

IAEA Safety Standards

for protecting people and the environment

The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors

Specific Safety Guide

No. SSG-84



IAEA

International Atomic Energy Agency



Documents

Document Sharing Hub

IAEA SAFETY STANDARDS AND RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

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

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

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

<https://www.iaea.org/resources/safety-standards>

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

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

RELATED PUBLICATIONS

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

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

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

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

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

THE OPERATING ORGANIZATION
AND THE RECRUITMENT,
TRAINING AND QUALIFICATION
OF PERSONNEL FOR
RESEARCH REACTORS



Documents

Document Sharing Hub

The following States are Members of the International Atomic Energy Agency:

AFGHANISTAN	GERMANY	PALAU
ALBANIA	GHANA	PANAMA
ALGERIA	GREECE	PAPUA NEW GUINEA
ANGOLA	GRENADA	PARAGUAY
ANTIGUA AND BARBUDA	GUATEMALA	PERU
ARGENTINA	GUYANA	PHILIPPINES
ARMENIA	HAITI	POLAND
AUSTRALIA	HOLY SEE	PORTUGAL
AUSTRIA	HONDURAS	QATAR
AZERBAIJAN	HUNGARY	REPUBLIC OF MOLDOVA
BAHAMAS	ICELAND	ROMANIA
BAHRAIN	INDIA	RUSSIAN FEDERATION
BANGLADESH	INDONESIA	RWANDA
BARBADOS	IRAN, ISLAMIC REPUBLIC OF	SAINT KITTS AND NEVIS
BELARUS	IRAQ	SAINT LUCIA
BELGIUM	IRELAND	SAINT VINCENT AND THE GRENADINES
BELIZE	ISRAEL	SAMOA
BENIN	ITALY	SAN MARINO
BOLIVIA, PLURINATIONAL STATE OF	JAMAICA	SAUDI ARABIA
BOSNIA AND HERZEGOVINA	JAPAN	SENEGAL
BOTSWANA	JORDAN	SERBIA
BRAZIL	KAZAKHSTAN	SEYCHELLES
BRUNEI DARUSSALAM	KENYA	SIERRA LEONE
BULGARIA	KOREA, REPUBLIC OF	SINGAPORE
BURKINA FASO	KUWAIT	SLOVAKIA
BURUNDI	KYRGYZSTAN	SLOVENIA
CAMBODIA	LAO PEOPLE'S DEMOCRATIC REPUBLIC	SOUTH AFRICA
CAMEROON	LATVIA	SPAIN
CANADA	LEBANON	SRI LANKA
CENTRAL AFRICAN REPUBLIC	LESOTHO	SUDAN
CHAD	LIBERIA	SWEDEN
CHILE	LIBYA	SWITZERLAND
CHINA	LIECHTENSTEIN	SYRIAN ARAB REPUBLIC
COLOMBIA	LITHUANIA	TAJIKISTAN
COMOROS	LUXEMBOURG	THAILAND
CONGO	MADAGASCAR	TOGO
COSTA RICA	MALAWI	TONGA
CÔTE D'IVOIRE	MALAYSIA	TRINIDAD AND TOBAGO
CROATIA	MALI	TUNISIA
CUBA	MALTA	TÜRKIYE
CYPRUS	MARSHALL ISLANDS	TURKMENISTAN
CZECH REPUBLIC	MAURITANIA	UGANDA
DEMOCRATIC REPUBLIC OF THE CONGO	MAURITIUS	UKRAINE
DENMARK	MEXICO	UNITED ARAB EMIRATES
DJIBOUTI	MONACO	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
DOMINICA	MONGOLIA	UNITED REPUBLIC OF TANZANIA
DOMINICAN REPUBLIC	MONTENEGRO	UNITED STATES OF AMERICA
ECUADOR	MOROCCO	URUGUAY
EGYPT	MOZAMBIQUE	UZBEKISTAN
EL SALVADOR	MYANMAR	VANUATU
ERITREA	NAMIBIA	VENEZUELA, BOLIVARIAN REPUBLIC OF
ESTONIA	NEPAL	VIET NAM
ESWATINI	NETHERLANDS	YEMEN
ETHIOPIA	NEW ZEALAND	ZAMBIA
FIJI	NICARAGUA	ZIMBABWE
FINLAND	NIGER	
FRANCE	NIGERIA	
GABON	NORTH MACEDONIA	
GEORGIA	NORWAY	
	OMAN	
	PAKISTAN	

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

IAEA SAFETY STANDARDS SERIES No. SSG-84

THE OPERATING ORGANIZATION AND THE RECRUITMENT, TRAINING AND QUALIFICATION OF PERSONNEL FOR RESEARCH REACTORS

SPECIFIC SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2023

COPYRIGHT NOTICE

All IAEA scientific and technical publications are protected by the terms of the Universal Copyright Convention as adopted in 1952 (Berne) and as revised in 1972 (Paris). The copyright has since been extended by the World Intellectual Property Organization (Geneva) to include electronic and virtual intellectual property. Permission to use whole or parts of texts contained in IAEA publications in printed or electronic form must be obtained and is usually subject to royalty agreements. Proposals for non-commercial reproductions and translations are welcomed and considered on a case-by-case basis. Enquiries should be addressed to the IAEA Publishing Section at:

Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna, Austria
fax: +43 1 26007 22529
tel.: +43 1 2600 22417
email: sales.publications@iaea.org
www.iaea.org/publications

© IAEA, 2023

Printed by the IAEA in Austria

May 2023

STI/PUB/2048

IAEA Library Cataloguing in Publication Data

Names: International Atomic Energy Agency.

Title: The operating organization and the recruitment, training and qualification of personnel for research reactors / International Atomic Energy Agency.

Description: Vienna : International Atomic Energy Agency, 2023. | Series: IAEA safety standards series, ISSN 1020-525X ; no. SSG-84 | Includes bibliographical references.

Identifiers: IAEAL 23-01570 | ISBN 978-92-0-102423-7 (paperback : alk. paper) | ISBN 978-92-0-102523-4 (pdf) | ISBN 978-92-0-102623-1 (epub)

Subjects: LCSH: Nuclear industry — Employees — Training of. | Nuclear reactors — Management. | Nuclear reactors — Research.

Classification: UDC 37.621.039 | STI/PUB/2048

FOREWORD

by Rafael Mariano Grossi
Director General

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

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

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

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

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

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

THE IAEA SAFETY STANDARDS

BACKGROUND

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

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

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

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

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

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

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

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

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

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

Safety Fundamentals

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

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it

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

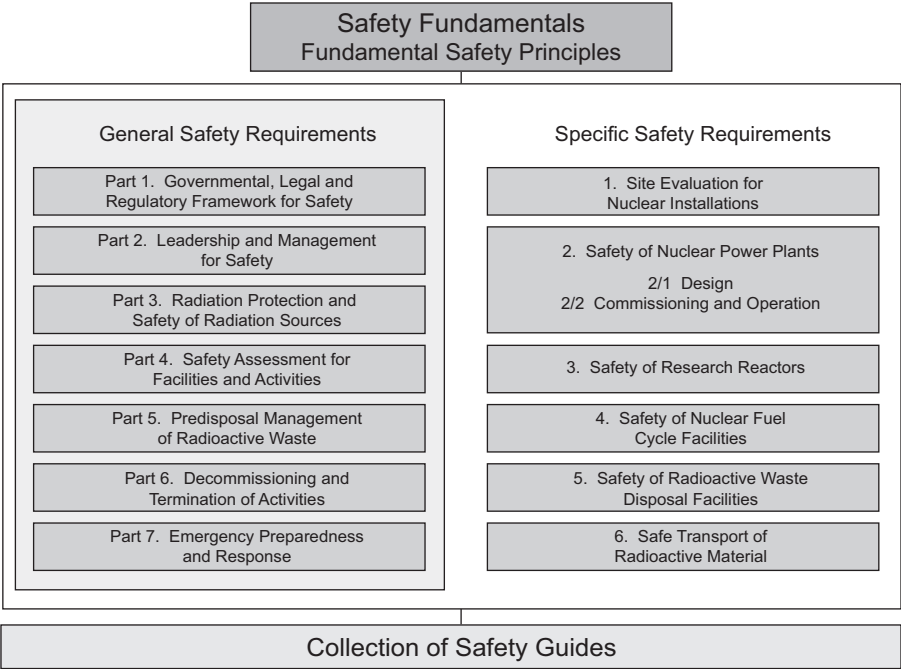


FIG. 1. The long term structure of the IAEA Safety Standards Series.

is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be

used by States as a reference for their national regulations in respect of facilities and activities.

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

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

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

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

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and five Safety Standards Committees, for emergency preparedness and response (EPReSC) (as of 2016), nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

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

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards.

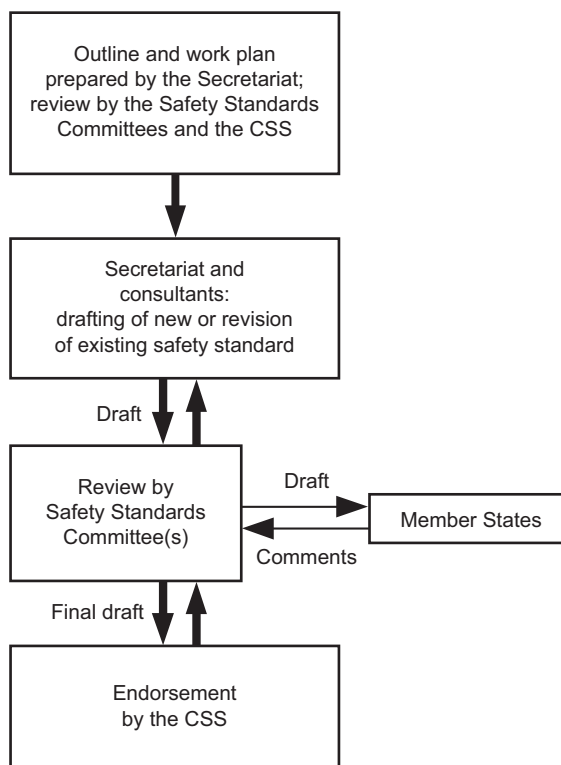


FIG. 2. The process for developing a new safety standard or revising an existing standard.

It articulates the mandate of the IAEA, the vision for the future application of the safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

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

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

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

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

CONTENTS

1.	INTRODUCTION.	1
	Background (1.1–1.6).....	1
	Objective (1.7, 1.8).....	2
	Scope (1.9–1.11).....	2
	Structure (1.12, 1.13)	3
2.	THE OPERATING ORGANIZATION OF A RESEARCH REACTOR	4
	Safety requirements for the operating organization of a research reactor (2.1–2.11).	4
	Organizational plan for a research reactor (2.12–2.19)	6
	Factors to be considered in determining the structure of the operating organization of a research reactor (2.20–2.32)	8
	Communications at a research reactor (2.33–2.37)	12
	Responsibilities at a research reactor (2.38–2.60)	14
	Management system for a research reactor (2.61–2.85).....	19
	Programmes for operation of a research reactor (2.86–2.149)	24
3.	STAFFING, RECRUITMENT AND SELECTION OF OPERATING PERSONNEL FOR A RESEARCH REACTOR (3.1–3.10).....	37
	Staffing arrangements for a research reactor (3.11–3.20).	40
	Selection process for personnel for a research reactor (3.21–3.23) ...	42
4.	TRAINING AND QUALIFICATION OF OPERATING PERSONNEL FOR A RESEARCH REACTOR (4.1–4.4)	43
	Approach to the training of research reactor personnel (4.5–4.14) ...	44
	Initial training programmes for research reactor personnel (4.15–4.32)	46
	Assessing the competence and qualification of research reactor personnel following training (4.33, 4.34)	52
	Continuing training and requalification of research reactor personnel (4.35–4.42)	53

5. AUTHORIZATION OF OPERATING PERSONNEL AT A RESEARCH REACTOR (5.1–5.4) 55

Operating personnel at a research reactor who require authorization (5.5–5.7) 56

Conditions of authorization for personnel at a research reactor (5.8–5.11). 57

Reauthorization of operating personnel at a research reactor (5.12, 5.13) 57

6. RECORDS OF RECRUITMENT, TRAINING AND QUALIFICATION OF PERSONNEL AT A RESEARCH REACTOR (6.1–6.3)..... 58

REFERENCES..... 59

ANNEX I: THE SYSTEMATIC APPROACH TO TRAINING. ... 63

ANNEX II: EXAMPLE OF A CURRICULUM FOR A TRAINING COURSE FOR RESEARCH REACTOR OPERATORS..... 67

CONTRIBUTORS TO DRAFTING AND REVIEW 89

1. INTRODUCTION

BACKGROUND

1.1. Requirements for the safety of research reactors, with particular emphasis on their design and operation, are established in IAEA Safety Standards Series No. SSR-3, Safety of Research Reactors [1].

1.2. This Safety Guide provides recommendations on the operating organization and the recruitment, training and qualification of personnel for research reactors.

1.3. This Safety Guide was developed in parallel with seven other Safety Guides on the safety of research reactors, as follows:

- (a) IAEA Safety Standards Series No. SSG-80, Commissioning of Research Reactors [2];
- (b) IAEA Safety Standards Series No. SSG-81, Maintenance, Periodic Testing and Inspection of Research Reactors [3];
- (c) IAEA Safety Standards Series No. SSG-82, Core Management and Fuel Handling for Research Reactors [4];
- (d) IAEA Safety Standards Series No. SSG-83, Operational Limits and Conditions and Operating Procedures for Research Reactors [5];
- (e) IAEA Safety Standards Series No. SSG-85, Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors [6];
- (f) IAEA Safety Standards Series No. SSG-10 (Rev. 1), Ageing Management for Research Reactors [7];
- (g) IAEA Safety Standards Series No. SSG-37 (Rev. 1), Instrumentation and Control Systems and Software Important to Safety for Research Reactors [8].

1.4. Additional recommendations on the safety of research reactors are provided in IAEA Safety Standards Series Nos SSG-20 (Rev. 1), Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report [9], and SSG-24 (Rev. 1), Safety in the Utilization and Modification of Research Reactors [10].

1.5. The terms used in this Safety Guide are to be understood as defined and explained in the IAEA Nuclear Safety and Security Glossary [11].

1.6. This Safety Guide supersedes IAEA Safety Standards Series No. NS-G-4.5, The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors¹.

OBJECTIVE

1.7. The objective of this Safety Guide is to provide recommendations on the operating organization of a research reactor, and on the recruitment, training and qualification of personnel, to meet the relevant requirements of SSR-3 [1], in particular Requirements 2 and 67–70.

1.8. The recommendations provided in this Safety Guide are aimed at operating organizations of research reactors, regulatory bodies, other organizations involved in a research reactor project and organizations involved in educational programmes on nuclear science and technology.

SCOPE

1.9. This Safety Guide is primarily intended for use for heterogeneous, thermal spectrum research reactors that have a power rating of up to several tens of megawatts. For research reactors of higher power, specialized reactors (e.g. fast spectrum reactors) and reactors that have specialized facilities (e.g. hot or cold neutron sources, high pressure and high temperature loops), additional guidance may be needed. For such research reactors, the recommendations provided in IAEA Safety Standards Series Nos SSG-72, The Operating Organization for Nuclear Power Plants [12], and SSG-75, Recruitment, Qualification and Training of Personnel for Nuclear Power Plants [13], might be more suitable. Homogeneous reactors and accelerator driven systems are outside the scope of this publication.

1.10. Some research reactors, critical assemblies and subcritical assemblies with a low hazard potential might need less comprehensive arrangements than are recommended in this Safety Guide. While all recommendations in this Safety Guide are to be considered, some might not be applicable to such research reactors, critical assemblies and subcritical assemblies (see Requirement 12 and paras 2.15–2.17 of SSR-3 [1], as well as IAEA Safety Standards Series

¹ INTERNATIONAL ATOMIC ENERGY AGENCY, The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors, IAEA Safety Standards Series No. NS-G-4.5, IAEA, Vienna (2008).

No. SSG-22 (Rev. 1), Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors [14]).

1.11. In this Safety Guide, subcritical assemblies will be mentioned separately only if a specific recommendation is not relevant for, or is applicable only to, subcritical assemblies.

STRUCTURE

1.12. Section 2 provides recommendations on the organizational structure and staffing of a research reactor and the duties and responsibilities of the personnel. These recommendations form the basis for the specification of personnel qualifications and of the prerequisites for the recruitment of individuals. Section 3 provides recommendations on the factors to be taken into account in the recruitment and selection process. Section 4 provides recommendations on the knowledge and experience that operating personnel² in various positions need to have, as well as on training systems and training programmes, including continuing training and requalification. Recommendations on the training and qualification of support personnel³ are also provided. Section 5 provides recommendations on the authorization and reauthorization of operating personnel by the operating organization and the regulatory body. Section 6 provides recommendations on recruitment, training and qualification records.

1.13. Annex I contains a description of the systematic approach to training. Annex II presents an example of a training curriculum that covers the main topics for the initial training and continuing training of reactor operators and senior reactor operators at a large research reactor.

² The operating personnel comprise the reactor manager, the reactor supervisor, the shift supervisors, the reactor operators, the maintenance personnel and the radiation protection personnel.

³ Support personnel are personnel other than the operating personnel and include technical personnel such as training officers, safety officers and reactor chemists (see paras 7.24 and 7.25 of SSR-3 [1]).

2. THE OPERATING ORGANIZATION OF A RESEARCH REACTOR

SAFETY REQUIREMENTS FOR THE OPERATING ORGANIZATION OF A RESEARCH REACTOR

2.1. Requirement 2 of SSR-3 [1] states:

“The operating organization for a research reactor facility shall have the prime responsibility for the safety of the research reactor over its lifetime, from the beginning of the project for site evaluation, design, construction, commissioning, operation, including utilization and modification, and decommissioning, until its release from regulatory control.”

2.2. Paragraph 4.1 of SSR-3 [1] states (footnote omitted):

“In order to ensure rigour and thoroughness at all levels of the staff in the achievement and maintenance of safety, the operating organization:

- (a) Shall establish and implement safety policies and shall ensure that safety matters are given the highest priority;
- (b) Shall clearly define responsibilities and accountabilities with corresponding lines of authority and communication;
- (c) Shall ensure that it has sufficient staff with appropriate qualifications and training at all levels;
- (d) Shall develop and strictly adhere to sound procedures for all activities that might affect safety, ensuring that managers and supervisors promote and support good safety practices, while correcting poor safety practices;
- (e) Shall review, monitor and audit all safety related matters on a regular basis, and shall take appropriate corrective actions where necessary;
- (f) Shall develop and sustain a strong safety culture, and shall prepare a statement of safety policy and safety objectives, which is disseminated to and understood by all staff.”

2.3. Requirement 67 of SSR-3 [1] states that **“The operating organization for a research reactor facility shall have the prime responsibility for safety in the operation of the facility.”**

2.4. Paragraph 7.2 of SSR-3 [1] (footnotes omitted) states:

“The operating organization shall establish an appropriate management structure for the research reactor and shall provide for all necessary infrastructure for the conduct of reactor operations. The...reactor management...shall include the reactor manager and the operating personnel. The operating organization shall ensure that adequate provision is made for all functions relating to the safe operation and utilization of the research reactor facility, such as maintenance, periodic testing and inspection, radiation protection, quality assurance and relevant support services.”

The reactor management comprises the members of the operating organization to whom the responsibility and authority for directing the operation of the research reactor facility has been assigned. The reactor manager is the member of the reactor management to whom the direct responsibility and authority for the safe operation of the research reactor are assigned by the operating organization and whose duties constitute the discharge of this responsibility.

2.5. Paragraph 7.3 of SSR-3 [1] states that “The responsibility of the operating organization for the safety of the research reactor shall not be delegated.”

2.6. Requirement 69 of SSR-3 [1] states:

“The operating organization for a research reactor facility shall assign direct responsibility and authority for the safe operation of the reactor to the reactor manager. The reactor manager shall have overall responsibility for all aspects of operation, training, maintenance, periodic testing, inspection, utilization and modification of the reactor. Discharge of this responsibility shall be the primary duty of the reactor manager.”

2.7. With regard to a research reactor, the term ‘operating organization’ includes an academic institution, corporation, institute, centre, national laboratory or other entity authorized by the regulatory body to operate a research reactor and to be responsible for its safety. In the majority of States, an operating organization is the legal entity responsible for fulfilling the financial, commercial and safety obligations and other obligations that might arise in connection with the operation of the research reactor. The reactor manager may also be a head of department or the centre director, or may hold other titles.

2.8. The senior management of the operating organization should demonstrate leadership on safety matters and take an active interest and participate in supervising safety throughout the entire lifetime of the research reactor. The reactor manager is responsible for the safety of the facility and for the management of its personnel and should therefore maintain close oversight of operations.

2.9. The operating organization is required to apply for an authorization from the regulatory body (see paras 3.4 and 3.5 of SSR-3 [1]) to operate a research reactor in accordance with national regulations. General requirements on the authorization of facilities and activities are established in IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety [15], and recommendations on this topic are provided in IAEA Safety Standards Series No. GSG-13, Functions and Processes of the Regulatory Body for Safety [16].

2.10. Compliance with the requirements of the regulatory body does not relieve the operating organization of its prime responsibility for safety. The discharge of this prime responsibility for safety should be regularly reviewed by the operating organization.

2.11. The function of the operating organization of a research reactor is to support an effective utilization programme in accordance with Requirement 83 of SSR-3 [1]. Experimenters and other users of the research reactor are often external to the operating organization or outside the normal line of control of the reactor management. Special arrangements should therefore be established for proper lines of authority and communication (see para. 7.4 of SSR-3 [1]) and for training of experimenters and other users (see para. 7.16 of SSR-3 [1]) in the safe design, construction, installation, operation, utilization and modification of experimental facilities.

ORGANIZATIONAL PLAN FOR A RESEARCH REACTOR

2.12. The operating organization should examine the various functions necessary for safe operation of the research reactor and should either assign authority and responsibility to the appropriate persons within the organization or make arrangements for external support personnel to perform designated tasks or programmes.

2.13. Paragraph 7.11 of SSR-3 [1] states:

“The organizational structure and the arrangements for discharging responsibilities shall be documented in the safety analysis report and made available to the staff and, if required, to the regulatory body. The structure of the operating organization shall be specified so that all roles that are critical for safe operation are specified and described. Proposed organizational changes to the structure and associated arrangements, which might be of importance to safety, shall be analysed in advance by the operating organization and submitted to the regulatory body for approval.”

2.14. The organizational plan should specify the general policies of the operating organization, the lines of responsibility and authority, the lines of communication, and the duties and numbers of operating personnel and their associated qualifications necessary for safe operation of the research reactor. In preparing the organizational plan, the operating organization should take into account all operational states and accident conditions.

2.15. The organizational plan should indicate the staffing arrangements in the categories of operating personnel and support personnel. The extent to which support functions are self-sufficient or are dependent on services from outside the operating organization should be specified. The organizational plan should specify human resource allocations and the duties and responsibilities of key personnel.

2.16. The organizational structure and the functions to be performed, as well as the lines of responsibility, authority and communication, should be clearly and unambiguously stated in the organizational plan. This description is required to be included in the safety analysis report (see para. 2.13) and in the documentation of the management system for the research reactor. This description is also often included in the operational limits and conditions (OLCs) that establish administrative requirements. Activities undertaken by the reactor management should be subject to approval by the regulatory body in accordance with national practices.

2.17. The organizational plan should be established well in advance of the commencement of operation of the research reactor so that the recruitment, selection, training and qualification of personnel can be completed, as necessary, for the commissioning stage and, in all cases, before the commencement of operation. The organizational plan should form the basis for the initial recruitment and training programme and for all subsequent recruitment and training programmes at the research reactor.

2.18. The organizational plan should be regularly reassessed by the operating organization and, if necessary, updated to reflect developments in technology and advances in knowledge regarding the safe operation of the research reactor. The reactor safety committee (see paras 7.26 and 7.27 of SSR-3 [1]) should review the initial organizational plan and any significant changes to the plan.

2.19. Paragraph 7.12 of SSR-3 [1] states:

“The operating organization shall be responsible for ensuring that the necessary knowledge, skills, attitudes and safety expertise are sustained at the research reactor, and that long term objectives for human resources are met and knowledge preservation policies are developed.”

The organizational plan should provide for succession planning to cover attrition and promotion within the organization to ensure a smooth transition for each key position without a detrimental loss of institutional knowledge.

FACTORS TO BE CONSIDERED IN DETERMINING THE STRUCTURE OF THE OPERATING ORGANIZATION OF A RESEARCH REACTOR

2.20. The factors that should be considered in determining the organizational structure and staffing of the operating organization of a research reactor include the following:

- (a) The need to ensure that all levels of defence in depth (see paras 2.10–2.14 of SSR-3 [1]) are properly implemented. The influence of human and organizational factors on one or more levels of defence in depth should be specifically considered, to avoid negative impacts on the reliability of these levels and the independence between the levels.
- (b) The need to ensure that structures, systems and components important to safety remain in accordance with their design assumptions and intent.
- (c) The need for a radiation protection programme, including workers' health surveillance.
- (d) The need to ensure the control of reactivity and to prevent inadvertent criticality.
- (e) The need to ensure that systems and components are available to cool the fuel, other reactor components and experimental devices, and to confine the radioactive material in all operational states and in accident conditions.
- (f) The need for the design, construction, operation and modifications to be thoroughly analysed and reviewed for the purpose of ensuring safety.

- (g) The need to be prepared for emergencies and to coordinate the emergency plan for the research reactor with the emergency plans of the regulatory body, public authorities and other organizations that may take actions in response to an emergency.
- (h) The need to minimize and control radioactive discharges and to provide for environmental monitoring.
- (i) The need to control access to the reactor and to certain areas on the site to ensure safety and to protect individuals and the research reactor against actions that could jeopardize safety.
- (j) The need to conduct activities affecting items important to safety in accordance with the management system, including the need to verify whether activities have been performed as specified.
- (k) The need for training and retraining of personnel to achieve and maintain adequate levels of competence and to promote a strong safety culture in the organization.
- (l) The need to consider all organizational factors that could affect human performance, so that work can be performed safely and satisfactorily without imposing unnecessary physical and psychological stress on personnel.
- (m) The need to ensure that a positive attitude towards safety is one of the criteria for recruiting and selecting personnel, appraising performance and promoting personnel.
- (n) The need for personnel to know and understand regulatory requirements, to be in a position to make proposals for meeting those requirements and to implement the proposals in a timely manner.
- (o) The need for an effective system of communication with the regulatory body.
- (p) The need for additional services and facilities for conducting activities such as fuel management, reactor chemistry control, in-service inspection, and monitoring and improvement of the performance of the research reactor, and for modifying and procuring special items.
- (q) The need for an effective system through which operating experience from elsewhere can be systematically reviewed and information fed back so that appropriate actions can be taken.
- (r) The need to ensure an open exchange of information upward, downward and horizontally within the operating organization.
- (s) The need to accommodate experimenters and other reactor users and to meet their needs for new or modified facilities to accomplish their utilization objectives.

2.21. In addition to the needs listed in para. 2.20, the organizational structure should be such as to ensure the following:

- (a) That technical services and expertise, including those needed for emergency response, are provided. The extent to which these are provided from within or from outside the organization is a matter of management policy.
- (b) That the review of safety related activities is independent of considerations of cost, schedules and reactor utilization.

2.22. The response time for obtaining services from off-site providers should be taken into account when determining the structure of the organization, in particular for a research reactor in a remote location. In such cases, the on-site organization should be capable of rendering all services that may be necessary before off-site support is available.

2.23. Descriptions of individual positions within the operating organization should be used to supplement the organizational plan (see paras 2.12–2.19). These descriptions should clearly define the authorities and responsibilities of and the competences necessary for each position within the operating organization. The descriptions of key positions (e.g. reactor manager, reactor supervisor, shift supervisor, senior reactor operator, reactor operator, radiation protection officer, maintenance personnel) may include provisions for delegating authority for periods when the incumbent is not available. In some States, a brief description of the key positions and provisions for delegation of authority is included in the OLCs that establish administrative requirements.

2.24. The description of the responsibilities of and the competences necessary for each position should form the basis for defining the qualifications and other prerequisites for recruitment, training and continuing training of individuals.

2.25. Proposed changes to staffing levels, ways of working or the organizational structure should be subject to analysis and independent review prior to their implementation. Changes should be monitored during and after their implementation to ensure that they are not detrimental to safety. Minimum staffing levels are often included in the OLCs that establish administrative requirements.

2.26. Before any changes are made to the organizational structure or staffing levels, the possible effects should be reviewed so that any safety implications can be properly considered. For such changes, independent internal review and review by the reactor safety committee may also be appropriate. If required by national regulations, the regulatory body should be informed about proposed

changes to the organizational structure or staffing levels that might conflict with the OLCs before their implementation. The regulatory body may then assess the proposed changes and either approve them or withhold approval and intervene if it concludes that the proposed changes would compromise safety.

2.27. The operating organization is required to provide adequate training and retraining of those operating personnel whose positions may need an authorization in accordance with regulatory requirements (see para. 7.5 of SSR-3 [1]). In particular, the reactor manager and designated operating personnel are required to hold authorizations issued by an appropriate authority. Further recommendations on the authorization of operating personnel are provided in Section 5 of this Safety Guide.

2.28. The operating organization should review the functions and responsibilities of the research reactor management (see paras 2.61–2.85) and should ensure that the organizational arrangements and staffing for these management functions and responsibilities are adequately addressed. Special consideration should be given to ensuring that the reactor manager has the necessary authority over operating personnel, external support personnel and experimenters performing safety related activities.

2.29. An operating organization such as an academic institution or a research centre may have centralized services designated to serve the entire institution or centre. In other cases, governmental units or private contractors may provide support services. Examples of functions that might be provided by support services to a research reactor include the following:

- (a) Training of personnel;
- (b) Development of the management system;
- (c) Measures for radiation protection and arrangements for emergency preparedness;
- (d) Maintenance, surveillance and in-service inspection;
- (e) Waste management and environmental monitoring;
- (f) Safety review and assessment, including reviews of safety management;
- (g) Core management and fuel handling, including arrangements for procurement;
- (h) Design, construction and commissioning of major modifications;
- (i) Firefighting service.

A research reactor is required to have its own radiation protection programme and emergency plan (see Requirements 84 and 81 of SSR-3 [1], respectively).

These may be part of the programme and plan for the entire institute or centre and may make use of services provided by the institute or centre.

2.30. The operating organization should ensure that the separate programmes for the operation of the research reactor described in paras 2.86–2.149 are integrated with one another to ensure the safe operation and utilization of the research reactor. This integration should be undertaken throughout the organization, under the direction of persons in designated positions of authority (e.g. reactor manager, reactor supervisor). The reactor safety committee (see para. 2.31) is required to review all proposed programmes for the operation of the research reactor (see para. 4.27 of SSR-3 [1]).

2.31. A reactor safety committee for reviewing the safety of operations (including modifications to the research reactor, to operating procedures and to the experimental programme (see para. 4.27 of SSR-3 [1])) should be included in the organizational plan described in paras 2.12–2.19 and should be consulted on the preparation of this plan. The operating organization should also define and document (e.g. in a written charter) the functions, composition, competence and communication channels of the reactor safety committee.

2.32. The reactor safety committee is required to be independent of the reactor manager and is required to provide advice to the operating organization (see Requirement 6 of SSR-3 [1]). The chairperson of the reactor safety committee should report to the operating organization, and the results of the committee's deliberations should be provided to the reactor manager. To ensure independence, the majority of individuals on the reactor safety committee should be from outside the line of control of the reactor manager. The administrative requirements for the reactor safety committee are often included in the OLCs.

COMMUNICATIONS AT A RESEARCH REACTOR

2.33. Paragraph 7.10 of SSR-3 [1] states that “lines of internal and external communication for the safe operation of the research reactor in all operational states and in accident conditions shall be clearly specified in writing.”

2.34. The reactor management should encourage and foster effective communication between all levels of the operating organization. Downward communication should clearly explain the objectives and expectations of the management, upward communication should facilitate the identification and

communication of problems to management, and horizontal communication should support effective coordination of work and collaboration.

2.35. Effective means of communication should be established at the research reactor to assist in the understanding of the safety policy (see Requirement 3 of SSR-3 [1]) and the implementation of an effective management system (see Requirement 4 of SSR-3 [1]). Through these means of communication, personnel should be able to understand and accept why particular standards of safety are required. Communication may be formal or informal, depending on the importance of the information provided. Communication should be such as to reinforce teamwork. In particular, there should be communication between shifts, in all operational states and in accident conditions. Horizontal communication should be fostered to establish open lines of communication between groups that work together in performing specific functions.

2.36. Arrangements should be established at the research reactor to facilitate feedback from individuals on any safety concerns. Such arrangements should include both formal mechanisms, such as safety meetings, and informal mechanisms, such as the provision of feedback to managers of the units within the operating organization. The management should be open and responsive to constructive criticism and to feedback received from individuals, especially operating personnel, and should avoid inhibiting effective communication.

2.37. External communications may involve the regulatory body, external maintenance organizations, the reactor vendor, emergency response organizations and technical support organizations. In particular, well defined and open means of communication with the regulatory body should be established. External communication should take into account the broader social framework within which the research reactor operates, and the requirement for the operating organization to communicate with interested parties (see para. 4.7(c) of IAEA Safety Standards Series No. GSR Part 2, Leadership and Management for Safety [17]).

RESPONSIBILITIES AT A RESEARCH REACTOR

Responsibilities of the operating organization

2.38. The operating organization should be structured so as to facilitate the discharge of the following responsibilities:

- (a) Ensuring the safe operation and utilization of the research reactor by means of implementing an appropriate organizational structure, allocating responsibilities and delegating authority within the organization.
- (b) Ensuring that there is an established decision making process that gives adequate consideration to safety in the selection of priorities and the organization of activities.
- (c) Establishing a safety policy, implementing operational policies, developing and applying safety performance standards and effectively implementing a management system for the research reactor (see paras 2.61–2.85).
- (d) Supporting a safe and productive utilization programme for the reactor.
- (e) Providing resources, services and facilities for the safe operation of the research reactor.
- (f) Establishing and implementing an appropriate policy on individual fitness for duty that addresses physical and mental fitness, fatigue, and aspects such as the use of drugs, tobacco and alcohol, in accordance with national regulations. This policy should apply to all employees, contractors, experimenters and other users. Similar provisions should be incorporated into the policy for access of visitors to the research reactor.
- (g) Liaising with design, construction, commissioning, manufacturing and other organizations involved with the research reactor to ensure proper knowledge transfer and understanding of the reactor design intent and assumptions, information and experience.
- (h) Liaising with the regulatory body and other relevant authorities for the purposes of understanding and ensuring compliance with regulatory requirements.
- (i) Providing adequate information for communications with the public.
- (j) Ensuring the collection, evaluation, implementation and dissemination of operating experience.

The organizational plan (see paras 2.12–2.19) should include a statement of these responsibilities.

2.39. The operating organization is required to ensure that the design, construction, commissioning, operation and decommissioning of the research reactor are

performed in accordance with established codes, standards, specifications, procedures and administrative controls (see para. 4.16 of SSR-3 [1]). In addition, the operating organization is responsible (a) for establishing procedures and arrangements to ensure control of the research reactor in all operational states and, to the extent possible, in accident conditions, (b) for ensuring that safety related functions are performed by competent and motivated personnel, and (c) for ensuring control of the fissile material and radioactive material used or generated.

2.40. The descriptions of the structure of the operating organization, the lines of responsibility, authority and communication, and the functions to be performed by individual departments (and by individuals in those departments, as appropriate) should be unambiguous and should leave no scope for improvisation in any operational state or in accident conditions. To ensure that there is a clear understanding of responsibilities, and of relationships between organizational units and between personnel within the operating organization, detailed job specifications should be defined. In particular, these relationships should be clearly defined for all activities that have a bearing on safety.

2.41. The operating organization is required to foster a working environment in which safety is given the highest priority (see para. 4.4 of SSR-3 [1]). Safety and nuclear security should be considered matters of personal accountability for all operating personnel. The working environment should be such as to encourage the achievement of high levels of safety in the operation and utilization of the research reactor as well as to ensure awareness of the interface between safety and security (see Requirement 90 of SSR-3 [1]). Management at all levels should promote the consistent application of safety standards.

2.42. The operating organization is responsible for providing all equipment, personnel, procedures and training and for establishing the management practices necessary for safe operation.

2.43. In accordance with Requirement 69 of SSR-3 [1], the operating organization assigns direct responsibility for safe operation to the reactor manager, who has day to day control of the research reactor. The operating organization should monitor the effectiveness of the reactor manager in discharging this responsibility and should take any necessary measures to ensure that safety is maintained at the levels established by the design, construction and commissioning of the research reactor, and as approved by the regulatory body.

2.44. Responsibilities and authorities that are delegated within the operating organization should be specified at the appropriate levels of management.

2.45. The operating organization should ensure that an adequate number of personnel possess the knowledge, training and skills necessary to supervise and evaluate the work of contractor personnel and temporary personnel. Supervision of contractors is the responsibility of the operating organization (see para. 7.1 of SSR-3 [1]). The operating personnel who supervise contractor personnel or other temporary personnel should be clearly specified. The operating organization should ensure that contractor personnel and temporary personnel who conduct activities on items important to safety are qualified to perform their assigned tasks. Documented assurance should be obtained that contractor personnel have the necessary qualifications prior to their involvement in these activities.

2.46. A wide range of contractual arrangements between the operating organization and suppliers is possible, from procurement of individual items to a turnkey contract. For procurement, the operating organization should assign knowledgeable and skilled personnel in the pre-operational stage of the research reactor to perform this task. For turnkey contracts, the supplier plays a wider role in the construction and testing of the reactor. However, since the operating organization retains prime responsibility for the design, construction, commissioning and safe operation of the structures, systems and components of the reactor, it should assign a sufficient number of knowledgeable and skilled personnel in each of these stages, especially prior to operation. Examples of areas where close cooperation with the supplier should be ensured include the following:

- (a) Training of operating personnel;
- (b) Preparation of the safety analysis report;
- (c) Commissioning of the reactor;
- (d) Maintenance, periodic testing and inspection;
- (e) Technical assistance during operation;
- (f) Preparation of operating procedures and emergency procedures.

2.47. The operating organization should aim to develop a mutual understanding and respect between itself and the regulatory body, which supports a frank and open, yet formal, relationship. Further recommendations on the role of the regulatory body in relation to the operating organization are provided in SSG-20 (Rev. 1) [9] and GSG-13 [16].

2.48. The operating organization is required to develop and implement a procedure for reporting to the regulatory body all incidents of significance to safety (see para. 7.9(k) of SSR-3 [1]). The criteria for reporting such events are often included in the OLCs that establish administrative requirements. The operating

organization is also required to submit or make available to the regulatory body documents and other information that it has requested (see para. 4.3 of SSR-3 [1]).

2.49. The operating organization is required to establish a programme for the analysis of operating experience to ensure that lessons are learned and that any necessary corrective actions are taken (see Requirement 88 of SSR-3 [1]). This programme is required to encourage the exchange of experience with national and international systems for the feedback of operating experience (see para. 7.126 of SSR-3 [1]). This programme will need to comply with any regulatory requirements.

Responsibilities of the reactor manager and other operating personnel

2.50. The operating personnel consist of the reactor manager and other individuals involved in the operation, maintenance and, in some cases, use of the research reactor. Their responsibilities include implementation of the safety policy of the operating organization; support of the operating organization in the establishment and fostering of a strong safety culture; and the performance, control and verification of safety related activities. Only operating personnel who hold an appropriate licence or authorization should be allowed to operate the research reactor controls (see also para. 5.9).

2.51. The reactor manager has direct responsibility for all aspects of the operation, utilization and modification of the research reactor. In discharging this responsibility, the reactor manager should ensure the overall coordination of technical support functions, irrespective of whether they are performed by site personnel, by personnel from other organizational units of the operating organization or by personnel from external organizations.

2.52. The reactor manager is required to ensure that operating personnel receive adequate initial training and retraining (see para. 7.15 of SSR-3 [1]).

2.53. The reactor manager should establish performance standards and management expectations for all activities relating to safe operation and utilization of the research reactor and should effectively communicate these standards and expectations throughout the operating organization. Managers themselves should meet these performance standards and should explain to the personnel why they are appropriate.

2.54. The reactor manager is responsible for overseeing the implementation of the operational policies of the operating organization and compliance with regulatory requirements. The reactor manager may be involved in providing information