

IAEA Safety Standards

for protecting people and the environment

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

Safety Guide

No. NS-G-4.5



IAEA

International Atomic Energy Agency

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

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

SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2008

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FOREWORD

by Mohamed ElBaradei
Director General

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

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

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

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

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

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EDITORIAL NOTE

An appendix, when included, is considered to form an integral part of the standard and to have the same status as the main text. Annexes, footnotes and bibliographies, if included, are used to provide additional information or practical examples that might be helpful to the user.

The safety standards use the form ‘shall’ in making statements about requirements, responsibilities and obligations. Use of the form ‘should’ denotes recommendations of a desired option.

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1. INTRODUCTION

BACKGROUND

1.1. This Safety Guide was developed under the IAEA programme for safety standards for research reactors, which covers all the important areas of research reactor safety. The Fundamental Safety Principles publication [1] establishes principles for ensuring the protection of workers, the public and the environment. Five of these principles¹ are directly addressed in this Safety Guide, which recommends how to meet, supplements and elaborates upon the safety requirements for the operating organization and for the recruitment, training and qualification of personnel that are established in paras 7.1–7.28 of the IAEA Safety Requirements on the Safety of Research Reactors [2].

1.2. Guidance on carrying out safety analyses and preparing the relevant documentation for research reactors is provided in Ref. [3]. Additional guidance on the safe operation of research reactors is provided in Ref. [4]. The specific recommendations provided in these two publications on the operating organization and on recruitment, training and qualification of personnel have been taken into account in this Safety Guide.

1.3. Two further IAEA Safety Standards Series publications have been used in the preparation of this Safety Guide, namely, those on The Operating Organization for Nuclear Power Plants [5] and on Recruitment, Qualification and Training of Personnel for Nuclear Powers Plants [6]. Many of the

¹ These are principles 1, 2, 3, 8 and 9 (see Ref. [1]):

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 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 and response for nuclear or radiation incidents.”

recommendations provided in these Safety Guides are also applicable to research reactors, particularly research reactors with large operating organizations that support extensive operation and utilization programmes.

1.4. The overriding consideration in developing this Safety Guide was that the safe operation of research reactors requires an operating organization with an appropriate organizational structure that is clearly specified, and that is staffed with competent managers and qualified personnel who have a deep awareness of the technical and administrative requirements for safety and who support a strong safety culture.

1.5. This Safety Guide draws on hundreds of reactor-years of operating experience and on the best practices of the international research reactor community.

OBJECTIVE

1.6. The objective of this Safety Guide is to provide general guidance both on meeting the requirements on the operating organization of a research reactor and on the recruitment, training and qualification of personnel on the basis of international best practices. Specific arrangements for different reactor types and different operating situations may be derived from this general guidance. The target audience for this Safety Guide includes senior managers of organizations responsible for the planning and operation of research reactor facilities, regulatory bodies, other persons involved in research reactor operation, and those involved in educational programmes on nuclear science and technology.

SCOPE

1.7. This Safety Guide describes the typical organization of research reactor facilities. While the organization for decommissioning of a research reactor may differ from that for the operational phase, the guidance provided in this publication related to the responsibilities of the operating organization and the establishment of a management system and effective communication system within the operating organization is also applicable to the decommissioning phase. The scope of this Safety Guide also covers the recruitment process and the qualifications to be required in terms of education, training and experience; the initial training programme and continuing training programme; the

authorization process for individuals whose duties have an immediate bearing on safety; and the process involved in the requalification and reauthorization of such individuals. The focus is mainly on research reactors having power levels of up to a few tens of megawatts. The level of detail in the organizational structure and staffing may therefore be substantially reduced for low power research reactors and for reactors with limiting characteristics (e.g. with very low excess reactivity or a large negative temperature coefficient).

1.8. The sections on staffing in this Safety Guide focus mainly on the training of operating personnel, including the reactor manager, reactor supervisor, shift supervisors, reactor operators, radiation protection personnel and maintenance personnel, but also include recommendations for the training of other facility personnel such as support personnel² and reactor users.

1.9. Research reactor facilities demonstrate a wide variety of designs, a wide range of power levels, different modes of operation and uses, differences in siting and differences in operating organizations. This variety of characteristics means that recommendations can only be stated in general terms; their implementation will require some flexibility, in particular when dealing with the organizational structure of the reactor operating organization and its staffing with competent personnel.

1.10. While all recommendations in this Safety Guide should be considered for application to any research reactor, a graded approach should be used. An organizational structure and staffing that are acceptable for a low power research reactor with limiting characteristics will be very different from those acceptable for a reactor with an intermediate or high power level. For these reasons, the recommendations in this Safety Guide should be graded³ for their applicability to any particular research reactor (see Ref. [2], paras 1.11–1.14). Depending on the complexity of the design, the hazard potential and the planned use of the reactor, grading may be of assistance in determining the required levels of education for the various staffing positions, the contents and the duration of the initial training and continuing training, and the nature of the assessment on completion of the training.

² Support personnel are operating personnel other than the reactor manager and the reactor operating personnel.

³ The recommendations should be graded, for example, by considering — using sound engineering judgement — the safety and operational importance of the topic, and the maturity and complexity of the area of research involved.

STRUCTURE

1.11. This Safety Guide consists of six sections and two annexes. Section 2 describes the organizational structure and the duties and responsibilities of the staff, and briefly summarizes the organizational considerations that determine the staffing recommendations for research reactor facilities. These recommendations form the basis for the specification of the required qualifications and of the prerequisites for the recruitment of individuals. Section 3 provides guidance on the factors to be taken into account in the recruitment and selection process. Section 4 provides guidance on the knowledge and experience that operating personnel in various positions (such as reactor operators, senior reactor operators and shift supervisors) are required to have, and describes training systems and training programmes, including continuing training and requalification, that may be used to ensure that operating personnel meet these requirements. Factors that should be considered for the training and qualification of support personnel are also presented. Section 5 deals with authorization and reauthorization of reactor operators by the operating organization and the regulatory body. Section 6 deals with the maintenance of training records.

1.12. Annex I contains an explanation of the systematic approach to training (SAT)⁴. Annex II presents an example of a training curriculum covering the main topics for the initial training and continuing training of reactor operators and senior reactor operators at a large research reactor facility.

2. THE OPERATING ORGANIZATION

GENERAL

2.1. The safety requirements on the operating organization of a research reactor facility are set out in paras 4.1–4.16 (management and verification of safety), paras 7.1–7.26 (organizational provisions) and para. 7.38 (administrative requirements) of Ref. [2]. The following requirements

⁴ The SAT is a logical progression from the identification of the competences required for performing a job to the development and implementation of training to achieve these competences, and the subsequent evaluation of this training.

excerpted from Ref. [2] are reproduced here for reference, as they form the basis for the guidance provided in this section:

“The operating organization 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 and construction, through to commissioning, operation, utilization, modification and decommissioning. In order to ensure rigour and thoroughness at all levels of the staff in the achievement and maintenance of safety, the operating organization shall:

- (a) Establish and implement safety policies and ensure that safety matters are given the highest priority;
- (b) Clearly define responsibilities and accountabilities with corresponding lines of authority and communication;
- (c) Ensure that it has sufficient staff with appropriate education and training at all levels;
- (d) Develop and strictly adhere to sound procedures for all activities that may affect safety, ensuring that managers and supervisors promote and support good safety practices while correcting poor safety practices;
- (e) Review, monitor and audit all safety related matters on a regular basis, implementing appropriate corrective actions where necessary;
- (f) Be committed to safety culture on the basis of a statement of safety policy and safety objectives which is prepared and disseminated and is understood by all staff” (Ref. [2], para. 4.1).

“The operating organization shall establish an appropriate management structure for the research reactor and shall provide for all necessary infrastructures for the conduct of reactor operations. The organization for reactor operation (the reactor management²⁷) shall include the reactor manager and 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 inspection, periodic testing and maintenance, radiation protection, quality assurance and relevant support services” (Ref. [2], para. 7.1).

²⁷ The reactor management comprises the members of the operating organization to whom the responsibility and the authority for directing the operation of the research reactor facility have been assigned.”

“The operating organization shall have the overall responsibility for the safety of the research reactor, which shall not be delegated. The reactor manager shall have the direct responsibility and the necessary authority for the safe operation of the research reactor. However, the regulatory body shall retain the authority to prohibit certain activities or to require their reconsideration if it so considers. A system for reviewing and reporting abnormal occurrences shall be established” (Ref. [2], para. 7.2).

“The operating organization shall assign direct responsibility and authority for the safe operation of the reactor to the reactor manager. The primary duties of the reactor manager shall comprise the discharge of this responsibility ... The reactor manager shall have overall responsibility for all aspects of operation, inspection, periodic testing and maintenance, and utilization and modification of the reactor” (Ref. [2], para. 7.11).

2.2. For the purpose of this Safety Guide, the term ‘operating organization’ is used to designate an academic institution, corporation, institute, centre, national laboratory or other entity that is authorized by the appropriate authority of the State to operate a research reactor and to be responsible for its safety. In accordance with the legal system 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 may arise in connection with the operation of the research reactor. The individual serving in the position generically termed ‘reactor manager’⁵ may hold the title of department head, centre director or any of various other titles.

2.3. The senior management of the operating organization should take an active interest in and should participate in supervising overall 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 reactor personnel, and should therefore maintain close oversight of operations.

⁵ The reactor manager is the single member of the reactor facility management who has been delegated direct responsibility and authority by the operating organization for the operation of the reactor and whose duties consist primarily in the discharge of this responsibility.

2.4. The operating organization is authorized to operate a research reactor through the licensing system in accordance with the national regulations. More information on the authorization and licensing of operating organizations is provided in section 5 of Ref. [7]. 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.

2.5. The function of a research reactor operating organization is to support an effective utilization programme. Experimenters and other users of research reactors are frequently 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, and for training of experimenters and other users in the safe design, construction, installation, operation, utilization and modification of experimental facilities.

ORGANIZATIONAL PLAN

2.6. Relevant requirements for the organizational plan are established in paras 7.3, 7.12, 7.13 and 7.16 of Ref. [2].

2.7. The operating organization should examine the various functions necessary for safe operation of the reactor, and should assign authority and responsibility to the appropriate internal organizational position or should make arrangements for external support personnel to perform the designated tasks or programmes.

2.8. On the basis of its examination and all applicable regulatory requirements, the operating organization should prepare a written organizational plan that specifies 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 necessary for safe operation of the reactor and their required qualifications. In preparing the organizational plan, the operating organization should take into account both operational states and accident conditions. 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 reactors. The safety committee (see para. 2.24 of this

Safety Guide) should review the initial organizational plan and any significant changes to the plan.

2.9. 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 for the required organization can be completed as necessary for the commissioning stage and, in all cases, before the commencement of routine operation. The organizational plan should form the basis for the initial recruitment and training programme and for all subsequent recruitment and training programmes.

2.10. The organizational plan should provide for the preparation of individuals for promotion to each key position to ensure a smooth transition without a detrimental loss of institutional knowledge when key individuals leave the organization.

STRUCTURE OF THE ORGANIZATION

2.11. The factors that should be considered in determining the organizational structure and staffing of a research reactor operating organization include, but are not limited to, the following:

- (a) The need to ensure that all levels of the defence in depth concept are properly implemented⁶;

⁶ The International Nuclear Safety Group (INSAG) defines five levels of defence in depth:

- Level 1: Prevention of abnormal operation and failures;
- Level 2: Control of abnormal operation and detection of failures;
- Level 3: Control of accidents within the design basis;
- Level 4: Control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of a severe accident;
- Level 5: Mitigation of the radiological consequences of significant external releases of radioactive material.

- (b) The need to ensure that structures, systems and components (SSCs) important to safety⁷ remain in accordance with their design assumptions and intent;
- (c) The need for radiation protection measures and related 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 devices⁸, and to contain the radioactive material in all operational states and in design basis 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 plans for the research reactor with those of the regulatory body, public authorities and other organizations that may be required to take actions in response to an emergency;
- (h) The need to minimize and control radioactive releases and to provide for environmental monitoring;
- (i) The need to control access to the reactor and to certain areas on the site to ensure radiological safety and to protect individuals and the reactor against actions that could jeopardize safety;
- (j) The need to conduct activities affecting items important to safety in accordance with the requirements of the management system, including the need to verify whether activities have been performed as specified;
- (k) The need for emphasis on training and retraining of personnel to achieve and maintain adequate levels of competence, and to promote a strong safety culture in the organization;

⁷ An item important to safety is an item that is part of a safety group and/or whose malfunction or failure could lead to radiation exposure of site personnel or members of the public. Items important to safety include:

- Those SSCs whose malfunction or failure could lead to undue radiation exposure of site personnel or members of the public;
- Those SSCs that prevent anticipated operational occurrences from leading to accident conditions;
- Those features that are provided to mitigate the consequences of malfunction or failure of SSCs.

⁸ Experimental devices are devices installed in or around the reactor to utilize neutron flux and ionizing radiation from the reactor for research, development, isotope production or certain other purposes.

- (l) The need to consider all organizational factors that could affect human performance, so that work can be carried out 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 the requirements of the regulatory body, to be in a position to make proposals for meeting the 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 activities such as fuel management, reactor chemistry control, in-service inspection, and monitoring and improvement of the performance of the 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 research objectives.

2.12. In addition, the organizational structure should be such as to ensure the following:

- (a) That technical services and expertise, including those required for emergencies, 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 use.

2.13. The document describing the reactor's organizational structure should indicate the staffing arrangements in the categories of operating personnel and support personnel⁹. Clear lines of authority should be established to deal with matters having a bearing on safety. The extent to which support functions are self-sufficient or are dependent on services from outside the operating organization should be specified in functional organizational plans. Such organizational plans should specify human resource allocations and the duties and responsibilities of key personnel.

2.14. The description of the organizational structure and of the functions to be performed, as well as of the lines of responsibility, authority and communication, should be clear and unambiguous. This description should be included in the safety analysis report and in the documentation of the management system. Functions to be performed by external organizations or consultants should be indicated in the description, together with the relevant lines of communication and authority. This description is often included in the section of the operational limits and conditions that establishes administrative requirements. Activities undertaken by the reactor facility management (referred to as the organization for reactor operation) should be subject to approval by the regulatory body in accordance with national practices.

⁹ Personnel are:

Direct operating personnel: Those persons reporting to the reactor manager having direct responsibility for the safe day to day running of the facility assigned to them by the operating organization. Included are the reactor supervisor, shift supervisor, senior reactor operator and reactor operator.

Operating personnel: Individual workers engaged in the operation of an authorized facility. Operating personnel in a research reactor facility include the reactor manager, reactor supervisor, shift supervisors, senior reactor operators, reactor operators, maintenance staff and radiation protection staff (see also direct operating personnel and support personnel).

Operator: Any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste or transport safety when undertaking activities, or in relation to any nuclear facilities or sources of ionizing radiation. This includes, inter alia, private individuals, governmental bodies, consignors or carriers, licensees, hospitals and self-employed persons.

Reactor management: See footnote 27 to para. 2.1 of this Safety Guide.

Reactor manager: See footnote 5.

Site personnel: All persons working in the site area of an authorized facility, either permanently or temporarily.

Support personnel: See footnote 2.

2.15. The response time for obtaining services from off-site sources should be taken into account when determining the structure of the organization, in particular for a research reactor sited at a remote location. In this case, the on-site organization should be capable of rendering all services that may be necessary immediately.

2.16. Descriptions of positions or equivalent procedural guidance should be used to supplement the organizational chart. Descriptions of positions should clearly define the authorities and responsibilities of and the competences necessary for each position within the reactor organization. The descriptions of key positions may include deputizing arrangements for periods when the incumbent is not available. A brief description of the key positions (e.g. reactor manager, senior reactor operator, reactor operator, radiation protection officer, reactor maintenance personnel) and their deputizing arrangements is often included in the section of the operational limits and conditions that establishes administrative requirements.

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

2.18. Proposed changes to staffing levels, ways of working or the organizational structure should be subject to analysis and independent review. 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 section of the operational limits and conditions that establishes administrative requirements.

2.19. Before any changes are made to the organizational structure, their possible effects should be reviewed so that any safety implications are properly considered. For such changes, independent internal review and review by the safety committee may also be appropriate. If so required by national regulations, the regulatory body should be informed about proposed changes that may be in conflict with the operational limits and conditions before their implementation. It may then assess the proposed changes to the organization and the operational limits and conditions, and either approve them or withhold approval and intervene if it concludes that the proposed changes would compromise safety.

2.20. The operating organization should provide for adequate training and retraining of those operating personnel whose positions require an authorization¹⁰ in accordance with national regulations and the requirements of the regulatory body. In particular, the reactor manager and designated operating personnel should hold authorizations issued by an appropriate authority. Operating personnel that should hold authorizations may include the reactor manager, the reactor supervisor, shift supervisors, senior reactor operators and reactor operators, as appropriate. For higher level positions (e.g. the facility director), an authorization may be required if the incumbent will be expected to operate the reactor.

2.21. The operating organization should review each management function discussed in paras 2.52–2.68 of this Safety Guide and should ensure that each function is adequately addressed and staffed. Special consideration should be given to ensuring that the reactor manager has the necessary authority over internal and external support personnel and experimenters performing activities relating to safety.

2.22. 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 supporting services. Examples of functions of supporting services that may be available to a research reactor facility include, but are not limited to, 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 review of safety management;
- (g) Core management and fuel handling, including arrangements for procurement;
- (h) Design, construction and commissioning of major modifications.

¹⁰ Authorization is the granting by a regulatory body or other governmental body of written permission for an operator to perform specified activities. Authorization could include, for example, licensing or registration. The term authorization is also sometimes used to describe the document granting such permission. In some Member States an authorization is referred to as a licence or a certificate.

Note that in some cases, such as for radiation protection and for emergency preparedness, a research reactor facility should have its own plan, which may also be part of the plan for the entire institute or centre and may make use of services provided by the institute or centre.

2.23. The operating organization should ensure that the separate operation management programmes discussed in paras 2.70–2.96 are integrated with each other to ensure the safe operation and utilization of the research reactor. In order for the coordinated activities to contribute to safety and to assist in the prevention or resolution of conflicts, this integration should be undertaken throughout the reactor organization under the direction of persons in designated positions of authority (e.g. reactor manager, reactor supervisor). The safety committee should review all such proposed management programmes.

2.24. A safety committee for reviewing the safety of reactor operations, including modifications to the reactor and to operating procedures and the experimental programme, should be included in the organizational plan. There should be a written charter that defines the function, composition and communication channels of the safety committee. The safety committee should be advisory to the operating organization. The chairperson of the 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 making up a quorum at the meetings of the safety committee should be from outside the line of control of the reactor manager. The safety committee should be consulted in preparing the organizational plan for the reactor. For requirements in respect of the safety committee, see paras 4.15, 7.18, 7.25 and 7.26 of Ref. [2]. Minimum requirements for the safety committee are often included in the section of the operational limits and conditions that establishes administrative requirements.

COMMUNICATION

2.25. Management should encourage and foster effective communication between all levels of the operating organization. Downward communication should clearly explain management's objectives and expectations; upward communication should facilitate the communication of problems to management and their identification; and horizontal communication should support effective coordination of work and collaboration.

2.26. Effective means of communication should be put in place to assist in the understanding of safety policy and the implementation of an effective management system for safety. Through communication, personnel should be able to understand why particular standards of safety are required and to accept these standards of safety. 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, both in normal operation and in emergencies. Horizontal communication should be fostered to establish open lines of communication between interacting groups that work together in performing specific functions.

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

2.28. In addition to good communication within the operating organization, good communication should be established with external organizations (e.g. 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 put in place. External communication should take into account the broader social framework within which the organization operates, and a constructive dialogue should be maintained with the representatives of groups affected by the activities of the operating organization and with other interested parties.

RESPONSIBILITIES

Responsibilities of the operating organization

2.29. The operating organization should be structured so as to facilitate the discharge of its responsibilities as follows:

- (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 with a view to achieving proper management and minimizing interface problems.
- (b) Ensuring that the previously established decision making process gives adequate consideration to the selection of priorities and the organization of activities.
- (c) Establishing safety policies, limits and requirements to effectively implement a management system for safe operation (see paras 2.52–2.68 of this Safety Guide) and verifying their effectiveness.
- (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, addressing physical and mental fitness and aspects such as the use of drugs or tobacco and alcohol abuse, in accordance with national regulations. This policy should apply to all employees, contractors, experimenters and other users, as applicable. Similar provisions should be incorporated into the policy for access of visitors to the facility.
- (g) Liaising with design, construction, commissioning, manufacturing and other organizations involved with the research reactor, to ensure proper transfer and understanding of the reactor design intent and assumptions, information and experience.
- (h) Liaising with public authorities and the regulatory body for the purposes of understanding and ensuring compliance with regulatory requirements.
- (i) Providing adequate information for the purposes of liaison with the public.
- (j) Ensuring the collection, evaluation, implementation and dissemination of operating experience.

The documentation describing the operating organization should include statements of these responsibilities.

2.30. The overall responsibility for the safety of a research reactor is required to rest with the operating organization. The operating organization is responsible for establishing safety criteria and for ensuring that the design, construction, commissioning, operation and decommissioning of the research reactor meet the safety criteria. In addition, it is responsible for the establishment of procedures and arrangements to ensure control of the reactor

2.31. The operating organization should be structured with clear lines of authority and communication and with well defined responsibilities. Its safety and security policies should be understandable to and applied by all personnel. However, the assignment of tasks should not reduce or divide the overall responsibility for safety, which must always lie with the operating organization. The operating organization should therefore remain in a supervisory position for delegated tasks.

2.33. The operating organization should foster a working environment in which safety and also security are seen as vital factors and matters of personal accountability for all 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. Management at all levels should promote the consistent application of safety standards.

2.35. The operating organization delegates authority for operation to the management of the research reactor facility (the organization for reactor operation), which has direct day to day control of the facility. The operating organization should monitor the effectiveness of the organization for reactor operation and should take any necessary measures to ensure that safety is maintained at the levels established by the design, construction and commissioning of the facility and approved by the regulatory body.

[illegible]

2.37. The operating organization should include an adequate number of personnel who possess the knowledge, training and skills necessary to supervise and evaluate the work of contractor personnel and temporary personnel. Supervision of contractor personnel should be the responsibility of the reactor manager. Members of the operating organization who supervise contractors or other temporary personnel should be clearly specified. The operating organization should ensure that contractors and temporary personnel who conduct activities on SSCs important to safety are qualified to perform their assigned tasks. Documented assurance should be obtained that contractors have the required qualifications prior to their involvement in these activities.

2.38. A wide range of contractual arrangements between the operating organization and suppliers is possible, from individual procurement to a turnkey contract. For procurement, the operating organization has a major task and will need the resources to accomplish it. The operating organization should assign knowledgeable and skilled personnel in the pre-operational stage to perform this task. For turnkey contracts, the supplier plays a more wide ranging 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 SSCs of the reactor, it should assign a sufficient number of knowledgeable and skilled personnel in the pre-operational stage. 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 normal operating procedures and emergency operating procedures.

2.39. The safety of the research reactor is subject to review, assessment and surveillance by a regulatory body that is required to be independent of the operating organization. For the achievement of the common objective of the regulatory body and the operating organization, namely, the safe operation and use of the research reactor, there should be a mutual understanding and respect that supports a frank and open, yet formal, relationship. Further recommendations on the role of the regulatory body in review and assessment are provided in Refs [3, 8].

2.40. The operating organization should develop and implement a procedure for reporting to the regulatory body all incidents of significance to safety, in accordance with established criteria. These criteria are often included in the section of the operational limits and conditions that establishes administrative requirements. The operating organization should also submit or make available to the regulatory body documents and other information, in accordance with the regulations and requirements. The operating organization should establish complementary programmes for the analysis of operating experience to ensure that lessons are learned and acted upon. Such experience should be shared with relevant national and international bodies. These programmes should be in compliance with the requirements of the regulatory body.

Responsibilities of the reactor manager and other operating personnel

2.41. The operating personnel consist of the reactor manager and other individuals involved in the operation, maintenance and, in some cases, use of the reactor. Their responsibilities include, inter alia, implementation of the safety policy of the operating organization, establishment and fostering of a safety culture, and control and verification of safety related activities. Only those operating personnel who hold an appropriate licence or authorization may manipulate the reactor controls.

2.42. The reactor manager has direct responsibility for all aspects of the operation, utilization and modification of the reactor. In discharging this responsibility, the reactor manager should also be responsible for the overall coordination of technical support functions, irrespective of whether they are performed by site personnel or by personnel from other organizational units of the operating organization or of external organizations. The reactor manager is responsible for the qualification (including adequate initial training and continuing training) of the operating personnel.

2.43. The reactor manager should establish performance standards and management expectations for all activities relating to safe operation and utilization of the reactor, and should effectively communicate these standards throughout the operating organization.

2.44. The reactor manager is responsible for ensuring compliance with the requirements of the operating organization and the regulatory body. In addition, the reactor manager may be involved in providing technical information about the reactor to potential experimenters and other users, in

public information activities and in maintaining relationships with local authorities.

2.45. To improve performance, the reactor manager and, where relevant, senior managers in larger reactor operation organizations should recognize, and help to meet, the need to develop the managerial and technical skills of all individuals involved in activities relating to the reactor facility. Adequate funds should be made available by the operating organization for the development and implementation of programmes to improve managerial and technical skills.

2.46. The reactor manager should set performance standards and expectations for the operating personnel in all aspects of the safe management of the reactor. In addition, managers themselves should meet these performance standards and should explain to the personnel why they are appropriate.

2.47. In assigning responsibilities for safety, managers should ensure that the individuals to whom responsibilities are assigned have the capabilities and the resources to discharge their responsibilities effectively. Managers should also ensure that personnel are aware of and accept their responsibilities for safety. Individuals should be aware of how their responsibilities relate to those of other individuals in the organization.

2.48. Authorized reactor operators should have the authority and responsibility to shut down the reactor if necessary for safety.

2.49. Managers should be responsible for the safety of all operations under their control. The structure of the organization should reflect this accountability of line managers for safety. However, the management structure should also reflect the specific requirements of the organization. The roles, responsibilities and authorities of managers of units within the organization for reactor operation should be clearly specified and should be compatible with each other.

2.50. Personnel external to the organization for reactor operation that provide a service or provide advice should have no direct authority over reactor personnel, although such external personnel may be personally or professionally responsible for the quality of the service or advice that they give. Operating personnel should first give careful consideration to any specialist advice provided and to any particular aspects before making any decisions.

2.51. The reactor manager should submit periodic summary reports on matters relating to safety to the safety committee for its consideration and should consider any information provided in response.

MANAGEMENT SYSTEM

2.52. The operating organization is required to establish and implement an integrated management system to ensure quality in all activities that may have an influence on the safe operation of the reactor [9]. Safety requirements for the management system are established in Refs [2, 9], and guidance on implementing the requirements is provided in Ref. [10]. The content of documents describing the management system should be made available to the regulatory body, as required.

Management responsibility

2.53. The management system should include the measures necessary to ensure that acceptable levels of safety and security are maintained throughout the lifetime of the research reactor, including the decommissioning stage. The management system should include those arrangements made by the operating organization that are necessary to promote a strong safety culture and to achieve and maintain acceptable levels of safety. It is the management's responsibility to recognize the safety significance of the organization's activities. Safety objectives, concepts and principles are considered in section 2 of Ref. [2], and requirements for the management and verification of safety are established in section 4 of Ref. [2].

2.54. The management system should include such organizational elements as: the definition of the safety policy; identification of the main responsibilities within the organization; definition of the activities and competences necessary to ensure safety; and arrangements to ensure that the activities of the organization are conducted safely. The management system should provide for monitoring of the implementation of management plans and should foster continuous improvement in safety performance on the basis of lessons learned at the reactor facility and at other reactor facilities. In addition, the management system should provide the framework that will enable individuals conducting activities at the reactor to carry out their tasks safely and successfully.