere in the State's regulatory infrastructure that can be used as a model.

- Regulatory review and maintenance of effective legal framework:
  Again, while some new legislation may be required, this area may increase resource requirements, but the necessary skills need to exist in one of the existing regulatory bodies.
- Training and Distribution of information:
  The availability of information on how the regulator works is likely to be one of the first requirements in Phase 3. An advantage of globally harmonised transport regulations is that information and training can be imported and adapted.
- Emergency planning and exercises:
  Because the quantity of radioactive material being carried will increase the importance of effective emergency response increases. Up to this point the radioactive material is most likely a secondary risk in any serious transport accident, while with development of a national nuclear power programme there may be cases where the radioactive material could be the primary risk in an accident. This could have wide ranging implications depending on the national emergency arrangement structure.
- Audits of management systems:
  Most States will have adequate capability in this area.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 7 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.23 of GSR Part 3 (DS379, revision of BSS115);
- TS-R-1 as a whole;

necessitates that:

Action 190. All relevant organizations should implement a plan to meet the intent of the international safety requirements and start to fill in the gaps identified in Phase 1.

Action 191. The regulatory body and organizations in charge of transport should join international associations to enhance mutual support.

3.82. Arrangements for fresh and spent fuel transportation are assessed, and based on this assessment (including security) the possible routes and modes of fuel transportations are tentatively identified. Feasibility of the plans is evaluated taking into account the access routes to the nuclear power plant site and the points of entry to and exit from the State.

3.83. An evaluation is also made for the transportation needs of low and intermediate level radioactive waste generated during plant operation, if a central national storage is being considered, as opposite to ultimate disposal of the waste near the nuclear power plant site.

3.84. Globally harmonised requirements for transport mean that it is possible to import assistance fairly easily. There are several groupings, or associations, of transport regulators worldwide that offer mutual support. Joining such a body at this stage would be appropriate.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 7 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.23 of GSR Part 3 (DS379, revision of BSS115);
- TS-R-1 as a whole;

necessitates that:

Action 192. The regulatory body and organizations in charge of transport should fully implement changes to the national requirements and arrangements for transportation of radioactive material.

3.85. The first transport of radioactive material, to be conducted as part of the new nuclear power programme, is transport of fresh nuclear fuel to the site. Requirements for such transport are in place and implemented for planning the transport. While other types of transports are not expected to take place during Phase 3, it is often a requirement that power plant operators have plans and contingencies in place for transport of material from reactors prior to their operation. As a result, the transport of all materials will need to be considered by the regulatory body during Phase 3, even though it may not start until a few years later.

List of main relevant IAEA safety standards

SF-1 Fundamental Safety Principles

TS-R-1 Regulations for the Safe Transport of Radioactive Material

TS-G-1.1 (Rev.1) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material

TS-G-1.2 Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material

TS-G-1.3 Radiation Protection Programmes for Transport Radioactive Material

TS-G-1.4 Management System for the Safe Transport of Radioactive Material

TS-G-1.5 Compliance Assurance for the Safe Transport of Radioactive Material

DS387 Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material

ACTIONS 193-200: INTERFACES WITH NUCLEAR SECURITY

Introduction

3.86. IAEA Safety Fundamentals document SF-1 states: “Safety measures and security measures have in common the aim of protection 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.”

3.87. This chapter presents interfaces between nuclear security and safety aspects, to be taken into account during the development process of a national nuclear power programme. The relevant information regarding the establishment of a nuclear security regime is provided in the Nuclear Security Series. Specific security recommendations are for nuclear power plants are provided in Physical Protection of Nuclear Material and Nuclear Facilities recommendations document (in preparation). Additional implementing guides are provided in the Nuclear Security Series.

3.88. The field covered respectively by safety and security is partially distinct but safety and security share a common objective and are mutually complementary. The acceptable risk is the same whether the initiating event of a given radiological release follows a natural event, equipment failure or a malicious act. Security covers prevention with regard to theft of nuclear material, as well as prevention of any risk of sabotage of nuclear facilities or radioactive material. With regard to the risk of theft of nuclear materials, control measures and accountability of nuclear material developed either at the national level or within the framework of international controls (safeguards) are also a specific part of security. Therefore, it is essential that safety and security have objectives and approaches that are common and mutually complementary.

3.89. Nuclear security and safety infrastructures have to be built during each phase of the development process of a National Nuclear Power Programme. However, they need to be developed, as far as possible, in a well-coordinated manner. Further information on this issue can be found in the INSAG-24 report “Relationship between Safety and Security in Nuclear Installations” (under preparation).

3.90. All organizations involved in a national nuclear power programme need to be made aware of the differences and commonalities of both safety and security to be able to factor

both into development plans. The synergy between safety and security has to be developed and encouraged; safety and security have to co-exist and mutually enhance each other.

Phase 1

In Phase 1, the progressive application of the following safety requirements:

- **7** and **12** of GSR Part 1 (DS415, revision of GS-R-1);
- **2.1** of GS-R-3;
- **2.25** of GSR Part 3 (DS379, revision of BSS115);

giving due consideration to the interfaces between nuclear safety and security, necessitates that:

Action 193. The government should consider the need to promote both safety and security cultures, taking into account their similarities and differences.

3.91. A culture for safety and security that governs the attitudes and behaviour of individuals in relation to safety and security will need to be integrated in management systems.

3.92. Safety culture and security culture are based on similar principles. However, there are some notions that are unique to security culture such as deterrence and confidentiality. Furthermore, with regard to the sharing of responsibility and the confidentiality of information, the development of a security culture will involve major participation of the government. The involvement of a great number of competent authorities in security matters imposes a certain number of structures and communication, information and exchange systems so that the organization involved understand and complement each other.

3.93. These cultures often involve individuals of diverse backgrounds and experiences. Since culture is an attribute of both organizations and individuals, it is important to provide safety and security individuals with an appreciation for the importance of each with an emphasis on the importance of integration and balance to achieve optimized protection.

3.94. Another important aspect that differentiates both cultures is the way information is handled. The need for transparency is quickly apparent with regard to safety. In the security field, due to the nature of the events considered, the sharing of information has to be restricted to a smaller and selected group of individuals. Information protection, in fact, makes it possible to prevent sensitive information related to protective measures or facility weakness from falling into the hands of potentially malicious minded people. Further, it is also

important to take measures to ensure that the knowledge of actual malicious acts do not encourage similar events.

3.95. There is a need to find a balance between transparency in the interest of safety and a need to protect certain information from disclosure because of its possible use by those intending to undertake a malicious act.

3.96. Implementation of the general solutions recommended above is to be underpinned through the promotion of safety culture and security culture. These cultures seek to establish that safety and security issues receive the attention warranted by their significance at both organisational and individual level.

Phase 2

In Phase 2, the progressive application of the following safety requirements:

- 7 and 12 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.1 of GS-R-3;
- 2.25 of GSR Part 3 (DS379, revision of BSS115);
- **5** of GSR Part 5;
- **5.16** of GS-R-2;

giving due consideration to the interfaces between nuclear safety and security, necessitates that:

Action 194. All the relevant organizations should coordinate safety and security aspects from the early stages of development, establishing maximum synergy and, where necessary, integration.

Action 195. The government in cooperation with legislative bodies should define the responsibilities of the operating organization and other competent authorities in relation to security.

Action 196. The government should develop mechanisms to communicate appropriate information to the public regarding safety and security.

3.97. The State has to take appropriate steps within the legislative and regulatory framework to establish and ensure the proper implementation of the State's security regime, including designation of a regulatory or competent authority(ies). The government has to ensure

effective overall cooperation and relevant information sharing between the regulatory and competent authorities and other security-related parts of the government. This needs to include sharing of relevant information in accordance with national arrangements.

3.98. All structures, systems, and procedures have to be examined with an eye to both security and safety aspects so as to assure that an optimal balance is achieved.

3.99. A single regulatory body may be responsible both for safety and security, or this body may consist of separate authorities due to the different fields covered by safety and security. In the latter case, they could have specific structures and means of control of a different type. A consultation and coordination mechanism is required between the two authorities to ensure efficient protection with regard to the risk of malicious acts and to manage regulatory requirements that may be contradictory.

3.100. With respect to the degree which nuclear safety and nuclear security are to be integrated, special attention is needed in relation to differences in the government's involvement since a larger number of authorities are concerned in security than in safety. Consequently, there are more interfaces to deal with and a greater need for cooperation and coordination.

Phase 3

In Phase 3, the progressive application of the following safety requirements:

- 7 and 12 of GSR Part 1 (DS415, revision of GS-R-1);
- 2.1 of GS-R-3;
- 2.25 of GSR Part 3 (DS379, revision of BSS115);
- 5 of GSR Part 5;
- 5.16 of GS-R-2;
- **17** of NS-R-2 (DS413);

giving due consideration to the interfaces between nuclear safety and security, necessitates that:

Action 197. The regulatory body (possibly consisting of several authorities) should ensure that security regulations do not compromise safety and that safety regulations do not compromise security.

Action 198. The operating organization should prepare a physical protection programme and submit it to the regulatory body as appropriate.

Action 199. All the relevant organizations should ensure that emergency preparedness and response plans in the fields of safety and security are complementary, coherent and well coordinated among the involved entities.

Action 200. The operating organization and the regulatory body should continue to promote safety and security culture in their respective organizations.

3.101. The operating organization needs to provide a physical protection programme that prevents or deters unauthorized access, intrusion, theft, surface attack and internal or external sabotage of systems important to safety and nuclear materials. This programme has to include clear plans and procedures to provide physical protection of the site through vehicle entrance and exit control, vehicle parking and traffic control and personnel access control.

3.102. A well-coordinated approach in nuclear safety and in nuclear security is beneficial to each discipline. Major decisions regarding safety and security enhancements require the consultation of each discipline on a continuous basis. Safety and security issues have to be evaluated on mutually supporting and reinforcing terms. For example, enhancements such as barriers, locks and fences that are designed to improve physical security may have the unintended consequence of delaying or preventing plant operators from taking actions to safely shut down and cool down the reactor. The arrangements for clear delineation of responsibilities with regard to safety and security aspects need to include coordination and communication processes as well as mechanisms for resolving potential conflicts between safety and security aspects.

3.103. Effort made to coordinate these two regimes is beneficial to both and help achieve a clearer understanding by all interested parties. Bridging the gap between the international conventions and standards or guidance is extremely important to this effort. If safety and security regulatory authorities are separate, consultation and coordination mechanisms are needed between both.

3.104. Both the operating organization and the competent authorities have to develop plans as appropriate to limit the consequences of a radiological accident. Plans designed for safety purposes will cover unintended events as well as those resulting from malicious acts.

3.105. The management of a crisis resulting from a malicious act may demand the participation of a greater number of State bodies compared to a crisis generated by an unintended event. In addition to the services required to minimize the consequences of the event, the following services may be concerned: law enforcement authorities, bomb disposal services and judicial authorities (even if the latter may intervene to a lesser degree during a crisis). Procedures have to be established and appropriate training provided to relevant staff to ensure that plant operating staff are not prevented or delayed from taking necessary actions.

3.106. Security plans for the installation are designed to prevent malicious acts succeeding through effective response measures, (so-called contingency plans) and, if necessary to secure the location before any mitigation action. The implementation of contingency plans precedes emergency plans concerning safety and constitutes the last line of defence against a malicious act. There is an obligation for these plans to be complementary and coherent. Therefore, it is also necessary to ensure that good coordination is organized between the different responders as part of overall emergency planning

3.107. Obviously, it is necessary to carry out joint exercises in order to confirm the coordination of the entire safety and security organization. Special attention has to be taken to validate that their implementation by security forces does not jeopardize safety and that security is not jeopardized during the implementation of the emergency plan.

Main relevant IAEA safety standard

SF-1 Fundamental Safety Principles

Other key-publication

INSAG-24 Relationship between Safety and Security in Nuclear Installations

REFERENCES

(to be done after the Member States 120-day Comment Period)

ANNEX 1. OVERVIEW OF THE ACTIONS TO BE CONDUCTED DURING EACH PHASE FOR THE ESTABLISHEMENT OF THE SAFETY INFRASTRUCTURE

This annex consists of three tables which comprise, for Phase 1, 2 and 3 respectively, all the actions identified in the Sections 2 and 3 of the Guide as well as the safety requirements which serve as a basis for these actions. The main three entities involved in the establishment of the national safety infrastructure, namely the government, the regulatory body and the operating organization, appear in separate columns of the tables such that it is easy for the user to identify the actions for which each of these entities have a role to play.

PHASE 1

Action No.	Responsible entities (main)			Actions to be taken so as to implement the IAEA Safety Standards in Phase 1, and bases for these actions
	Government, legislators	Regulatory body	Operating organization	
Implementing the IAEA General Safety Requirements for the Safety Infrastructure				
1 – National policy and strategy				*Page 15*
Basis	**1** of GSR Part 1 (DS415, revision of GS-R-1); **3.17 and 3.126** of GSR Part 3 (DS379, revision of BSS115); **2** of GSR Part 5;			
1				The government should consider the necessary elements of a national policy and strategy for safety, in conjunction with the fundamental safety objective and principles established in the IAEA Safety Fundamentals.
2				The government should ensure the coordination among the stakeholders of all the activities of the safety infrastructure development.
3				The government should ensure that the status of the national safety infrastructure is assessed in relevant areas and that radiological aspects are adequately analysed in the environmental impact assessment (EIA).
4				The government in cooperation with legislative bodies should take due account of the assessment of the safety infrastructure elements and the fundamental principle of justification when making a decision on whether or not to introduce nuclear power
2 – Global nuclear safety régime				*Page 21*
Basis	**1** and **14** of GSR Part 1 (DS415, revision of GS-R-1); **6.3 to 6.6** of GS-R-3;			
10				The government should prepare for active participation in the Global Nuclear Safety Régime.
11				The government should begin dialogue with neighbouring States regarding its projects to establish a nuclear power programme.
12				The government and other relevant organizations should establish contact with foreign and international organizations to seek advice on matters related to safety.

3 – Legal framework					*Page 26*
Basis	**1, 2 ,3 and 4** of GSR Part 1 (DS415, revision of GS-R-1); **2.12 and 2.13** of GSR Part 3 (DS379, revision of BSS115); **1** of GSR Part 5; **3.3 and 3.4** of WS-R-5;				
19				The government in cooperation with legislative bodies should identify all necessary elements of a legal framework for the safety infrastructure, and plan how to structure and develop it.	
20				The government in cooperation with legislative bodies should consider the process which needs to be employed to licence nuclear power facilities in the later stages of the programme.	
4 – Regulatory framework					*Page 32*
Basis	**1, 3, 4,7 and 11** of GSR Part 1 (DS415, revision of GS-R-1); **2.14 to 2.17** of GSR Part 3 (DS379, revision of BSS115); **1** of GSR Part 5;				
23				In case the nuclear safety regulatory body is already established or identified in Phase 1 (which is not the scenario developed in this Safety Guide, where it is established at the beginning of Phase 2), it should be involved together with the government in the safety infrastructure development activities from the beginning.	
24				The government should recognize the need for an effectively independent and competent regulatory body, and consider the appropriate position of the regulatory body in the State's structure.	
25				The government should identify the prospective senior managers of the regulatory body.	
26				The government should consider the various alternative regulatory approaches and recognize their importance with subsequent activities.	
5 – Transparency and openness					*Page 43*
Basis	**1** and **36** of GSR Part 1 (DS415, revision of GS-R-1); **3.6** and **5.26** of GS-R-3; **1** of GSR Part 5;				
40				The government should establish a policy and guidance to inform general public and interested parties of the benefits and risks of nuclear power as needed to facilitate their involvement.	
41				The government should establish a process to ensure that the comments resulting from consultation with relevant interested parties are considered, and it should communicate about the results of these considerations to the interested parties.	
6 – Funding and financing					*Page 47*
Basis	**1, 3, 10** and **11** of GSR Part 1 (DS415, revision of GS-R-1); **4.1** of GS-R-3; **1** of GSR Part 5; **6.1 to 6.5** of WS-R-5; **1, 3** and **4** of NS-R-2 (DS 413);				
49				The government in cooperation with legislative bodies should plan funding for education and training, research centres, support activities, etc.	
50				The government should consider funding mechanisms for the regulatory body, and plan it.	
51				The government should plan funding for radioactive waste and spent fuel management, decommissioning and final disposal.	

52				The government should consider financing mechanisms of a nuclear power plant to ensure long term safety.
7 – External support organizations and contractors				*Page 53*
Basis	**4, 11, 13** and **20** of GSR Part 1 (DS415, revision of GS-R-1); **3.14** and **5.23** of GS-R-3; **2.21** of GSR Part 3 (DS379, revision of BSS115); **3** of NS-R-2 (DS413);			
60				The government should consider the availability of expertise, industrial capability, technical infrastructure and services that could support the long term national safety infrastructure.
61				The government should assess the need to create or to enhance national organizations providing support to the nuclear power programme, and to improve the national technical infrastructure.
8 – Leadership and management for safety				*Page 62*
Basis	**1** and **19** of GSR Part 1 (DS415, revision of GS-R-1); GS-R-3 **as a whole**; **2.43, 2.44** and **2.47** of GSR Part 3 (DS379, revision of BSS115); **6.1 to 6.9** of NS-R-3;			
73				The government should recognize the essential role of safety management and leadership in order to achieve a high level of safety and to foster safety culture within organizations.
74				The government should ensure that all the activities conducted in Phase 1 are included in the framework of an effective management system.
75				The government should give emphasis to persons with a strong safety culture and strong leadership capabilities when identifying senior managers for the prospective organizations to be established.
9 – Human resources development				*Page 67*
Basis	**1, 11** and **18** of GSR Part 1 (DS415, revision of GS-R-1); **4.1, 4.3** and **4.5** of GS-R-3; **2.19** and **2.20** of GSR Part 3 (DS379, revision of BSS115); 4 of NS-R-2 (DS413);			
6				The government should consider a strategy for securing high-quality personnel.
87				The government should identify competencies required in nuclear safety areas and approximate number of experts needed.
88				The government should explore national and foreign institutions that could provide education and training.
89				The government should identify gaps in existing training institutions and plan to start training and establish new institutions as needed.
90				The government should consider sending nuclear trainees to study and work in foreign institutions.
10 – Research for safety and regulatory purposes				*Page 74*
Basis	**1** and **11** of GSR Part 1 (DS415, revision of GS-R-1);			
100				The government should consider areas where in-depth knowledge is necessary to assess and analyze safety aspects of a nuclear power plant and identify research centres that can start research programmes in necessary knowledge areas.
101				The government should identify gaps in domestic research centres' capabilities to meet the needs in core areas, and plan to establish new research centres for core areas as deemed needed.

11 – Radiation protection					*Page 78*
Basis	**7** of GSR Part 1 (DS415, revision of GS-R-1); **2.12** and **4.2** of GSR Part 3 (DS379, revision of BSS115); **4.1 to 4.15** of NS-R-3;				
106				The government should consider the additional radiation hazards and special needs presented by nuclear power plant operation.	
107				The government should ensure that a radiological environmental impact analysis is conducted.	
108				The government in cooperation with legislative bodies should recognize the need for integrating radiation protection and new nuclear power plant safety regulations.	
12 – Safety assessment					*Page 85*
Basis	**5, 6** and **8** of GSR Part 4;				
118				The government should consider the safety goals and principles that are to be applied to the development of the national nuclear power programme.	
13 – Safety of radioactive waste, spent fuel management and decommissioning					*Page 91*
Basis	**7** and **10** of GSR Part 1; **2.22** of GSR Part 3 (DS379, revision of BSS115); **1** and **2** of GSR Part 5; **2.1, 3.1 to 3.4**, **6.1 to 6.5** of WS-R-5;				
123				The government should consider a range of options for radioactive waste management (including disposal), spent fuel management and decommissioning, based on a comprehensive long term strategy.	
124				The government should recognize long term safety requirements and cost implications of radioactive waste management (including disposal), spent fuel management and decommissioning.	
125				The government should plan to establish, or expand as appropriate, a national organization responsible for radioactive waste management.	
14 – Emergency preparedness and response					*Page 97*
Basis	**7** and **8** of GSR Part 1 (DS415, revision of GS-R-1); **4.2** of GSR Part 3 (DS379, revision of BSS115); **2.1 to 2.6** of GS-R-2;				
135				The government should recognize the need for early establishment of emergency plans.	
136				The government should identify national institutions and new arrangements to support Emergency Preparedness and Response (EPR).	
Implementing the IAEA Specific Safety Requirements for the Safety Infrastructure					
15 – Operating organization					*Page 102*
Basis	**5, 6** and **11** of GSR Part 1 (DS415, revision of GS-R-1); **2.36** of GSR Part 3 (DS279, revision of BSS115); **1** and **4** of NS-R-2 (DS413);				
148				In case the operating organization is already established or identified in Phase 1 (which is not the scenario developed in this Safety Guide, where it is established at the beginning of Phase 2), it should be involved together with the government in the safety infrastructure development activities from the beginning.	
149				The government should consider the financial strength and the necessary competencies and staffing that are expected from an organization operating a	

				nuclear power plant so as to ensure long term safety.
150				The government should prepare a plan to define or establish, as necessary, the operating organization.
16 – Site survey, site selection and evaluation				*Page 115*
Basis	**3.126** of GSR Part 3 (DS379, revision of BSS115); **2.1 to 2.29**, **3.1 to 3.55**, **4.1 to 4.15, 6.1 to 6.9** of NS-R-3;			
161				The government should ensure that potential sites are identified and candidate sites are selected on the basis of a set of defined criteria, at a regional scale and using available data.
17 – Design safety				*Page 122*
Basis	NS-R-1 (DS414)			
171				The government should understand the objectives of nuclear safety, and why and how nuclear safety impacts the design of a nuclear power plant.
172				The government should consider the various designs available from vendors and understand the most important safety features.
18 – Preparation for commissioning				-
-				*No action in Phase 1.*
19 – Transport safety				*Page 131*
Basis	**7** of GSR Part 1 (DS415, revision of GS-R-1); **2.23** of GSR Part 3 (DS379, revision of BSS115); TS-R-1 **as a whole**;			
189				The government should consider the impact on the legal and regulatory framework by the transport of nuclear fuel and nuclear waste, beyond the existing transport of radioactive material.
20 – Interfaces with nuclear security				*Page 137*
Basis	**7** and **12** of GSR Part 1 (DS415, revision of GS-R-1); **2.1** of GS-R-3; **2.25** of GSR Part 3 (DS379, revision of BSS115);			
193				The government should consider the need to promote both safety and security cultures, taking into account their similarities and differences.

PHASE 2

Action No.	Responsible entities (main)			Actions to be taken so as to implement the IAEA Safety Standards in Phase 2, and bases for these actions
	Government, legislators	Regulatory body	Operating organization	
Implementing the IAEA General Safety Requirements for the Safety Infrastructure				
1 – National policy and strategy				*Page 18*
Basis	1 of GSR Part 1 (DS415, revision of GS-R-1); 3.17 and 3.126 of GSR Part 3 (DS379, revision of BSS115); 2 of GSR Part 5;			
5				The government in cooperation with legislative bodies should establish a clear national policy and strategy for safety in order to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals.
6				The government should ensure that the development of the various elements of the safety infrastructure is adequately coordinated.
7				The government in cooperation with legislative bodies should ensure identification and progressive allocation of responsibilities to the relevant organizations involved in safety infrastructure development.
2 – Global nuclear safety régime				*Page 23*
Basis	1 and 14 of GSR Part 1 (DS415, revision of GS-R-1); 6.3 to 6.6 of GS-R-3;			
13				All the relevant organizations should continue participation in the Global Nuclear Safety Regime
14				The government in cooperation with legislative bodies should adhere to the relevant international conventions, as identified in Phase 1.
15				All the relevant organizations should strengthen cooperation with countries with advanced nuclear power programmes on matters related to safety.
3 – Legal framework				*Page 29*
Basis	1, 2 ,3 and 4 of GSR Part 1 (DS415, revision of GS-R-1); 2.12 and 2.13 of GSR Part 3 (DS379, revision of BSS115); 1 of GSR Part 5; 3.3 and 3.4 of WS-R-5;			
21				The government in cooperation with legislative bodies should enact and implement essential elements of the legal framework for the safety infrastructure.
4 – Regulatory framework				*Page 34*
Basis	1, 3, 4, 7, 11, **16, 17, 18, 21, 22, 23, 24, 25, 26, 30 and 32** of GSR Part 1 (DS415, revision of GS-R-1); 2.14 to 2.17 of GSR Part 3 (DS379, revision of BSS115); 1 and **3** of GSR Part 5; **3.5 and 3.6** of WS-R-5; **3.7** of GS-R-3;			
27				Action 27. The government in cooperation with legislative bodies should establish an effectively independent regulatory body, if not already established,

				and empower it with the adequate legal authority, technical and managerial competence, and human and financial resources to fulfil its responsibilities in the nuclear power programme.
28				The government in cooperation with legislative bodies should, in particular, appoint senior managers and key experts to the regulatory body and form its organizational structure.
29				The regulatory body should consider adopting the IAEA Safety Standards for developing a consistent regulatory approach, possibly supported with appropriate national requirements and guides.
30				The regulatory body should issue regulations or guides specifying the documentation and procedures needed in the various steps of licensing.
31				The regulatory body should specify safety requirements needed for tendering process.
32				The regulatory body should begin establishing suitable working relationship with the operating organization and international organizations.
5 – Transparency and openness				*Page 44*
Basis	1, **21, 34** and 36 of GSR Part 1 (DS415, revision of GS-R-1); 3.6, 5.26 and **5.27** of GS-R-3; **2.30** and **2.33** of GSR Part 3 (DS379, revision of BSS115); 1 and **3** of GSR Part 5; **2** of NS-R-2 (DS413);			
42				The government should inform all interested parties regarding the safety implications of the decision on the implementation of a national nuclear power programme.
43				All the relevant organizations should continue informing the general public and interested parties on safety issues, including health and environmental impacts.
6 – Funding and financing				*Page 48*
Basis	1, 3, 10 and 11 of GSR Part 1 (DS415, revision of GS-R-1); 4.1 of GS-R-3; 1 of GSR Part 5; 6.1 to 6.5 of WS-R-5; 1, 3 and 4 of NS-R-2 (DS 413);			
53				The government in cooperation with legislative bodies should establish the necessary arrangements to provide assured long-term financing for education and training, research centres, support activities, etc.
54				The government in cooperation with legislative bodies should be adequately implementing funding mechanism for the regulatory body.
55				The operating organization should plan and ensure appropriate financing so as not to compromise safety during all the stages of the nuclear power programme
56				The government in cooperation with legislative bodies should enact legislation that requires collection of funds and securing these funds for long term management of waste and decommissioning.
7 – External support organizations and contractors				*Page 55*
Basis	4, 11, 13, **17** and 20 of GSR Part 1 (DS415, revision of GS-R-1); 3.14**, 5.14**, 5.23 and **5.24** of GS-R-3; 2.21 and **2.38** of GSR Part 3 (DS379, revision of BSS115); **37** of NS-R-1 (DS414) 3 and **31** of NS-R-2 (DS413);			
62				The operating organization and the government as appropriate should encourage national industrial organizations to develop their capabilities with the objective

				of participating in the construction of nuclear power plant and supporting safe long term operation.
63				The government should establish organizations providing expertise, engineering or other technical support to the national nuclear power programme, as identified in Phase 1.
64				Expertise, engineering and other technical support organizations should begin building competence and quality assurance programmes.
65				The regulatory body and the operating organization should plan arrangements for overseeing the activities performed by external support organizations and contractors.
66				The operating organization and the government should start to implement plans for improving national technical infrastructure, as needed to fill in previously identified gaps.
8 – Leadership and management for safety				*Page 63*
Basis	1, 19 and **35** of GSR Part 1 (DS415, revision of GS-R-1); GS-R-3 as a whole; 2.43, 2.44, **2.45**, 2.47, **2.48** and **2.49** of GSR Part 3 (DS379, revision of BSS115); **7** of GSR Part 5; 6.1 to 6.9 of NS-R-3; **2** of NS-R-2 (DS413); **306** of TS-R-1;			
76				The regulatory body and the operating organization should start developing and implementing effective management systems in their respective organizations and promote a strong safety culture.
77				The regulatory body and the operating organization should develop competences in managing growth and change of the organization.
78				The regulatory body and the operating organization should start making appropriate arrangements for measurement, assessment (both self assessment and independent assessment) as well as continuous improvement of their management systems.
9 – Human resources development				*Page 69*
Basis	1, 11 and 18 of GSR Part 1 (DS415, revision of GS-R-1); 4.1, 4.3, **4.4** and 4.5 of GS-R-3; 2.19, 2.20, **2.29, 2.49** and **3.103** of GSR Part 3 (DS379, revision of BSS115); 4 and **7** of NS-R-2 (DS413); **311 to 315** of TS-R-1;			
91				All the relevant organizations should implement a strategy to attract and retain trained high-quality personnel.
92				All the relevant organizations should support the training of prospective nuclear staff in foreign nuclear organizations.
93				The regulatory body and the operating organization should actively recruit staff so as to ensure capability in the relevant areas in a timely manner.
94				The government in cooperation with legislative bodies and other applicable organizations should establish new institutes or new curricula, as identified in Phase 1.
95				All the relevant organizations should start education and training of necessary number of persons in academic and vocational institutions.
10 – Research for safety and regulatory purposes				*Page 75*
Basis	1 and 11 of GSR Part 1 (DS415, revision of GS-R-1);			

	3 of GSR Part 5;			
102				The operating organization and the regulatory body should be involved in the definition of safety research areas.
103				The government in cooperation with legislative bodies should implement plans to establish new research institutes, as identified in Phase 1.
104				Research centres should begin conducting safety research in core areas in which in-depth knowledge is essential to support safe long term operation.
11 – Radiation protection				*Page 79*
Basis	7 of GSR Part 1 (DS415, revision of GS-R-1); 2.12, **2.26 to 2.38, 3.5 to 3.138,** 4.2, **4.3 to 4.21, Schedule III** and **Schedule IV** of GSR Part 3 (DS379, revision of BSS115); 4.1 to 4.15 of NS-R-3; **78** and **79** of NS-R-1 (DS414); **301 to 303** of TS-R-1;			
109				The regulatory body and/or the government in cooperation with legislative bodies should amend the national legislation and/or regulations as appropriate for radiation protection.
110				The regulatory body should establish the radiological criteria regarding workers, the public and the environment, both for normal operation and for accidental conditions of a nuclear power plant.
112				The operating organization should update the radiological environmental impact analysis for the selected site, as appropriate.
112				The regulatory body should review and assess the radiological environmental impact analysis for the selected site, as appropriate.
113				The operating organization should use all the appropriate safety and regulatory information regarding radiation protection to prepare the bid specifications for the nuclear power plant.
12 – Safety assessment				*Page 86*
Basis	**24, 25** and **26** of GSR Part 1 (DS415, revision of GS-R-1); **3.28 to 3.34** of GSR Part 3 (DS379, revision of BSS115); **1, 2, 3, 4**, 5, 6, 8, **14, 15, 16** of GSR Part 4;			
119				The operating organisation, the regulatory body and external expert support organizations as appropriate should develop the expertise to prepare for the conduct or the review of safety assessments.
13 – Safety of radioactive waste, spent fuel management and decommissioning				*Page 92*
Basis	7 and 10 of GSR Part 1; 2.22 and **3.125** of GSR Part 3 (DS379, revision of BSS115); 1, 2, **3, 4, 5, 6, 7, 8, 9, 10, 11, 12** and **17** of GSR Part 5; 2.1, **2.2, 2.3, 2.5**, 3.1 to 3.4, **3.5 to 3.8, 4.1 to 4.8**, 6.1 to 6.5 of WS-R-5; **22** of NS-R-2 (DS413); **35, 36** and **38** of NS-R-1 (DS414);			
126				The government in cooperation with legislative bodies should establish the radioactive waste management organization, as necessary.
127				The government in cooperation with legislative bodies, the radioactive waste management organization and the regulatory body should establish the national strategy for radioactive waste and spent fuel management and decommissioning, and set the goals for its implementation in appropriate schedule, including site investigations for radioactive waste disposal.
128				The regulatory body should issue the necessary regulatory requirements on waste

				and spent fuel management and decommissioning, as appropriate.
129				The operating organization shall consider the necessary arrangements for ensuring safe management of radioactive waste, spent fuel and decommissioning, and for minimizing the generation of radioactive waste.
14 – Emergency preparedness and response				*Page 97*
Basis	7 and 8 of GSR Part 1 (DS415, revision of GS-R-1); 4.2, **4.3 to 4.21** and **Schedule IV** of GSR Part 3 (DS379, revision of BSS115); 2.1 to 2.6, **3.1 to 3.20, 5.2 to 5.30** of GS-R-2; **18** of NS-R-2 (DS413); **304 and 305** of TS-R-1;			
137				The government should define the national institutions with responsibilities for EPR.
138				The government should define the general approach based on the severity of the emergency situations.
139				The government should start implementing new arrangements as identified in Phase 1 for strengthening the emergency infrastructure.
140				The regulatory body should develop basic regulations on emergency planning.
141				The operating organization should start developing a general nuclear power plant emergency preparedness programme.
Implementing the IAEA Specific Safety Requirements for the Safety Infrastructure				
15 – Operating organization				*Page 105*
Basis	5, 6 and 11 of GSR Part 1 (DS415, revision of GS-R-1); 2.36 of GSR Part 3 (DS279, revision of BSS115); 1, **2, 3**, 4 and **5** of NS-R-2 (DS413);			
151				The operating organization should be established, if not already established, and recognize that it has prime responsibility for safety.
152				The operating organization should appoint managers and key experts, and define its organizational structure.
153				The operating organization should establish a suitable working relationship with the regulatory body and with relevant national and international organizations.
154				The operating organization should establish the bid evaluation process, giving due consideration to safety aspects.
16 – Site survey, site selection and evaluation				*Page 117*
Basis	3.126 of GSR Part 3 (DS379, revision of BSS115); 2.1 to 2.29, 3.1 to 3.55, 4.1 to 4.15, 6.1 to 6.9 of NS-R-3;			
162				The regulatory body should establish specific safety requirements for site evaluation, including the process for authorizing the selected site, in compliance with applicable IAEA Safety Standards.
163				The operating organization should complete the investigations related to the suitability of the candidate sites and select the preferred candidate site for the first nuclear power plant, using specific site data, information, studies and assessments conducted with the full temporal and spatial scales of investigations.
164				The operating organization should prepare the Site Evaluation Report (SER) and submit it to the regulatory body, based on a full assessment of the selected site and including the confirmation of site acceptability and the characterization of the site for the definition of the site related design basis parameters.
165				The regulatory body should review and assess the SER, and make a regulatory

				decision regarding the acceptability of the selected site and the site related design bases.
166				The operating organization should use all the appropriate safety and regulatory information related and derived from the site assessment to prepare the bid specifications for the nuclear power plant.
167				The operating organization should start the site and environmental monitoring programme as described in the SER.
17 – Design safety				*Page 122*
Basis	**2.48, 3.36 to 3.45** and **3.117** of GSR Part 3 (DS379, revision of BSS115); NS-R-1 as a whole; **6.43 to 6.51** of NS-R-5;			
173				All the relevant organizations should obtain an in-depth understanding of safety principles and requirements applicable to the design of nuclear power plants.
174				The operating organization should conduct a thorough market survey on the available nuclear power technologies and investigate their safety features.
175				The regulatory body should prepare and enact national safety regulations on design necessary for bid specification.
176				The operating organization and/or the regulatory body, in referencing the IAEA Safety Standards, should specify the codes and standards which provide acceptable reference for design and construction of the plant.
177				The operating organization should include in the bid specification all the safety and regulatory aspects, as necessary for design considerations.
18 – Preparation for commissioning				-
-				*No action in Phase 1.*
19 – Transport safety				*Page 134*
Basis	7 of GSR Part 1 (DS415, revision of GS-R-1); 2.23 of GSR Part 3 (DS379, revision of BSS115); TS-R-1 as a whole;			
190				All relevant organizations should implement a plan to meet the intent of the international safety requirements and start to fill in the gaps identified in Phase 1.
191				The regulatory body and organizations in charge of transport should join international associations to enhance mutual support.
20 – Interfaces with nuclear security				*Page 139*
Basis	7 and 12 of GSR Part 1 (DS415, revision of GS-R-1); 2.1 of GS-R-3; 2.25 of GSR Part 3 (DS379, revision of BSS115); **5** of GSR Part 5; **5.16** of GS-R-2;			
				All the relevant organizations should coordinate safety and security aspects from the early stages of development, establishing maximum synergy and, where necessary, integration.
				The government in cooperation with legislative bodies should define the responsibilities of the operating organization and other competent authorities in relation to security.
				The government should develop mechanisms to communicate appropriate information to the public regarding safety and security.

PHASE 3

Action No.	Responsible entities (main)			Actions to be taken so as to implement the IAEA Safety Standards in Phase 3, and bases for these actions	
	Government, legislators	Regulatory body	Operating organization		
Implementing the IAEA General Safety Requirements for the Safety Infrastructure					
1 – National policy and strategy					*Page 19*
Basis	1 of GSR Part 1 (DS415, revision of GS-R-1); 3.17 and 3.126 of GSR Part 3 (DS379, revision of BSS115); 2 of GSR Part 5;				
8				The government in cooperation with legislative bodies should continue to execute the national policy and strategy for safety.	
9				The government in cooperation with legislative bodies should ensure that the regulatory body and the operating organization are fulfilling their responsibilities.	
2 – Global nuclear safety régime					*Page 24*
Basis	1 and 14 of GSR Part 1 (DS415, revision of GS-R-1); 6.3 to 6.6 of GS-R-3; **24** of NS-R-2 (DS413);				
16				All the relevant organizations should ensure continued participation in international activities and networks for strengthening safety.	
17				The operating organization should implement a strong cooperation programme with the vendor and with organization(s) operating the selected reactor, for strengthening safety.	
18				The regulatory body should implement a strong cooperation programme with the vendor country and with other regulatory bodies which have oversight experience with the selected reactor.	
3 – Legal framework					*Page 30*
Basis	1, 2 ,3 and 4 of GSR Part 1 (DS415, revision of GS-R-1); 2.12 and 2.13 of GSR Part 3 (DS379, revision of BSS115); 1 of GSR Part 5; 3.3 and 3.4 of WS-R-5;				
22				The government in cooperation with legislative bodies should ensure that the legal framework for the safety infrastructure is fully in place and is being complied by the relevant organizations.	
4 – Regulatory framework					*Page 38*
Basis	1, 3, 4, 7, 11, 16, 17, 18, 21, 22, 23, 24, 25, 26, **27, 28, 29,** 30, **31,** 32 and **33** of GSR Part 1 (DS415, revision of GS-R-1); 2.14 to 2.17 of GSR Part 3 (DS379, revision of BSS115); 1 and 3 of GSR Part 5; 3.5 and 3.6 of WS-R-5; 3.7 of GS-R-3;				
33				The regulatory body should select and implement a regulatory approach in accordance with national arrangements.	
34				The regulatory body should maintain suitable working relationships with the	

				operating organization.
35				The regulatory body should ensure adequate planning for all the required oversight activities to be conducted during licensing, construction, commissioning and operation.
36				The regulatory body should establish a consistent procedure for issuing, revising and revoking regulations and guides.
37				The regulatory body should ensure that a comprehensive set of regulations and guides is fully in place to regulate construction, commissioning and operational activities at the appropriate time.
38				The regulatory body should implement its inspection and enforcement programme during construction.
39				The regulatory body should review and assess programmes to be implemented by the operating organization, as appropriate.
5 – Transparency and openness				*Page 45*
Basis	1, 21, 34 and 36 of GSR Part 1 (DS415, revision of GS-R-1); 3.6, 5.26 and 5.27 of GS-R-3; 2.30 and 2.33 of GSR Part 3 (DS379, revision of BSS115); 1 and 3 of GSR Part 5; **4.53 to 4.54**, **4.82 to4.84** of GS-R-2; 2 of NS-R-2 (DS413);			
44				All the relevant organizations should establish and maintain confidence and trust with the interested parties, including the public.
45				All the relevant organizations should continue explaining the rationale for introducing nuclear power, including benefits and risks, and the measures taken to limit the risks.
46				The regulatory body should communicate about the licensing process, the safety requirements, and the regulatory oversight to interested parties.
47				The operating organization and the regulatory body should communicate about the construction progress and the commissioning programme to interested parties.
48				The operating organization and the regulatory body should maintain transparency regarding problems and difficulties encountered with all the interested parties involved in the construction programme, including suppliers.
6 – Funding and financing				*Page 49*
Basis	1, 3, 10 and 11 of GSR Part 1 (DS415, revision of GS-R-1); 4.1 of GS-R-3; 1 of GSR Part 5; 6.1 to 6.5 of WS-R-5; 1, 3 and 4 of NS-R-2 (DS 413);			
57				The government in cooperation with legislative bodies should continue providing appropriate funding for the efficient and effective conduct of the regulatory activities.
58				The operating organization should ensure that financing is sufficient to sustain the safe operation of the nuclear power plant.
59				The government and/or the regulatory body should ensure that a system for the funding of decommissioning and radioactive waste management is implemented.
7 – External support organizations and contractors				*Page 58*
Basis	4, 11, 13, 17 and 20 of GSR Part 1 (DS415, revision of GS-R-1); 3.14, 5.14, **5.15 to 5.20**, 5.23, 5.24 and **5.25** of GS-R-3;			

	2.21 and 2.38 of GSR Part 3 (DS379, revision of BSS115); 37 of NS-R-1 (DS414); 3 and 31 of NS-R-2 (DS413);			
62				The operating organization and the government as appropriate should encourage national industrial organizations to develop their capabilities with the objective of participating in the construction of nuclear power plant and supporting safe long term operation.
63				The government should establish organizations providing expertise, engineering or other technical support to the national nuclear power programme, as identified in Phase 1.
64				Expertise, engineering and other technical support organizations should begin building competence and quality assurance programmes.
65				The regulatory body and the operating organization should plan arrangements for overseeing the activities performed by external support organizations and contractors.
66				The operating organization and the government should start to implement plans for improving national technical infrastructure, as needed to fill in previously identified gaps.
8 – Leadership and management for safety				*Page 64*
Basis	1, 19 and 35 of GSR Part 1 (DS415, revision of GS-R-1); GS-R-3 as a whole; 2.43, 2.44, 2.45, **2.46**, 2.47, 2.48 and 2.49 of GSR Part 3 (DS379, revision of BSS115); 7 of GSR Part 5; **5.37 to 5.39** of GS-R-2; 6.1 to 6.9 of NS-R-3; **2** of NS-R-1 (DS414); 2, **8, 9** and **15** of NS-R-2 (DS413); 306 of TS-R-1;			
79				The senior management of all the relevant organizations should provide effective leadership and effective management for safety to ensure a sustainable high level of safety.
80				All the relevant organizations should continue the implementation of an integrated management system that promotes the concept that safety shall be paramount within the organization, overriding all other demands.
81				The operating organization and the regulatory body should ensure that the effectiveness of their management system is monitored, measured, and that self-assessments as well as independent assessments are conducted regularly for continuous improvement.
82				All the relevant organizations should ensure that appropriate arrangements for knowledge management (including record and report management) and knowledge transfer are in place.
83				All the relevant organizations should ensure that leadership and succession development programme are in place to develop future leaders with strong emphasis on safety.
84				The operating organization should prepare a safety management programme as well as the corresponding chapter of the SAR.
85				The regulatory body should review and assess the operating organization's programme on safety management.
9 – Human resources development				*Page 71*
Basis	1, 11 and 18 of GSR Part 1 (DS415, revision of GS-R-1); 4.1, 4.3, 4.4 and 4.5 of GS-R-3;			

	2.19, 2.20, 2.29, **2.41**, 2.49 and 3.103 of GSR Part 3 (DS379, revision of BSS115); 4 and 7 of NS-R-2 (DS413); 311 to 315 of TS-R-1;			
96				The operating organization, the regulatory body and other support organizations should ensure sufficient and competent human resources for the efficient and effective conduct of all activities at the appropriate time.
97				The operating organization should prepare a human resources management programme (including staffing, qualification and training) as well as the corresponding parts of the SAR.
98				The regulatory body should review and assess the operating organization's programme regarding human resources management.
99				The government should continue promoting educational development in the nuclear field so as to provide a continuing flow of qualified people in the relevant areas.
10 – Research for safety and regulatory purposes				*Page 76*
Basis	1 and 11 of GSR Part 1 (DS415, revision of GS-R-1); 3 of GSR Part 5;			
105				Research centres and other applicable organizations should focus the research on the actual features and the safety aspects of the nuclear power plant that will be constructed, including the actual site.
11 – Radiation protection				*Page 81*
Basis	7 of GSR Part 1 (DS415, revision of GS-R-1); 2.12, 2.26 to 2.38, **2.39 to 2.42**, 3.5 to 3.138, 4.2, 4.3 to 4.21, Schedule III and Schedule IV of GSR Part 3 (DS379, revision of BSS115); 4.1 to 4.15 of NS-R-3; 78 and 79 of NS-R-1 (DS414); **21** of NS-R-2 (DS413); 301 to 303 of TS-R-1;			
114				The operating organization should establish a radiation protection management programme as well as the corresponding chapter of the SAR.
115				The operating organization should establish an environmental radiological monitoring programme as well as the corresponding chapter of the SAR.
116				The regulatory body should review and assess the operating organization's programmes regarding radiation protection and relevant environmental aspects, and verify compliance with the regulatory requirements.
117				The regulatory body should ensure that arrangements are in place for confirmatory monitoring of all releases from the nuclear power plant to the environment.
12 – Safety assessment				*Page 87*
Basis	24, 25 and 26 of GSR Part 1 (DS415, revision of GS-R-1); 3.28 to 3.34 of GSR Part 3 (DS379, revision of BSS115); 1, 2, 3, 4, 5, 6, **7**, 8, **9, 10, 11, 12, 13**, 14, 15, 16, **17, 18, 19, 20, 21, 22, 23** and **24** of GSR Part 4; **5** and **39** of NS-R-1 (DS414); **12** of NS-R-2 (DS413);			
120				The operating organisation should perform comprehensive safety assessments of the nuclear power plant and produce SARs to demonstrate that all the relevant safety requirements have been met.
121				The regulatory body should carry out comprehensive review of the SARs performed by the operating organisation to verify compliance with the regulatory requirements.

				External expert organizations or individuals should be providing support to the operating organisation and/or the regulatory body for performing or reviewing safety assessments, as needed.
13 – Safety of radioactive waste, spent fuel management and decommissioning				*Page 94*
Basis	7 and 10 of GSR Part 1; 2.22 and 3.125 of GSR Part 3 (DS379, revision of BSS115); 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, **13, 14, 15, 16**, 17, **18, 19** and **20** of GSR Part 5; 2.1, 2.2, 2.3, **2.4**, 2.5, 3.1 to 3.4, 3.5 to 3.8, 4.1 to 4.8, **5.1 to 5.14**, 6.1 to 6.5 of WS-R-5; 22 and **33** of NS-R-2 (DS413); 35, 36 and 38 of NS-R-1 (DS414);			
130				The regulatory body should fully implement its regulatory oversight programme for radioactive waste and spent fuel management facilities and activities, as appropriate.
131				The operating organization should prepare a waste and spent fuel management programme as well as a decommissioning management programme, in complete coherence with the national strategy, and prepare the corresponding chapters of the SAR.
132				The regulatory body should review and assess the operating organization's programme on waste and spent fuel management and decommissioning, and verify compliance with the regulatory requirements.
133				The operating organization and the radioactive waste management organization should make interim storage facilities fully operational and ready to receive radioactive waste and spent fuel from the nuclear power plant.
134				The government and the radioactive waste management organization should follow international efforts and progress toward disposal of radioactive waste.
14 – Emergency preparedness and response				*Page 99*
Basis	7 and 8 of GSR Part 1 (DS415, revision of GS-R-1); 4.2, 4.3 to 4.21 and Schedule IV of GSR Part 3 (DS379, revision of BSS115); 2.1 to 2.6, 3.1 to 3.20, **4.1 to 4.100**, 5.2 to 5.30, **5.31-5.39** of GS-R-2; 18 of NS-R-2 (DS413); 304 and 305 of TS-R-1;			
142				The regulatory body should establish specific regulations on emergency planning.
143				The operating organization should develop and implement nuclear power plant emergency preparedness programme, plans and procedures, and prepare the corresponding chapter of the SAR.
144				The government and the regulatory body should develop and implement local, national, and international emergency preparedness programmes.
145				The government and the regulatory body should establish arrangements for coordination between the nuclear power plant emergency response plan and the plans of the relevant national institutions involved in emergency response.
146				The regulatory body should review and assess the nuclear power plant emergency programme, plans and procedures, and verify compliance with the regulatory requirements.
147				The operating organization, the regulatory body and the government should demonstrate emergency response capabilities by conducting appropriate exercises, involving local communities and authorities.
Implementing the IAEA Specific Safety Requirements for the Safety Infrastructure				
15 – Operating organization				*Page 107*

Basis	5, 6 and 11 of GSR Part 1 (DS415, revision of GS-R-1); **3.7** of GS-R-3; 2.36 and **2.42** of GSR Part 3 (DS279, revision of BSS115); **1** of NS-R-1 (DS414); 1, 2, 3, 4, 5, **6, 8, 19, 20, 23, 24, 26, 27, 28, 29, 30, 31** and **32** of NS-R-2 (DS413); **9.4, 9.49 to 9.53** of NS-R-5;			
155				The operating organization should implement a safety policy that gives safety matters the highest priority, as part of its management system.
156				The operating organization should develop goals and objectives to be accomplished in terms of safety.
157				The operating organization should give due consideration to safety aspects during the evaluation of bids.
158				The operating organization should prepare all safety documentation required by the licensing process, such as the SARs, in accordance with the national regulatory requirements.
159				The operating organization should develop all necessary operation management programmes (including operations and maintenance) and submit them to the regulatory body as appropriate.
160				The operating organization should ensure the completion of construction of the nuclear power plant in accordance with design bases and with due consideration given to safety aspects.
16 – Site survey, site selection and evaluation				*Page 120*
Basis	3.126 of GSR Part 3 (DS379, revision of BSS115); 2.1 to 2.29, 3.1 to 3.55, 4.1 to 4.15, **5.1**, 6.1 to 6.9 of NS-R-3;			
168				The operating organization should prepare the chapter on site evaluation of the SAR, and then update it taking into account the specificities of the chosen reactor and the data and information gathered during the pre-operational stage.
169				The operating organization should implement necessary safety improvements to the site, if required, regarding the site protection measures defined as a result of the external hazard assessment tasks.
170				The operating organization should continue to implement the environmental and site monitoring programme.
17 – Design safety				*Page 124*
Basis	2.48, 3.36 to 3.45 and 3.117 of GSR Part 3 (DS379, revision of BSS115); NS-R-1 as a whole; **10** and **11** of NS-R-2 (DS413); 6.43 to 6.51 of NS-R-5;			
178				The operating organization should establish a ‘design entity’ which will maintain the knowledge of the design and its configuration management during the lifetime of the plant.
179				The operating organization should ensure adequate safety review of the designs proposed by the vendors in the submitted bids.
180				The operating organization should establish proper interaction with the vendor for the preparation of the safety documents.
181				The operating organization should prepare and provide the safety documents requested in the licensing process, such as the SARs.
182				The regulatory body should review and assess the safety documentation such as the SARs, and verify compliance with regulatory requirements.
183				The operating organization and the regulatory body should ensure adequate

				validation and verification of the design of the nuclear power plant and SSCs.
184				The operating organization and the regulatory body should implement a process to address modifications in the design during construction and afterwards.
18 – Preparation for commissioning				*Page 128*
Basis	**25** of NS-R-2 (DS413);			
185				The regulatory body should issue requirements on commissioning.
186				The operating organization should establish a comprehensive commissioning programme, prepare the corresponding chapter of the SAR as appropriate and ensure sufficient number of operating staff to be involved in commissioning activities.
187				The operating organization should establish mechanisms for transfer of responsibilities with the constructor at the end of Phase 3.
188				The regulatory body should review and assess the commissioning programme, and verify compliance with requirements and prepare a programme to oversee the commissioning of systems important to safety in the next Phase.
19 – Transport safety				*Page 135*
Basis	7 of GSR Part 1 (DS415, revision of GS-R-1); 2.23 of GSR Part 3 (DS379, revision of BSS115); TS-R-1 as a whole;			
192				The regulatory body and organizations in charge of transport should fully implement changes to the national requirements and arrangements for transportation of radioactive material.
20 – Interfaces with nuclear security				*Page 140*
Basis	7 and 12 of GSR Part 1 (DS415, revision of GS-R-1); 2.1 of GS-R-3; 2.25 of GSR Part 3 (DS379, revision of BSS115); 5 of GSR Part 5; 5.16 of GS-R-2; **17** of NS-R-2 (DS413);			
197				The regulatory body (possibly consisting of several authorities) should ensure that security regulations do not compromise safety and that safety regulations do not compromise security.
198				The operating organization should prepare a physical protection programme and submit it to the regulatory body as appropriate.
199				All the relevant organizations should ensure that emergency preparedness and response plans in the fields of safety and security are complementary, coherent and well coordinated among the involved entities.
200				The operating organization and the regulatory body should continue to promote safety and security culture in their respective organizations

ANNEX 2. LIST OF THE IAEA SAFETY REQUIREMENTS AND GUIDES, AND OTHER SAFETY KEY-PUBLICATIONS TO BE CONSIDERED

This annex consists of a table which provides a list, for each "element" of the national safety infrastructure, of the IAEA Safety Requirements, the IAEA Safety Guides and other safety key-publications (mainly INSAG reports) to be considered for the establishment of a sustainable Safety Infrastructure in compliance with the IAEA Safety Standards, in addition to the Safety Fundamentals SF-1.

The IAEA website provides an up-to-date list of current IAEA Safety Standards as well as information on IAEA Safety Standards being drafted or reviewed: http://www-ns.iaea.org/downloads/standards/status.pdf .

Type of publication			Safety publications to be considered, in addition to the **SF-1** Fundamental Safety Principles	
IAEA Safety Requirements	IAEA Safety Guides	Other key-safety publications		
Implementing the IAEA General Safety Requirements for the Safety Infrastructure				
1 – National policy and strategy				*Page 15*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)	
			INSAG-5 The Safety of Nuclear Power	
			INSAG-12 Basic Safety Principles for Nuclear Power Plants	
			INSAG-22 Nuclear Safety Infrastructure for a National Nuclear Power Programme Supported by the IAEA Fundamental Safety Principles	
2 – Global nuclear safety régime				*Page 21*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)	
			INSAG-21 Strengthening the Global Nuclear Safety Regime	
			IAEA Handbook on Nuclear Law	
3 – Legal framework				*Page 26*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)	
			IAEA Handbook on Nuclear Law	
4 – Regulatory framework				*Page 32*

			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities
			GS-G-1.2 Review and Assessment of Nuclear Facilities by the Regulatory Body
			GS-G-1.3 Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body
			GS-G-1.4 Documentation for Use in Regulating Nuclear Facilities
			DS416 Licensing Process for Nuclear Installations
			GS-G-1.5 Regulatory Control of Radiation Sources
			WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment
			INSAG-5 The Safety of Nuclear Power
			INSAG-12 Basic Safety Principles for Nuclear Power Plants
			INSAG-17 Independence in regulatory decision making
5 – Transparency and openness			*Page 43*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			GS-R-3 The Management System for Facilities and Activities
			INSAG-20 Stakeholder Involvement in Nuclear Issues
6 – Funding and financing			*Page 47*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities
			GS-R-3 The Management System for Facilities and Activities
			GSR Part 5 Predisposal Management of Radioactive
			WS-R-5 Decommissioning of Facilities Using Radioactive Material
			NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)
			NS-G-2.4 The Operating Organization for Nuclear Power Plants
7 – External support organizations and contractors			*Page 51*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			DS429 External Expert Support on Safety issues
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)
			GS-R-3 The Management System for Facilities and Activities
			GS-G-3.1 Application of the Management System for Facilities and Activities

			GS-G-3.2 The Management System for Technical Services in Radiation Safety
			DS349 The Management System for Nuclear Installations
			NS-R-1 Safety of Nuclear Power Plants: Design (under revision, DS414)
			NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, DS413)
			NS-G-2.4 The Operating Organization for Nuclear Power Plants
			INSAG-18 Managing Change in the Nuclear Industry: the Effects on Safety
8 – Leadership and management for safety			*Page 61*
			GS-R-3 The Management System for Facilities and Activities
			GS-G-3.1 Application of the Management System for Facilities and Activities
			DS349 Management Systems for Nuclear Installations
			GS-G-3.2 The Management System for Technical Services in Radiation Safety
			GS-G-3.3 The Management System for the Processing, Handling and Storage of Radioactive Waste
			GS-G-3.4 The Management System for the Disposal of Radioactive Waste
			TS-G-1.4 Management System for the Safe Transport of Radioactive Material
			INSAG-4 Safety culture
			INSAG-5 The Safety of Nuclear Power
			INSAG-12 Basic Safety Principles for Nuclear Power Plants
			INSAG-13 Management of Operational Safety in Nuclear Power Plants
			INSAG-15 Key Practical Issues in Strengthening Safety Culture
9 – Human resources development			*Page 67*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → DS415 Governmental, Legal and Regulatory Framework for Safety (to become GSR Part 1)
			GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities
			GS-R-3 The Management System for Facilities and Activities
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → DS379 Radiation Protection and Safety of Radiation Sources (to become GSR Part 3)
			RS-G-1.4 Building Competence in Radiation Protection and the Safe Use of Radiation Sources
			NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, DS413)
			NS-G-2.4 The Operating Organization for Nuclear Power Plants
			NS-G-2.8 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants
			INSAG-16 Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety
10 – Research for safety and regulatory purposes			*Page 74*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → DS415 Governmental, Legal and Regulatory Framework for Safety (to become GSR Part 1)
			GS-R-3 The Management System for Facilities and Activities

			GSR Part 5 Predisposal Management of Radioactive
			NS-R-4 Safety of Research Reactors
			INSAG-16 Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety
11 – Radiation protection			*Page 78*
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)
			RS-G-1.1 Occupational Radiation Protection
			RS-G-1.2 Assessment of Occupational Exposure due to Intakes of Radionuclides
			RS-G-1.3 Assessment of Occupational Exposure due to External Sources of Radiation
			RS-G-1.4 Building Competence in Radiation Protection and the Safe Use of Radiation Sources
			RS-G-1.7 Application of the Concepts of Exclusion, Exemption and Clearance
			RS-G-1.8 Environmental and Sources Monitoring for Purposes of Radiation Protection
			RS-G-1.9 Categorization of Radioactive Sources
			DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection
			WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment
			NS-G-3.2 Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants
			NS-G-1.13 Radiation Protection Aspects of Design for Nuclear Power Plants
			NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power
			INSAG-9 Potential Exposure in Nuclear Safety
12 – Safety assessment			*Page 84*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			GSR Part 4 Safety Assessment for Facilities and Activities
			GS-G-4.1 Format and Content of the Safety Analysis Report for Nuclear Power Plants
			DS365 Risk-Informed Decision Making
			GS-G-1.2 Review and Assessment of Nuclear Facilities by the Regulatory Body
			NS-G-1.2 Safety Assessment and Verification for Nuclear Power Plants
			DS 393 Performance and Application of Level 2 PSA for Nuclear Power Plants
			DS 394 Performance and Application of Level 1 PSA for Nuclear Reactors
			DS 395 Deterministic Safety Analyses and their Application for Nuclear Power Plants
			NS-G-2.10 Periodic Safety Review of Nuclear Power Plants
			DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection
			INSAG-6 Probabilistic Safety Assessment
13 – Safety of radioactive waste, spent fuel management and decommissioning			*Page 91*

			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)
			GSR Part 5 Predisposal Management of Radioactive
			111-G-1.1 Classification of Radioactive Waste → **DS390** Classification of Radioactive Waste
			WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment
			WS-G-2.5 Predisposal Management of Low and Intermediate Level Radioactive Waste
			WS-G-2.6 Predisposal Management of High Level Radioactive Waste
			WS-G-6.1 Storage of Radioactive Waste
			DS284 Safety Assessment for Radioactive Waste Predisposal Facilities and Activities
			WS-R-5 Decommissioning of Facilities Using Radioactive Material
			WS-G-2.1 Decommissioning of Nuclear Power Plants and Research Reactors → **DS402** Decommissioning of Nuclear Power Plants and Research Reactors
			DS354 Disposal of Radioactive Waste (to become new **SSR5**)
			NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants
			GS-G-3.3 The Management System for the Processing, Handling and Storage of Radioactive Waste
			NS-R-5 Safety of Nuclear Fuel Cycle Facilities
			DS371 Storage of Spent Fuel
14 – Emergency preparedness and response			*Page 97*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)
			GS-R-2 Preparedness and Response for a Nuclear or Radiological Emergency
			GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency
			SS109 Intervention Criteria in a Nuclear or Radiation Emergency → **DS44** Criteria for Use in Planning Response to Nuclear and Radiological Emergencies
			TS-G-1.2 Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material
Implementing the IAEA Specific Safety Requirements for the Safety Infrastructure			
15 – Operating organization			*Page 102*
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)

			NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)
			NS-G-2.1 Fire Safety in Operation of Nuclear Power Plants
			NS-G-2.2 Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants
			NS-G-2.3 Modifications to Nuclear Power Plants
			NS-G-2.4 The Operating Organization for Nuclear Power Plants
			NS-G-2.5 Core Management and Fuel Handling for Nuclear
			NS-G-2.6 Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants
			NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants
			NS-G-2.8 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants
			NS-G-2.9 Commissioning for Nuclear Power Plants
			NS-G-2.10 Periodic Safety Review of Nuclear Power Plants
			NS-G-2.11 A System for the Feedback of Experience from Events in Nuclear Installations
			NS-G-2.12 Ageing Management for Nuclear Power Plants
			NS-G-2.14 Conduct of Operations at Nuclear Power Plants
			DS385 Severe Accident Management Programme for Nuclear Power Plants
			DS388 Chemistry Programme for Water Cooled Nuclear Power Plants
			GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety → **DS415** Governmental, Legal and Regulatory Framework for Safety (to become **GSR Part 1**)
			INSAG-5 The Safety of Nuclear Power
			INSAG-12 Basic Safety Principles for Nuclear Power Plants
			INSAG-13 Management of Operational Safety in Nuclear Power Plants
			INSAG-18 Managing Change in the Nuclear Industry: the Effects on Safety
			INSAG-23 Improving the International System for Operating Experience Feedback
16 – Site survey, site selection and evaluation			*Page 114*
			BSS115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources → **DS379** Radiation Protection and Safety of Radiation Sources (to become **GSR Part 3**)
			NS-R-3 Site Evaluation for Nuclear Installations
			NS-G-3.1 External Human Induced Events in Site Evaluation for Nuclear Power Plants
			NS-G-3.2 Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants
			NS-G-3.3 Evaluation of Seismic Hazard for Nuclear Power Plants → **DS422** Evaluation of Seismic Hazards for Nuclear Installations
			NS-G-3.4 Meteorological Events in Site Evaluation for Nuclear Power Plants **NS-G-3.5** Flood Hazard for Nuclear Power Plants on Coastal and River Sites → → **DS417** Hydrological and Meteorological Hazards in Site Evaluation of Nuclear Installations (to combine **NS-G-3.4** and **NS-G-3.5**)
			NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plant

			50-SG-S9 Site survey for Nuclear Power Plants (under update and revision process)
			DS405 Volcanic hazards for nuclear installations
			DS416 Licensing Process for Nuclear Installations
			RS-G-1.8 Environmental and Sources Monitoring for Purposes of Radiation Protection
			DS427 Radiological Environmental Impact Analysis for the verification of Radiological Protection
17 – Design safety			*Page 122*
			NS-R-1 Safety of Nuclear Power Plants: Design (under revision, **DS414**)
			NS-G-1.1 Software for Computer Based Systems Important to Safety in Nuclear Power Plants
			NS-G-1.2 Safety Assessment and Verification for Nuclear Power Plants
			NS-G-1.3 Instrumentation and Control Systems Important to Safety in Nuclear Power Plants
			NS-G-1.4 Design of Fuel Handling and Storage Systems for Nuclear Power Plants
			NS-G-1.5 External Events Excluding Earthquakes in the Design of Nuclear Power Plants
			NS-G-1.6 Seismic Design and Qualification for Nuclear Power Plants
			NS-G-1.7 Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants
			NS-G-1.8 Design of Emergency Power Systems for Nuclear Power Plants
			NS-G-1.9 Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants
			NS-G-1.10 Design of Reactor Containment Systems for Nuclear Power Plants
			NS-G-1.11 Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants
			NS-G-1.12 Design of the Reactor Core for Nuclear Power Plants
			NS-G-1.13 Radiation Protection Aspects of Design for Nuclear Power Plants
			DS367 Safety Classification of Structures, Systems and Components in Nuclear Power Plants
			DS393 Development and Application of Level 2 PSA for Nuclear Power Plants
			DS394 Development and Application of Level 1 PSA for Nuclear Reactors
			DS395 Deterministic Safety Analyses and their Application for Nuclear Power Plants
			NS-G-2.7 Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants
			NS-G-2.10 Periodic Safety Review of Nuclear Power Plants
			NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plant
			SS79 Design of Radioactive Waste Management Systems at Nuclear Power Plants
			GSR Part 4 Safety Assessment for Facilities and Activities
			GS-G-4.1 Format and Content of the Safety Analysis Report for Nuclear Power Plants
			INSAG-6 Probabilistic Safety Assessment
			INSAG-10 Defence in Depth in Nuclear Safety
18 – Preparation for commissioning			*Page 128*

			NS-R-2 Safety of Nuclear Power Plants: Operation (under revision, **DS413**)
			NS-G-2.9 Commissioning for Nuclear Power Plants
19 – Transport safety			*Page 131*
			TS-R-1 Regulations for the Safe Transport of Radioactive Material
			TS-G-1.1 (Rev.1) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material
			TS-G-1.2 Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material
			TS-G-1.3 Radiation Protection Programmes for Transport Radioactive Material
			TS-G-1.4 Management System for the Safe Transport of Radioactive Material
			TS-G-1.5 Compliance Assurance for the Safe Transport of Radioactive Material
			DS387 Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material
20 – Interfaces with nuclear security			*Page 137*
			INSAG-24 Safety and Security Interface in Nuclear Installations

ANNEX 3. THE FUNDAMENTAL SAFETY PRINCIPLES

Fundamental Safety Objective

The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation.

Fundamental Safety Principles

Principle 1: Responsibility for safety
The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

Principle 2: Role of government
An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.

Principle 3: Leadership and management for safety
Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks.

Principle 4: Justification of facilities and activities
Facilities and activities that give rise to radiation risks must yield an overall benefit.

Principle 5: Optimization of protection
Protection must be optimized to provide the highest level of safety that can reasonably be achieved.

Principle 6: Limitation of risks to individuals
Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm.

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

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

Principle 9: Emergency preparedness and response
Arrangements must be made for emergency preparedness for and response to nuclear or radiation incidents.

Principle 10: Protective actions to reduce existing or unregulated radiation risks
Protective actions to reduce existing or unregulated radiation risks must be justified and optimized.

ANNEX 4. REQUIREMENTS (TITLES) STATED IN GSR Part 1 (DS415, revision of GS-R-1, dated 14 July)

(for the convenience of Member States during the 120-day Comment Period)

RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMEN

Requirement 1: National policy and strategy
Requirement 2: Establishment of a framework for safety
Requirement 3: Establishment of a regulatory body
Requirement 4: Independence of the regulatory body
Requirement 5: Prime responsibility for safety
Requirement 6: Compliance and Responsibility for safety
Requirement 7: Coordination of different authorities with responsibilities for safety within the regulatory framework.
Requirement 8: Emergency preparedness and response
Requirement 9: System for protective actions to reduce existing or unregulated radiation risks
Requirement 10: Provision for decommissioning of facilities and the management of radioactive waste and spent fuel
Requirement 11: Competence for safety
Requirement 12: Interfaces with nuclear security and with the State system of accounting for and control of nuclear material.
Requirement 13: Provision of technical services

THE GLOBAL SAFETY REGIME

Requirement 14: International obligations and arrangements for cooperation
Requirement 15: Sharing of operating experience and regulatory experience

RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

Requirement 16: Organizational structure of the regulatory body and allocation of resources
Requirement 17: Effective independence during conduct of regulatory activities
Requirement 18: Staffing and competence of the regulatory body
Requirement 19: The management system of the regulatory body
Requirement 20: Liaison with advisory bodies and support organizations
Requirement 21: Liaison between the regulatory body and authorized parties
Requirement 22: Stability and consistency of regulatory control
Requirement 23: Authorization by the regulatory body
Requirement 24: Demonstration of Safety for authorization
Requirement 25: Review and assessment of information relevant to safety
Requirement 26: Graded approach for review and assessment
Requirement 27: Inspection of facilities and activities
Requirement 28: Type of inspection of facilities and activities
Requirement 29: Graded approach for inspections
Requirement 30: Establishment of enforcement policy
Requirement 31: Enforcement of regulatory requirements and conditions
Requirement 32: Regulations and guides
Requirement 33: Review of regulations and guides
Requirement 34: Promotion of regulations and guides to interested parties
Requirement 35: Safety related records
Requirement 36: Communication and consultation with interested parties

ANNEX 5. REQUIREMENTS (TITLES) STATED IN GSR Part 3 (DS379, revision of BSS115, draft 2.0 dated 7 May)

(for the convenience of Member States during the 120-day Comment Period)

GENERAL REQUIREMENTS FOR PROTECTION AND SAFETY
Definitions (2.1)
Interpretations (2.2)
Resolution of conflicts (2.3-2.5)
Entry into force (2.6-2.7)
Implementation of radiation protection principles (2.8-2.11)
Responsibilities of government (2.12-2.25)
Responsibilities of the regulatory body (2.26-2.35)
Responsibilities of other parties (2.36-2.42)
Management Requirements (2.43-2.49)

PLANNED EXPOSURE SITUATIONS
Scope (3.1-3.4)
Generic requirements (3.5-3.65)
Occupational exposure (3.66-3.110)
Public exposure (3.111-3.138)
Medical exposure (3.139-3.179)

EMERGENCY EXPOSURE SITUATIONS
Scope (4.1)
Generic requirements (4.2-4.6)
Public exposure (4.7-4.11)
Exposure of emergency workers (4.12-4.19)
Transition from an emergency exposure situation to an existing exposure situation (4.20-4.21)

EXISTING EXPOSURE SITUATIONS
Scope (5.1)
Generic requirements (5.2-5.5)
Public exposure (5.6-5.23)
Occupational exposure (5.24-5.31)

SCHEDULES
Schedule I. Exemption and clearance
Schedule II. Categorization of sealed sources
Schedule III. Dose limits for planned exposure situations
Schedule IV. Criteria for use in emergency preparedness and response

ANNEX 6. REQUIREMENTS (TITLES) STATED IN NS-R-1 (DS414, dated 28 July)

(for the convenience of Member States during the 120-day Comment Period)

MANAGEMENT OF SAFETY IN DESIGN
Requirement 1: Responsibility of the operating organisation
Requirement 2: Management system processes
Requirement 3: Design of the plant
Requirement 4: Proven engineering practices
Requirement 5: Safety assessment
Requirement 6: Provisions for construction
PRINCIPAL TECHNICAL REQUIREMENTS
Requirement 7: Application of defence in depth
Requirement 8: Fundamental safety functions
Requirement 9: Radiation protection and acceptance criteria
REQUIREMENTS FOR PLANT DESIGN
DESIGN ENGINEERING
Requirement 10: Design basis of items important to safety
Requirement 11: Design limits and acceptance criteria
Requirement 12: Postulated initiating events
Requirement 13: Exclusion of rare events
Requirement 14: Design rules
Requirement 15: Operational limits and conditions
Requirement 16: Design basis accidents
Requirement 17: Beyond design basis accidents
Requirement 18: Hazards
Requirement 19: Safety classification
Requirement 20: Reliability of structures, systems and components
Requirement 21: Common cause failures
Requirement 22: Single failure criterion
Requirement 23: Fail-safe design
Requirement 24: Auxiliary services
DESIGN FOR LIFETIME SAFE OPERATION
Requirement 25: In-service testing, maintenance, repair, refurbishment, inspection and monitoring
Requirement 26: Equipment qualification
Requirement 27: Ageing
HUMAN FACTORS
Requirement 28: Design for optimal operator performance
OTHER DESIGN CONSIDERATIONS
Requirement 29: Sharing of structures, systems and components between nuclear power plants
Requirement 30: Systems containing fissile or radioactive materials
Requirement 31: Power plants used for cogeneration, heat generation or desalination
Requirement 32: Escape routes
Requirement 33: Communication systems
Requirement 34: Control of access to the plant
Requirement 35: Prevention of interference with items important to safety
Requirement 36: Interactions of systems
Requirement 37: Interactions between the electrical power grid and the plant

Requirement 38: Features to facilitate decommissioning
SAFETY ANALYSIS
Requirement 39: Safety analysis of the plant design
ADDITIONAL REQUIREMENTS FOR DESIGN OF SPECIFIC PLANT SYSTEMS
REACTOR CORE AND ASSOCIATED FEATURES
Requirement 40: General design
Requirement 41: Performance of fuel elements and assemblies
Requirement 42: Fuel element capability in design basis accidents
Requirement 43: Control of the reactor core
Requirement 44: Reactor shutdown
REACTOR COOLANT SYSTEM
Requirement 45: Design of the reactor coolant system
Requirement 46: Protection of the coolant boundary
Requirement 47: Inventory of reactor coolant
Requirement 48: Cleanup of the reactor coolant
Requirement 49: Removal of residual heat from the core
Requirement 50: Emergency core cooling
Requirement 51: Heat transfer to an ultimate heat sink
CONTAINMENT STRUCTURE & SYSTEM
Requirement 52: Design of the containment system
Requirement 53: Control of containment leakage
Requirement 54: Containment isolation
Requirement 55: Containment access
Requirement 56: Control of the containment atmosphere
INSTRUMENTATION AND CONTROL SYSTEMS
Requirement 57: Provision of instrumentation
Requirement 58: Control systems
Requirement 59: Protection system
Requirement 60: Reliability and testability of I & C safety systems
Requirement 61: Use of computer based equipment in systems important to safety
Requirement 62: Separation of safety systems
Requirement 63: Control room
Requirement 64: Supplementary control room
Requirement 65: Emergency control centre
Requirement 66: Emergency power supply
AUXILIARY SYSTEMS
Requirement 67: Reliability of auxiliary systems.
Requirement 68: Process and post accident sampling systems
Requirement 69: Auxiliary heat transport systems
Requirement 70: Compressed air systems
Requirement 71: Air conditioning and ventilation systems
Requirement 72: Fire protection systems
Requirement 73: Lighting systems
Requirement 74: Overhead lifting equipment
Requirement 75: Steam supply system, feedwater, and turbine generators
Requirement 76: Waste treatment and control systems
Requirement 77: Fuel handling and storage systems
RADIATION PROTECTION
Requirement 78: Design for radiation protection
Requirement 79: Means of radiation monitoring

ANNEX 7. REQUIREMENTS (TITLES) STATED IN NS-R-2 (DS413, dated 22 July)

(for the convenience of Member States during the 120-day Comment Period)

MANAGEMENT AND ORGANISATIONAL STRUCTURE
Requirement 1: Responsibilities of the Operating Organization
Requirement 2: Management system
Requirement 3: Structure and Functions of the Operating Organization
Requirement 4: Staffing of the Operating Organization

MANAGEMENT OF OPERATIONAL SAFETY
Requirement 5: Safety Policy
Requirement 6: Operational limits and conditions
Requirement 7: Qualification and training of personnel
Requirement 8: Performance of safety related activities
Requirement 9: Monitoring and review of safety performance
Requirement 10: Control of plant configuration and status
Requirement 11: Management of modifications
Requirement 12: Periodic safety review
Requirement 13: Equipment qualification (EQ)
Requirement 14: Ageing management
Requirement 15: Records and reports
Requirement 16: Long term operation programme

OPERATIONAL SAFETY PROGRAMMES
Requirement 17: Physical protection
Requirement 18: Emergency preparedness
Requirement 19: Accident management
Requirement 20: Fire Safety
Requirement 21: Radiation protection
Requirement 22: Radioactive waste management
Requirement 23: Industrial safety
Requirement 24: Feedback of operational experience

PLANT COMMISSIONING
Requirement 25: Commissioning programme

PLANT OPERATIONS
Requirement 26: Operating procedures
Requirement 27: Operation control rooms and control equipment
Requirement 28: Material conditions and housekeeping
Requirement 29: Chemistry programme
Requirement 30: Core management and fuel handling

MAINTENANCE, TESTING, SURVEILLANCE AND INSPECTION
Requirement 31: Maintenance, testing, surveillance and inspection programmes
Requirement 32: Outage management

PREPARATION TO DECOMMISSIONING
Requirement 33: Preparation to decommissioning

CONTRIBUTORS TO DRAFTING AND REVIEW

Akimoto, S.	Japan Nuclear Energy Safety Organization (JNES), Japan
Akstulewicz, F.	Nuclear Regulatory Commission (NRC), United States
Aoki, M.	International Atomic Energy Agency
Bastos, J.	International Atomic Energy Agency
Boal, T.	International Atomic Energy Agency
Buglova, E.	International Atomic Energy Agency
Calpena, S.	International Atomic Energy Agency
Caruso, G.	International Atomic Energy Agency
Cherf, A.	International Atomic Energy Agency
Deboodt, P.	International Atomic Energy Agency
Delattre, D.	International Atomic Energy Agency
Dusic, M.	International Atomic Energy Agency
El-Shanawany, M.	International Atomic Energy Agency
Gasparini, M.	International Atomic Energy Agency
Godoy, A.	International Atomic Energy Agency
Graves, D.	International Atomic Energy Agency
Gregoric, M.	International Atomic Energy Agency
Guo, L.	International Atomic Energy Agency
Gürpinar, A.	International Atomic Energy Agency
Jamet, P.	International Atomic Energy Agency
Jones, G.	International Atomic Energy Agency
Kearney, M.	International Atomic Energy Agency
Kueny, L.	Autorité de Sûreté Nucléaire (ASN), France
Laaksonen, J.	Radiation and Nuclear Safety Authority (STUK), Finland

Lachaume, J.-L.	Autorité de Sûreté Nucléaire (ASN), France
Lederman, L.	International Atomic Energy Agency
Lignini, F.	International Atomic Energy Agency
Lipar, M.	International Atomic Energy Agency
Lyons, J.	Nuclear Regulatory Commission (NRC), United States
Mallick, S.	Pakistan Nuclear Regulatory Authority (PNRA), Pakistan
Mansoux, H.	International Atomic Energy Agency
Nicic, A.	International Atomic Energy Agency
Perdiguier, P.	International Atomic Energy Agency
Rowat, J.	International Atomic Energy Agency
Servière, G.	Électricité de France (EDF), France
Sollogoub, P.	International Atomic Energy Agency
Starz, A.	International Atomic Energy Agency
Stewart, J.	International Atomic Energy Agency
Taniguchi, T.	International Atomic Energy Agency
Telleria, D.	International Atomic Energy Agency
Vaisnys, P.	International Atomic Energy Agency
Wheatley, J.	International Atomic Energy Agency
Weinstein, E.	International Atomic Energy Agency
Winter, D.	International Atomic Energy Agency