IAEA SAFETY STANDARDS SERIES

Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

SAFETY GUIDE

No. NS-G-2.8

INTERNATIONAL
ATOMIC ENERGY AGENCY
VIENNA

IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish standards of safety for protection against ionizing radiation and to provide for the application of these standards to peaceful nuclear activities.

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Information on the IAEA's safety standards programme (including editions in languages other than English) is available at the IAEA Internet site

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RECRUITMENT, QUALIFICATION AND TRAINING OF PERSONNEL FOR NUCLEAR POWER PLANTS

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

Printed by the IAEA in Austria
November 2002
STI/PUB/1140

SAFETY STANDARDS SERIES No. NS-G-2.8

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INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2002

IAEA Library Cataloguing in Publication Data

Recruitment, qualification and training of personnel for nuclear power plants : safety guide. — Vienna : International Atomic Energy Agency, 2002.
p. ; 24 cm. — (Safety standards series, ISSN 1020–525X ; no. NS-G-2.8)
STI/PUB/1140
ISBN 92–0–117902–2
Includes bibliographical references.

1. Nuclear power plants — Personnel management. I. International Atomic Energy Agency. II. Series.

IAEAL 02–00302

FOREWORD

by Mohamed ElBaradei
Director General

One of the statutory functions of the IAEA is to establish or adopt standards of safety for the protection of health, life and property in the development and application of nuclear energy for peaceful purposes, and to provide for the application of these standards to its own operations as well as to assisted operations and, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of nuclear energy.

The following bodies oversee the development of safety standards: the Commission on Safety Standards (CSS); the Nuclear Safety Standards Committee (NUSSC); the Radiation Safety Standards Committee (RASSC); the Transport Safety Standards Committee (TRANSSC); and the Waste Safety Standards Committee (WASSC). Member States are widely represented on these committees.

In order to ensure the broadest international consensus, safety standards are also submitted to all Member States for comment before approval by the IAEA Board of Governors (for Safety Fundamentals and Safety Requirements) or, on behalf of the Director General, by the Publications Committee (for Safety Guides).

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA. Any State wishing to enter into an agreement with the IAEA for its assistance in connection with the siting, design, construction, commissioning, operation or decommissioning of a nuclear facility or any other activities will be required to follow those parts of the safety standards that pertain to the activities to be covered by the agreement. However, it should be recalled that the final decisions and legal responsibilities in any licensing procedures rest with the States.

Although the safety standards establish an essential basis for safety, the incorporation of more detailed requirements, in accordance with national practice, may also be necessary. Moreover, there will generally be special aspects that need to be assessed on a case by case basis.

The physical protection of fissile and radioactive materials and of nuclear power plants as a whole is mentioned where appropriate but is not treated in detail; obligations of States in this respect should be addressed on the basis of the relevant instruments and publications developed under the auspices of the IAEA. Non-radiological aspects of industrial safety and environmental protection are also not explicitly considered; it is recognized that States should fulfil their international undertakings and obligations in relation to these.

The requirements and recommendations set forth in the IAEA safety standards might not be fully satisfied by some facilities built to earlier standards. Decisions on the way in which the safety standards are applied to such facilities will be taken by individual States.

The attention of States is drawn to the fact that the safety standards of the IAEA, while not legally binding, are developed with the aim of ensuring that the peaceful uses of nuclear energy and of radioactive materials are undertaken in a manner that enables States to meet their obligations under generally accepted principles of international law and rules such as those relating to environmental protection. According to one such general principle, the territory of a State must not be used in such a way as to cause damage in another State. States thus have an obligation of diligence and standard of care.

Civil nuclear activities conducted within the jurisdiction of States are, as any other activities, subject to obligations to which States may subscribe under international conventions, in addition to generally accepted principles of international law. States are expected to adopt within their national legal systems such legislation (including regulations) and other standards and measures as may be necessary to fulfil all of their international obligations effectively.

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.

The English version of the text is the authoritative version.

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1. INTRODUCTION

BACKGROUND

1.1. In order to achieve and maintain high levels of safety, nuclear power plants are required to be staffed with an adequate number of highly qualified and experienced personnel who are duly aware of the technical and administrative requirements for safety and are motivated to adopt a positive attitude to safety, as an element of safety culture [1]. Efforts should be made to ensure that qualified candidates are recruited or selected for promotion. To establish and maintain a high level of competence, appropriate staff training and qualification programmes should be in place at the plant and kept under constant review to ensure their relevance.

1.2. This Safety Guide was prepared under the IAEA programme for safety standards for nuclear power plants. The present publication is a revision of and supersedes the IAEA Safety Guide on Staffing of Nuclear Power Plants and the Recruitment, Training and Authorization of Operating Personnel, issued in 1991 as Safety Series No. 50-SG-O1 (Rev. 1). It elaborates on and supplements Section 3 of the Safety Requirements publication on Safety of Nuclear Power Plants: Operation [1], on the qualification and training of nuclear power plant personnel to ensure safe operation. It is related to the Safety Guide on the Operating Organization for Nuclear Power Plants [2], which presents recommendations on the organizational structure for a nuclear power plant and thereby provides a basis for plant staffing.

OBJECTIVE

1.3. The objective of this Safety Guide is to outline the various factors that should to be considered in order to ensure that the operating organization has a sufficient number of qualified personnel for safe operation of a nucler power plant. In particular, the objective of this publication is to provide general recommendations on the recruitment and selection of plant personnel and on the training and qualification practices that have been adopted in the nuclear industry since the predecessor Safety Guide was published in 1991 (see para. 1.2). In addition, this Safety Guide seeks to establish a framework for ensuring that all managers and staff employed at a nuclear power plant demonstrate their commitment to the management of safety to high professional standards.

SCOPE

1.4. This Safety Guide deals specifically with those aspects of qualification and training that are important to the safe operation of nuclear power plants. It provides recommendations on the recruitment, selection, qualification, training and authorization of plant personnel; that is, of all personnel in all safety related functions and at all levels of the plant. Some parts or all of this Safety Guide may also be used, with due adaptation, as a guide to the recruitment, selection, training and qualification of staff for other nuclear installations (such as research reactors or nuclear fuel cycle facilities).

STRUCTURE

1.5. Section 2 gives guidance on the recruitment and selection of suitable personnel for a nuclear power plant. Section 3 gives guidance on the establishment of personnel qualification, explains the relationship between qualification and competence, and identifies how competence may be developed through education, experience and training. Section 4 deals with general aspects of the training policy for nuclear power plant personnel: the systematic approach, training settings and methods, initial and continuing training, and the keeping of training records. Section 5 provides guidance on the main aspects of training programmes, including those for specific categories of personnel. Section 6 gives recommendations on facilities and materials used for training. Section 7 defines authorization and provides guidance on who should be authorized to perform certain tasks, or to hold certain positions in which they have direct control or supervision of changes in the operational status of the plant or have duties with a direct bearing on safety.

2. RECRUITMENT AND SELECTION

STAFFING ARRANGEMENTS

2.1. The operating organization should be staffed with competent managers and a sufficient number of qualified personnel having due awareness of the technical and administrative requirements for safety of a nuclear power plant and the motivation to adopt and promote an attitude of safety awareness. A sufficient number of experienced staff, supplemented as necessary by consultants or contractors, should be available to ensure the safe operation of the plant, so that duties relevant to safety may

be carried out without undue haste or pressure. Attitude towards safety should be a selection criterion in hiring or promoting plant personnel.

2.2. The plant staffing plan should be regularly reassessed and updated in accordance with necessary organizational changes. Organizational changes will result from changes to work programmes or from the feedback of operating experience, especially when significant improvements in safety or in the understanding of root causes can help to avoid the recurrence of events. Issues as diverse as age profiles of plant personnel, advances in automatic control or changes in waste management policies could initiate such a reassessment process.

2.3. More information on the organizational arrangements for the staffing of nuclear power plants, the basis for the organizational plan and factors affecting the organizational structure can be found in Ref. [2].

RECRUITMENT POLICY

2.4. The recruitment and selection of personnel who can meet established competence requirements is essential for the safe and reliable operation of a nuclear power plant. The operating organization is responsible for the recruitment and selection of staff. Suitably qualified personnel should be selected and recruited in accordance with approved procedures.

2.5. The recruitment and selection policy at a nuclear power plant should be aimed at retaining a pool of experienced staff covering a broad range of operational and safety expertise. A broad distribution of both age and experience should be established to ensure that the necessary pool of knowledge, skills and safety expertise is sustained and that long term objectives of human resources policy are met.

2.6. Motivational and career development aspects relating to individuals and to the organization as a whole should be considered in the recruitment and selection processes. Hiring employees from within the operating organization permits high quality work to be rewarded and motivates personnel to enhance their competence so as to enable them to apply for higher positions. Job stability is an asset that the operating organization should use to sustain motivation by finding the right balance between internal promotion and external recruitment.

2.7. It may be necessary to hire personnel externally if positions at the plant cannot be filled internally because of a shortfall of staff with the necessary level of education

or appropriate experience. Candidates with relevant qualifications and experience may be recruited from conventional power plants, design groups and nuclear research establishments, and may be given appropriate practical experience and training at a nuclear power plant under the guidance of experienced staff. Candidates from conventional power plants should be given due consideration for recruitment to direct operations and maintenance positions, because of their greater experience in routine operations and maintenance and their ability to cope with the needs of day to day operations.

2.8. When the formal requirements for experience cannot be met, consideration should be given to the practices used in some States: in such a situation personnel may be recruited directly from schools, technical colleges and universities. Specialized training should be provided in theoretical disciplines as well as on the job through specific system, equipment and simulator training at the plant and at other organizations domestically and abroad.

2.9. The operating organization should be aware that the recruitment and selection of personnel for a new plant can be anticipated in terms of positions and recruitment schedules, so that a plan can be prepared well in advance of the beginning of plant construction. The replacement of personnel who reach retirement age at an existing operational plant or the appointment of personnel to decommission a plant can also be anticipated, in order to prepare recruitment and selection schedules. However, vacancies also arise through personnel leaving or moving to other positions, or through premature retirement. Such situations require some flexibility in the recruitment and selection processes described in this section.

2.10. In addition to complying with the State's regulatory provisions and practices that are applicable to industrial health and safety, the operating organization should ensure that all operating staff whose duties have a bearing on safety be medically examined at the time of recruitment and periodically thereafter, to ensure that their state of health is suitable for the duties and responsibilities assigned to them. Aptitude tests should be used where applicable. For key and critical positions, operating organizations may also conduct psychological tests. Medical fitness for duty requirements should be clearly defined for each position. All site personnel who may be occupationally exposed to radiation at the plant should be subject to initial and periodic medical examinations as appropriate.

2.11. A programme to identify personnel with a tendency towards drug or alcohol abuse should be established. Personnel prone to drug or alcohol abuse should not be employed for safety related tasks.

SELECTION PROCESS

2.12. The selection of staff should be based on an anticipation of how well a candidate will develop the required competence, through additional education, experience, training and development. At this stage, the person's potential for occupying higher positions may also be taken into account.

2.13. The selection process should include the following steps:

— establishing the criteria for accepting or rejecting applications and for classifying acceptable candidates,
— obtaining information about the candidates,
— interviewing the candidates,
— objective testing of the candidates to measure their aptitude for the job,
— assessing information on candidates against the criteria in order to reach a decision,
— applying the requirements for medical and psychological fitness for duty in that position.

2.14. The selection criteria should be based on the requirements for the position in question. The required entry level competences developed through education, experience and prior training should be cited (see Section 3).

2.15. The selection criteria should include such factors as education, experience, problem solving ability, emotional stability, motivation, initiative, communication skills, work background and, where required, mechanical aptitude. In addition, specific safety culture related attributes such as a questioning attitude, a rigorous and prudent approach, and communication and learning abilities should be taken into consideration in selecting candidates for safety related positions at a nuclear power plant.

2.16. Control room staff and other personnel who may have to respond to a crisis should be considered for their ability to work together as a team in emergency conditions. In the allocation of staff to particular teams, the likely personal interactions should be taken into account. In the interests of safety, mechanisms should be established for signalling changing circumstances that would require a reallocation of staff to avert potential conflict.

2.17. Some recruited personnel may have to take extended periods of time for gaining additional experience, training or even further education to reach the level of competence necessary for the position they will eventually occupy. The selection process should identify those recruits who are prepared to learn or be trained, who

meet the entry requirements of the relevant courses, and who are likely to achieve the required competence and to benefit from self-assessment.

2.18. Managerial and supervisory positions may be filled either by promoting staff from within the organization or by recruiting individuals from outside. The candidates for such positions should be selected on the basis of criteria that favour appropriate attitudes towards safety and that emphasize proven, conservative, safety enhancing decision making. In either case, the following factors should be taken into account [3]:

— management skills, including analytical, supervisory, leadership and communication abilities;
— experience (performance in previous jobs);
— education and training;
— knowledge of plant operations;
— psychological and physiological characteristics;
— attitudes towards quality and nuclear safety;
— attitudes towards learning and own training;
— attitudes towards the training and career development of subordinates.

2.19. The final selection of a candidate should be based on predetermined criteria, in order to reduce the influence of subjective factors. The relevant recommendations should be made by a group of skilled and knowledgeable staff who are familiar with the competence required for the position to be filled and with the human resources policies of the operating organization.

RECRUITMENT PROGRAMME FOR NEW NUCLEAR POWER PLANTS

2.20. Utilities planning to build a first nuclear power plant or the first of a new type of plant with significant technological differences should begin their recruitment and training programmes for the new plant relatively earlier than those who already have experience with such a plant and can call upon an existing pool of expertise. Initial recruitment should be completed in sufficient time before the commissioning of a plant to allow staff to gain experience of the design and construction by working alongside contractors and commissioning personnel, and to receive appropriate training and familiarize themselves with the plant. By participating in design and construction activities, personnel will acquire a better understanding of the design intents, the assumptions on which the safety criteria are based and the technical characteristics of the plant.

2.21. The operating organization should prepare a schedule showing how the initial recruitment and selection of plant personnel will be planned and implemented. If a plant is the first of several of a type to be built, the period covered by this schedule should begin with the start of construction work. As additional plants are constructed and operated, this period may be reduced. The general features of the schedule for the first plant should be those indicated in paras 2.22–2.25.

2.22. A few senior managers, particularly the plant manager and deputy plant manager, should be recruited at the very beginning of the recruitment period, since their first duties include supporting the pre-operational activities and planning and carrying out further recruitment and training. Particular attention should be given to the early recruitment of shift supervisors and senior operators.

2.23. Relatively early recruitment of operators and technicians is advisable for a new plant. Time should be allocated for performing duties for which no training is required or which can be accomplished under supervision before commissioning. Time should also be allocated to operators and technicians for accomplishing the training required before they assume the full responsibilities of their positions. Some of these personnel could be assigned to the plant supplier or construction organization to acquire experience with new and/or complex equipment during construction.

2.24. An important aspect of training for technicians should be to work with the construction organization and commissioning personnel in the checking and initial calibration of instruments and controls, and in the initial operation of equipment prior to fuel loading. Some individuals may therefore be recruited and employed at the site well before the commencement of operation.

2.25. Initial recruitment of the most experienced craftspersons needed for a new plant should start about one year after recruitment of the operators and technicians. While senior craftspersons may receive specialized training at suppliers' plants during the assembly and pre-shipment testing of special equipment such as diesel or gas turbine sets, large pumps or fuel handling equipment, most craftspersons are hired when they are needed. Craftspersons generally do not require lengthy training programmes, unless the particular skills asked of them are as yet unavailable to the operating organization, such as those of a certified nuclear welder. Recruitment should continue according to operational needs, with account taken of any training that may be necessary and of the opportunities available to give recruits work in construction and commissioning in order for them to gain first hand experience with the installed equipment and systems.

3. COMPETENCE AND QUALIFICATION

QUALIFICATION REQUIREMENTS

3.1. Qualification is a formal statement resulting from an assessment or audit of an individual's competence to fill a position and perform all duties assigned to that position in a responsible manner. Competence is the ability to apply skills, knowledge and attitudes in order to perform an activity or a job to specified standards in an effective and efficient manner. Competence may be developed through education, experience and formal training. For specific safety related functions, several competence criteria may need to be satisfied, and competence should be acquired by a combination of the above mentioned methods. When competence is being assessed, the qualification becomes a formal statement of competence.

3.2. The operating organization should ensure that all personnel who may be required to perform duties that affect safety have a sufficient understanding of the plant and its safety features and sufficient other competences, such as management and supervisory skills, to perform their duties safely. In a graded approach according to their assigned duties and tasks, all personnel should be trained in safety management in their areas of responsibility.

3.3. Before undertaking any safety related work, staff should demonstrate the appropriate knowledge, skills and attitudes to ensure safety under a variety of conditions relating to their duties. Staff should be trained in the safety management principles that are of relevance to their work, and in how to promote safety culture and conservative decision making by means of positive feedback and recognition.

3.4. Safety culture in terms of attitudes, as well as skills in communication, teamwork, management and supervision, leadership, appreciation and use of analytical methods, and other 'soft skills' should be demonstrated by plant personnel. Examples of these competences are given in Appendix I.

3.5. The competence of plant personnel should also include such aspects of safety culture as a questioning attitude, a rigorous and prudent approach to safety, and the necessary communication skills, as indicated in Appendix II.

3.6. When personnel are to be replaced, a reasonable amount of time overlap should be provided for, so that replacement personnel can acquire an understanding of their new duties and responsibilities and of ongoing activities prior to assuming their positions.

3.7. The competence of each individual should be assessed against established requirements before that individual is assigned to a position. The competence of all individuals should be fully assessed periodically by various means while they perform the duties allocated to their position; the assessment should also cover the actual individual performance in the workplace. The requirements should be established in such a way as to ensure that the competences are appropriate to the tasks and activities to be performed.

3.8. Appropriate records of assessments against competence and qualification requirements should be established and maintained for each individual at the plant.

3.9. Only qualified persons should be entrusted with functions important to the safe supervision, operation and maintenance of a nuclear power plant. These functions and the related duties and responsibilities should be clearly indicated in the description of the operating organization and of each position (work assignment). For each category of personnel the necessary competence may be defined by means of:

— educational level (academic qualification),
— previous experience (including direct and related experience),
— training and continuing training.

3.10. Irrespective of any formal authorization issued by other bodies, it should be the responsibility of the operating organization to ensure the appropriate qualification of all on-site and off-site personnel. The responsibility of ensuring that individuals remain appropriately qualified should rest with the operating organization, although individuals should accept some responsibility in maintaining and developing their own competence through continuing professional training.

3.11. It should be the responsibility of the operating organization to ensure that qualification requirements are established for positions in the organization. The need for specific skills and knowledge will be different for different functional levels and positions. The balance between managerial and technical competences should be evaluated by the operating organization in establishing qualification requirements.

3.12. Medical fitness requirements should be specified and satisfied, in particular for those positions that are safety related or for those persons who could be subject to occupational radiation exposure.

3.13. A formal authorization may be required before a person is assigned to a designated position (see Section 7).

EDUCATIONAL BACKGROUND

3.14. Education provides the general knowledge and develops the intellectual skills that are the foundations of competence; therefore education should be taken into consideration in the preparation of training programmes for plant personnel. Educational requirements should be accorded great importance for all plant positions. Training programmes should be used to complement formal education with practical and job related knowledge and skills.

3.15. For all categories of personnel, the educational requirements should be appropriate for their duties and responsibilities. The most frequently required technical disciplines in a nuclear power plant are mechanical, electrical and instrumentation and control (I&C) engineering. These disciplines should be available for many direct operating, support and monitoring functions. Chemistry or chemical engineering should be available for chemical and waste treatment functions, physics or nuclear engineering for reactor physics and fuel management functions, and physics or health physics for radiation protection functions.

3.16. Owing to the considerable differences in the abilities developed by education systems in different States, meeting the requirements of formal educational qualification is generally not in itself sufficient. On the basis of an analysis of the actual abilities (knowledge and skills) developed through the national education system, each operating organization should decide which educational qualifications are necessary for each particular position at its plant.

3.17. On the basis of a graded approach, the personnel involved in plant operating functions should be sufficiently knowledgeable about the basics of all the disciplines affecting plant operation, including radiation protection and nuclear safety. Specifically, a job related educational background in engineering, reactor physics or nuclear technology should be required of the plant manager, heads of departments (divisions), shift supervisors and reactor operators.

3.18. The managers and technical specialists should possess a wide knowledge of general science and technology (physics, mathematics, chemistry, thermodynamics). Managers, shift supervisors and operators should have knowledge of nuclear science and nuclear engineering disciplines. The scope of knowledge, and therefore the educational requirements, should be commensurate with the position to be occupied. Managers and technical specialists should have in depth knowledge of the specific areas relating to their work (for example, in mechanical, electrical, electronic, chemical or civil engineering). Some specific areas, such as core management, fuel handling and radioactive waste management, require a comprehensive knowledge of

nuclear physics and engineering. Persons recruited for managerial positions should have an educational background in administrative aspects and human resources management.

3.19. Managers and technical specialists should have a university degree or equivalent certification in management, engineering or science, or some other educational background appropriate for the education system of the State concerned and the specific job assigned. They may have attained the required competence also through appropriate experience and training, as permitted by the regulations of the State. Many positions, however, should be filled by personnel having credentials established strictly by formal education. For example, the title electrical engineer is established by formal degree and cannot be obtained by way of experience or training.

3.20. As a general rule, the education of technicians should provide them with the following:

— a good grasp of the basic sciences that form the foundation of the area of technology in which they will be working;
— in depth knowledge of the fundamentals in their area of technology;
— practical training and experience in the application of their knowledge and skills;
— an overview of the interfaces between their specific field of technology and the technologies to which it relates;
— the capability to communicate, which includes oral, written and technical communication (including mechanical drawings and electrical and electronic circuit diagrams).

Although there is no special need to be highly trained in manual skills, technicians should be familiar with the work and skills of craftspersons.

3.21. Craftspersons should have highly developed manual skills and corresponding knowledge, which can be acquired in vocational schools or apprenticeship programmes.

3.22. The following practices in relation to educational requirements are common in most States [4]:

(a) Managerial positions (plant manager, deputy plant manager, operations manager, safety manager, maintenance manager, quality assurance manager, technical support manager and training manager) should be occupied by university graduates in engineering or physical sciences. Additionally, in some

States it is a requirement that the incumbents of some of these positions have a master's degree in engineering. It is good practice for the training manager to have a degree in education or social sciences.

(b) The other positions for which a university level education is normally required are those of shift technical adviser and safety engineer. Reactor physicists, radiation protection officers, plant chemists and maintenance engineers will generally have university degrees, and some of the more junior staff may also have completed university level education.

(c) The plant and/or unit and/or control room shift supervisor will often hold a degree from a university or engineering college. For control room operators, a requirement to have a diploma from a technical school is current practice in the majority of States, although operators may have a university or engineering college degree. The position of field operator, as is common practice, requires as a minimum a secondary school diploma.

(d) The remaining technical positions may be filled by graduates of vocational and technical schools.

3.23. Training instructors should ideally have an academic background in an education related subject, in addition to a degree in an appropriate discipline in their area(s) of responsibility.

3.24. It should be noted that in some States the educational requirements for some plant positions are prescribed by the regulatory body.

REQUIREMENTS FOR EXPERIENCE

3.25. Experience is the knowledge gained and the skills developed while performing the duties of a position. Three principal grades of experience can be distinguished as follows:

(a) General plant experience, which comprises a general knowledge of nuclear power plants and the related activities. This sort of experience may be gained by occupying various positions at different plants.

(b) Plant familiarity, which is the detailed knowledge of a particular plant or activity, and which can only be obtained by way of day to day work in a particular position.

(c) Breadth of experience, which relates to knowledge not directly connected with the duties of a particular position. It includes a knowledge of interfacing activities, and a wider knowledge of the plant and the operating organization which may extend to other activities outside the plant.

3.26. General plant experience confers knowledge of the general properties of the plant (or of maintenance or similar activities) which is broadly applicable. This sort of experience can be acquired by working at different plants. Experience in several plants can add to the general plant experience of operating personnel, and in the same way, experience of maintenance in plants of different types adds to the general experience of maintenance personnel. By performing the tasks and duties of a position in an operating function, a knowledge of plant behaviour is built up over a period of time which, by a process of generalization, can be applied to a range of plants. The regulatory procedures in some States recognize the need for such knowledge by requiring that operators who need formal authorization have a minimum number of years of plant experience, and recognize its general nature by accepting that a part of this experience may have been acquired in other plants, including conventional power plants. This type of knowledge appears to be retained for long periods, even after work in a plant has ended.

3.27. Familiarity with a plant can only be acquired and maintained by working there in a certain position. Familiarity with the plant is essential for control room and other plant operators, because they should be able to recall details of that particular plant within the time limits allowed for actions and decisions. This type of knowledge is lost rapidly after regular work in the position has ceased. Its short retention time is recognized by some regulatory authorities who make continued practice in an operating function at the particular plant a requirement for a formal authorization to be renewed or maintained.

3.28. Breadth of experience comprises knowledge of matters outside the activities immediately pertaining to a position. The breadth of experience depends on the range of work to which an individual has been exposed, and accordingly a utility can develop breadth of experience in its personnel by giving them a variety of job experiences. Many utilities have adopted job rotation on a regular basis as a policy. Persons in managerial and supervisory positions should have breadth of experience. Supervisors should have knowledge of the activities of all positions under their control. Further, in higher managerial positions, the decisions that have to be taken will frequently involve knowledge not only of subordinate positions but also of matters outside the plant organization, such as company policies.

3.29. In addition, safety culture and safety management experience are specific attributes to be taken into account in the selection and assignment processes for plant personnel. The main reason why nuclear experience is required by some regulatory bodies for positions in operations and plant management is the belief that these specific attributes can be better acquired while working at a nuclear power plant or related nuclear facility. Such regulatory requirements often specify the minimum length of experience at a nuclear power plant required.

3.30. The experience requirements indicated in paras 3.31–3.39 are examples of the length of time for which persons have typically been subject to the range of operations and experiences necessary to understand the particulars of a task or job position. However, these requirements may vary between States. The number of years should not be given as much importance as the quality of the experience, the competence of the organization from which that experience was gained or the level of responsibility that was accorded to the person during the time in which they were gaining the experience. Documented recommendations of educators, instructors and former employers (especially those from operating organizations and regulatory authorities) should be given considerable importance in evaluating the experience and competence of an individual. Persons having previously held an authorization (licence) from a nuclear operating organization for a significant length of time should be considered to have documented experience. For plant managers, supervisory staff for plant work groups and control room operators, documented experience may be the best indicator of future work performance and safe operation.

Managers and supervisory personnel

3.31. Successful performance in subordinate positions is an acceptable form of experience for senior positions. The plant manager, deputy plant manager, operations manager, safety manager, maintenance manager, quality assurance manager, technical support manager and training manager should have a range of experience in positions of increasing responsibility (recommendations for the scope of this experience are given in the following paragraphs). The requirements for these positions and for the shift supervisors should include demonstration of leadership ability in relation to plant personnel and, on occasion, to contractors for whose activities they may become responsible.

3.32. Plant managers should have experience in several key areas of plant activity such as operation, maintenance or technical support. This experience may usually be gained over a period of between 10 and 15 years, but not less than five years. Plant managers should also have appropriate management experience.

3.33. Heads of operations, maintenance, quality assurance, training and technical support should have sufficient experience in their respective fields of activity to develop specific competence and management ability. The head of operations should, in addition, have experience in reactor operations. Experience may usually be gained over a period of between five and eight years, with a minimum of two to three years at nuclear power plants, of which six months should be at the site concerned (or a similar site).

3.34. The head of radiation protection and the person responsible for reactor physics should have gathered specific experience at comparable facilities. Sufficient experience may usually be gained over a period of between four and six years at nuclear facilities, with a minimum of two to three years at nuclear power plants, of which six months should be at the site concerned (or a similar site).

3.35. Shift supervisors should have operational shift experience in reactor operations at a nucler power plant, with team and leadership experience. This experience may usually be gained over a period of between four and six years, with a minimum of two to three years at an operating plant, of which 12 months should be at the site concerned (or a similar site).

Operators

3.36. Control room operators should have operational shift experience in nuclear or conventional power plants. Sufficient experience may be gained over a period of between three and four years, of which a minimum of two years should be at a nuclear power plant, with six months at the site concerned (or a similar site).

3.37. All other operators should have the experience appropriate to their duties and responsibilities. In general, one year of experience should be considered a minimum prerequisite for the field operator's position (see Ref. [4]).

Technicians and craftspersons

3.38. Senior technicians and craftpersons should have between two and three years of practical experience. The other technicians and craftspersons should have the appropriate experience to demonstrate the skills necessary to perform their duties and discharge their responsibilities.

3.39. Some experience for all categories of positions may be gained in design, construction and commissioning activities. Personnel involved in these activities should develop an understanding of the design intents and assumptions, of the safety criteria and of the technical characteristics of the plant.

QUALIFICATION OF EXTERNAL PERSONNEL

3.40. Contractors may perform a considerable part of the activities relating to safe operation of the plant, even though the prime responsibility for safe operation rests

with the operating organization. The operating organization should ensure that contractor personnel involved in safety related activities are competent, qualified and medically fit to perform their assigned tasks.

3.41. The contractors selected for specific safety related work should be required to provide documentary evidence that they and their staff have the appropriate training and qualification to perform the assigned work and, if necessary, the required certification (for example, for some categories of welders). This information should be obtained prior to independent involvement of contractor personnel in these activities. In addition, confirmation of relevant experience in carrying out similar work may be requested of the contractor.

3.42. All suppliers and contractors involved in design, engineering, manufacturing, construction, operation, maintenance or other safety related activities should be aware of the applicable standards while working at a nuclear power plant or for an operating organization. Suppliers and contractors should understand the safety culture demonstrated by the plant personnel. This understanding is mutually beneficial for the suppliers, the contractors and the operating organization.

4. TRAINING POLICY

GENERAL ASPECTS

4.1. The operating organization is responsible for training its own staff and ensuring that contractors' staff are suitably trained and experienced so that all work is carried out safely. The operating organization is also required to make sure that all personnel who are assigned duties that can affect safety have a sufficient understanding of the plant and its safety features and sufficient competence, in areas such as management and supervisory skills, to ensure safe operation of the plant. This requires that staff competence be sustained by regular training and review, and that development programmes be used to ensure the continuous availability of competent staff to meet the needs of the organization, with account taken of retirements and promotions.

4.2. The operating organization should formulate an overall training policy. This policy is the commitment by the operating organization and plant management to the training of personnel and an acknowledgement of the critical role that training plays in the safe, reliable operation and maintenance of the plant.

4.3. The training policy should be known, understood and supported by all persons concerned. Plant department managers and the plant training manager should be involved in developing the training policy and implementing procedures, as a way of facilitating their acceptance of the policy.

4.4. A training plan should be prepared on the basis of the long term needs and goals of the plant. This plan should be evaluated periodically in order to ensure that it is consistent with current (and future) needs and goals. Factors which can change a training plan include: commissioning experience, operational experience and decommissioning experience at the plants of the operating organization; feedback of operational experience from other plants; significant modifications to the plant or to the operating organization; changes in regulatory requirements; and changes in the State's education system.

4.5. The training needs for duties important to safety should be considered a priority, and relevant plant procedures, references, resources, tools, equipment and standards should be used in the training process to ensure, as far as practicable, that errors, omissions and poor practices are not accepted. For these critical duties, the training environment should be as realistic as possible, to promote positive carry-over from the training environment to the actual job environment.

4.6. All aspects of safety should be covered in the training. Training is one of the means to promote safety culture, and, accordingly, should be fully encouraged and supported by plant managers, who should also be trained in safety culture. Job specific training programmes should be tailored in the way that best contributes to the development of those skills and attitudes that relate to the safety aspects of the job.

4.7. For each of the positions important to safety in the operating organization, a series of requirements for initial and continuing training should be established. These requirements should vary according to the individual position, level of responsibility and specific level of competence required, and should be prepared by persons having specific competence in plant operation and experience in developing training activities. The established requirements should relate to the tasks and activities to be performed.

4.8. It should be the responsibility of the plant manager, with reference to each position important to safety, to ensure that:

— training needs are continuously analysed and an overall training programme is developed;
— the training unit is provided with all necessary resources and facilities;
— the performance of all trainees is assessed at various stages of the training;

— the effectiveness of the training is evaluated;
— the competence of the persons occupying such positions is periodically checked, and continuing training or retraining is provided on a regular basis so that their level of competence is maintained;
— in allocating resources, the implementation of training programmes is given high priority.

4.9. The training unit will be responsible for assisting the plant manager in establishing, verifying and maintaining the competence of plant staff. Line managers and supervisors should be accountable for the qualification of their personnel; they should be involved in defining training needs, evaluating the job performance of personnel, providing feedback to the training department and ensuring that the training provided reflects operating experience. Managers and supervisors should ensure that production requirements do not interfere with the conduct of training programmes.

4.10. The existence of full time training staff should not relieve plant line managers of their responsibility to ensure that their staff are adequately trained and qualified. Supervisors should recognize and make provision for the training needs of their subordinates. The responsibilities and authority of training personnel, as distinct from those of line managers, should be clearly defined and understood.

4.11. Consideration should be given to enhancing training programmes for staff at ageing plants to compensate for losses of personnel due to retirement or job changes and for other reasons. Training programmes should also be adapted to accommodate the special technical, administrative and operational needs of an ageing plant.

4.12. The trend towards automation of the functions of plant operators involves the alteration of operators' tasks, for example, from remote manual operation to the monitoring, supervision and evaluation of automatic operations. Operators are faced with the need for interpreting greater amounts of processed information, and maintenance personnel may be faced with more complex equipment. The automation of low level tasks has also altered many jobs. In many cases, jobs are now broader in scope and demand more thinking than before. Plant personnel should be prepared to operate in this altered environment and, consequently, training programmes should reflect these changes.

SYSTEMATIC APPROACH TO TRAINING

4.13. A systematic approach to training should be used for the training of plant personnel (see Ref. [5]). The systematic approach provides a logical progression, from

identification of the competences required for performing a job, to the development and implementation of training towards achieving these competences, and to the subsequent evaluation of this training. The use of a systematic approach to training offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control, leading to greater reliability of training results and enhanced safety and efficiency of the plant [6].

4.14. A systematic approach to training should include the following phases:

— Analysis. This should comprise the identification of training needs and of the competences required to perform a particular job.
— Design. In this phase, competences should be converted into training objectives. These objectives should be organized into a training plan.
— Development. In this phase, training materials should be prepared so that the training objectives can be achieved.
— Implementation. In this phase, training should be conducted by using the training materials developed.
— Evaluation. In this phase, all aspects of the training programmes should be evaluated on the basis of data collected in each of the other phases. This should be followed by feedback leading to improvements in the training programmes and to plant improvements.

TRAINING SETTINGS AND METHODS

4.15. The following training settings and methods, which are widely used and have proved to be effective in attaining the training objectives when appropriately chosen, should be considered:

(a) The classroom is the most frequently adopted training setting. Classroom training time should be carefully controlled and structured to achieve the training objectives in a timely and efficient manner. Its effectiveness should be enhanced by the use of appropriate training methods such as lectures, discussions, role playing, critiquing and briefing. Training aids and materials such as written materials, transparencies, audio and video based materials, computer based systems, plant scale models and part-task simulators should be used to support classroom instruction where necessary.
(b) On the job training should be conducted in accordance with prescribed guidelines provided by incumbent staff who have been trained to deliver this form of training. Progress should be monitored and assessments should be carried out by an independent assessor.

(c) Initial and continuing simulator based training for the control room shift team should be conducted on a simulator that represents the control room. The simulator should be equipped with software of sufficient scope to cover normal operation, anticipated operational occurrences and a range of accident conditions. Other personnel may also benefit from simulator based training.
(d) Training mock-ups and models should be provided for activities that have to be carried out quickly and skilfully and which cannot be practised with actual equipment. Training mock-ups should be full scale if practicable. Laboratory and workshop training should be provided to ensure safe working practices in those environments.
(e) Self-study training does not have to be undertaken at a training facility, but in all cases the trainees should have support from a designated expert.

4.16. In general, the training should consist of periods of formal training in the classroom mixed with intervals of simulator, laboratory or workshop training, and should include practical training at the plant.

4.17. Plant commissioning provides an important opportunity for hands-on training for both direct operating personnel and personnel in supporting functions. Before fuel is loaded at a new plant, testing of components and systems can be undertaken with freedom of access, which is not possible later in the plant's operating lifetime.

4.18. The training of control room operators should include, as a minimum, classroom training, on the job training and simulator training. The classroom training and on the job training should be planned and controlled to ensure that all necessary objectives are achieved during the training period. Simulator sessions should be structured and planned in detail to ensure adequate coverage of the training objectives and to avoid possible negative training due to the limits of simulation. The sessions should include preliminary briefings and follow-up critiques.

4.19. Training at a plant reference, full scope simulator facility should be provided for control room operators whose actions have an immediate influence on plant behaviour. Trainees should also be confronted with infrequent and abnormal situations which have a low probability of occurrence and therefore cannot be enacted in real plant practice. Consideration should be given to training control room staff as a team to develop team skills, good communication and co-ordination habits and trust in the application of plant procedures.

4.20. The importance of training by means of simulators and computers should be emphasized in order to develop human–machine interface skills. Some plants now tend to operate steadily with few forced shutdowns, owing to the efforts of plant

personnel and to technical improvements, or for a longer operating cycle, owing to improved fuel performance and core management. Their personnel therefore tend to have fewer opportunities of experiencing abnormal operating occurrences and actual plant startups and shutdowns.

4.21. All progress made in training should be assessed and documented. The means of assessing a trainee's ability include written examinations, oral questioning and performance demonstrations. A combination of written and oral examinations has been found to be the most appropriate form of demonstrating knowledge and skills. In the assessment of simulator training, predesigned and validated observation forms and checklists should be utilized in order to increase objectivity. All assessments of simulator training sessions should include an evaluation of the trainees, the feedback given and further measures considered as a result of the evaluation. Assessment should not be regarded as a one-off activity. In some States, reassessment of individuals by instructors and their immediate supervisors is undertaken at regular intervals.

INITIAL AND CONTINUING TRAINING

4.22. Comprehensive training should comprise initial training and continuing training or retraining. Initial training should be provided to persons before they are assigned to a job or a position within the operating organization. Continuing training should be provided for all persons throughout their working life, as it is necessary to ensure that their knowledge, skills and attitudes are maintained current in both theory and practice. Continuing training should also be directed to the permanent improvement of skills and attitudes which is necessary for safety related activities. In some States, retraining is an alternative term for continuing training. In other States, retraining specifically describes training in a different knowledge, skill or attitude, required because of a major modification to the existing plant or to plant operation, the installation of a new plant or a change of job. The training programme for every individual should define the contents of the initial training, continuing training or retraining. Special training may be necessary if an employee shows deficiencies in performance, when an employee has been away from a safety critical assignment for several months or more, or if there is a need to prepare for an infrequent eventuality.

4.23. Initial and continuing training for all employees of the operating organization, including plant personnel, should include general employee training (see para. 4.43) as well as training for a thorough understanding of their particular duties and responsibilities and of their contribution to the safe and efficient operation of the organization's plant.

4.24. In initial and continuing training, trainees should be evaluated by means of written, oral and practical examinations or by discussions of the key knowledge, skills and tasks required for performing their jobs.

4.25. An initial training programme should be established for all plant personnel to achieve the necessary competence to carry out their jobs. Initial training should help personnel to achieve a high level of performance in terms of safety and professionalism, in order to meet the operational standards required to ensure safe operation of the plant. The goals of initial training should include the following:

— to complement any formal education in the general areas of technology and science;
— to provide an understanding of safety management, procedures and standards of performance;
— to impart a knowledge of nuclear technology and of the plant concerned;
— to provide an understanding of the principles of operating and maintenance of specific plant systems and equipment;
— to develop specific skills relating to the job assignments;
— to emphasize safety aspects of the plant in general and specific safety aspects relating to the tasks assigned;
— to inculcate appropriate attitudes towards safety.

4.26. The goal of continuing training is to maintain the high performance level of plant personnel. To achieve this goal, areas of knowledge necessary for safe plant operation should be systematically reviewed. The continuing training programme should cover recent industry and plant specific operating experience, identified problems in performance, plant modifications and procedural changes. Continuing training should achieve the following:

— improve the knowledge and skills of personnel when changes in the scope of jobs are identified;
— maintain and in selected areas enhance the skills and knowledge necessary to accomplish routine, abnormal and emergency duties;
— increase the level of understanding of selected fundamental matters that were presented in initial training, with emphasis on areas of demonstrated weakness;
— maintain an awareness of the responsibility for safe operation of the plant and of the consequences of negligence and faults;
— correct deficiencies in personnel performance that have been detected through the analysis of plant operating experience;

— maintain the personnel's knowledge of plant modifications and procedural changes in areas to which they are assigned;
— emphasize lessons learned from industry and plant specific operating experience to prevent the repetition of errors;
— emphasize topics identified by managers and supervisors;
— enhance the performance of operations personnel through timely training for infrequent, difficult and important operational tasks.

4.27. Theoretical concepts in such areas as reactor physics, principles of operation of plant systems and equipment, thermohydraulics, plant chemistry, reactor safety, industrial safety and radiation protection should be reviewed periodically.

4.28. All personnel who have specific duties in an emergency should be given continuing training in the performance of these duties. Fire fighting drills should be included in the continuing training programme for plant personnel who are assigned responsibilities for fire fighting.

4.29. Continuing training should be carried out on a regular basis. A programme should be conducted periodically for all groups of personnel whose functions are important to the safe operation of the plant. By means of continuing training based on a systematic approach, it should be ensured that levels of qualification and competence are maintained and upgraded when necessary. Continuing training or retraining may also include training to improve the career development potential of selected individuals. Continuing training should therefore be regarded as an integral part of the operation of a plant.

4.30. For operators, continuing training should be provided at appropriate intervals to ensure that the knowledge and understanding essential to safe and efficient plant operation are retained and refreshed, in particular for dealing with abnormal and accident conditions. Structured continuing training or retraining for operators should be given on a representative simulator. Simulator training exercises should be planned systematically and carried out annually. Such exercises should reflect operating experience with emphasis on those situations that do not occur frequently, for example startup, shutdown, special transients and accident conditions. Teamwork should be emphasized in dealing with incidents and accidents.

4.31. The time necessary for all personnel to undergo formal continuing training on a regular basis should be taken into account when work schedules are established. In the case of the maintenance group, refresher training should be given on maintenance activities that are normally performed only infrequently.

TRAINING FOR EMERGENCIES

4.32. A training programme for emergencies should be established to train and evaluate plant staff and staff from external emergency response organizations in confronting accident conditions, coping with them and maintaining and improving the effectiveness of the response. Emergency preparedness exercises should be designed to ensure that plant staff and staff from other participating organizations possess the essential knowledge, skills and attitudes required for the accomplishment of non-routine tasks under stressful emergency conditions [7].

4.33. While the emergency assignments of plant personnel are based on their routine job assignments for normal operation, they should also receive specialized training relevant to the duties they will have to perform in an emergency. The purpose of this training should be:

— to demonstrate how effectively an emergency plan, or part of it, can be implemented;
— to confirm the adequacy of the plan to deal with the emergency and to identify potential improvements;
— to verify that the appropriate lines of communication are established and maintained;
— to verify that all individuals participating in the exercise are familiar with, and capable of performing, the emergency duties assigned to them;
— to verify that emergency response and all related duties can be carried out in a timely manner according to the planned schedule and in stressful situations.

4.34. Training should be provided for all staff members who have assignments under the emergency plan. The training for emergencies should include the periodic performance of emergency drills and exercises. Training should also include conventional safety, in particular in fire fighting and medical first aid. Periodic drills and exercises should be held to reinforce training and to assess the effectiveness of the emergency response capability. There should be full scale exercises involving external organizations such as the police, fire services, ambulance teams, rescue teams and other emergency services.

4.35. Exercise scenarios at the plant as well as simulator scenarios should be carefully prepared, including training objectives, conditions for termination and reference sources. Furthermore, the conduct of a plant exercise should not create any condition which could jeopardize plant safety.

4.36. Supplementary training should be provided for those staff members who are required to perform specialized duties in the event of an accident. For example, topics such as nuclear safety analysis, applicable codes, standards and regulations, information on evaluated safety margins of the plant, symptom oriented procedures and accident management measures should be covered. The principal results of any probabilistic safety assessment of the plant, showing the importance of plant systems in preventing damage or severe accidents, should be included in the training programme.

4.37. Plant emergency response using emergency operating procedures (EOPs) should be practised in the simulator, to provide operating personnel with the necessary knowledge and skills to demonstrate competent emergency actions. Specific in depth training in EOPs should be provided to overcome the degradation of operating personnel's performance that can occur in stressful situations. In addition, classroom training should be included to ensure that personnel with special emergency assignments understand the conceptual basis and terminology and structure of the EOPs, and their own roles and responsibilities in the implementation of EOPs. More guidance on EOPs can be found in Ref. [7].

4.38. Training on implementation of EOPs should include, but is not limited to:

(a) A description of the plant response to various types of initiating event, using graphics for illustration as required. The description should be based on best estimate calculations or on actual operating data. A few response alternatives for each type of event should be used to show how the plant is brought to a safe shutdown state by controlling the symptoms.
(b) A discussion of the basic recovery strategy for each type of event, and possible alternatives. Results of calculations, as well as limiting conditions and constraints for the alternative strategies, should be given.
(c) An explanation of the principles of ensuring plant safety by maintaining a set of critical safety functions.
(d) An explanation of the logic and organization of the EOPs, including the roles of individual members of the operating team.
(e) A description of recovery methods and a discussion of the purpose of each step, or group of related steps, of the EOPs.
(f) An explanation of the conditions and requirements under which an EOP could be modified, including the required reference to, or possible changes in, the relevant technical documentation.

4.39. Specific training should be provided in the procedures to be followed if an accident occurs that exceeds the design basis of the plant and the emergency plan is

implemented. This training may be conducted in a combination of settings including simulation, emergency drills and classroom training. Control room simulators are usually not validated for beyond design basis accidents, and great care is required in their use for the training of operating personnel in beyond design basis accidents. The simulators could be used in exercises for initial accident classification and decision making. Consideration should be given to using workstations and other advanced computer applications to simulate accident evolutions after core damage has occurred.

4.40. Plant managers and senior operating personnel should be trained in directing plant staff, using available information, plant systems and equipment to mitigate the consequences of severe accidents. Operating personnel should be trained in recognizing situations in which the EOPs are not adequate and accident management procedures and/or guidance should be used. Training exercises should be designed adequately to ensure that the decision making function is developed and clearly understood by the accident management team.

4.41. Training of the managers and the technical specialists involved in accident management should include, but is not limited to:

(a) Diagnosing and/or assessing the accident:

- assessing the status of the core, containment and important safety systems;
- predicting the probable timing of key events in the accident;
- assessing core damage;
- anticipating problems likely to cause the situation to deteriorate further;
- estimating pressure rise and temperature rise from the projected hydrogen combustion or reactor vessel failure.

(b) Formulating the accident response:

- identifying and assessing accident management strategies to prevent or arrest core damage, prevent containment failure and reduce releases of radioactive material;
- using all available insights, including evaluations from probabilistic safety assessment, to set priorities for corrective actions.

(c) Taking response actions:

- taking positive action to re-establish the redundancy, diversity and independence of the safety systems, and integrating efforts with those of control room operators;

— implementing accident management strategies to arrest core damage, prevent containment failure and reduce releases of radioactive material.

(d) Monitoring and updating the strategies:

— monitoring the effectiveness of strategies implemented by control room operators;
— anticipating problems likely to further degrade the core and safety systems.

4.42. The training programmes in accident management should be reviewed periodically and updated as necessary to take account of new knowledge and in-house and external experience.

4.43. A general training programme should also be provided for on-site staff who have no emergency duties, to familiarize them with the procedures for alerting personnel to emergency conditions. Similar training, or at the minimum a well structured information briefing, should be provided to contractor personnel or other temporary personnel.

RECORDS AND REPORTS

4.44. Training documentation consists of records and reports associated with the training programmes and with the trainees' performance. These records and reports should be used to assist the management in monitoring the effectiveness of a training programme, as well as in an annual follow-up by the management of personnel competence. They also should provide a historical record of the changes made to a programme as a result of evaluation and feedback.

4.45. The operating organization should maintain adequate records of the training of individuals (including on the job training), of the performance of individual trainees (including a list of main activities performed on the job) and of any formal authorization given. The main purposes of these records are:

— to provide evidence of the competence of all persons whose duties have a bearing on safety;
— to provide evidence of authorization;
— to enable line managers to deploy their staff effectively, ensuring that only suitably qualified and experienced staff are assigned to safety related tasks;
— to provide the information necessary for reviews of the training programme and for corrective actions, if necessary;

— to provide the documentation necessary to meet regulatory requirements (in the granting or renewing of authorizations).

4.46. Records of training programmes should be maintained to permit the review of contents, schedules and results of current and past programmes. These records should be classified according to type and retention period, and should be appropriately located, organized and indexed for ease of retrieval.

4.47. The administration, storage and safe keeping of records should follow the requirements of the plant's quality assurance system, in accordance with any other applicable requirements. The requirements and recommendations of the IAEA on Quality Assurance for Safety in Nuclear Power Plants and Other Nuclear Installations [8] apply (in particular, Safety Guide Q3: Document Control and Records).

4.48. The training group should report periodically to appropriate levels of management on the status and effectiveness of training activities. Significant events or problems in training should be identified and reported when they occur.

5. TRAINING PROGRAMMES

GENERAL ASPECTS

5.1. All new employees starting work at a plant should be introduced to the organization and their working environment in a systematic and consistent manner. General personnel training programmes should give new employees a basic understanding of their responsibilities and of safe work practices, the importance of quality programmes and of following procedures, and the practical means of protecting themselves from the hazards associated with their work. Hands-on training in means of radiation protection that are common to all plant personnel should be provided to all those who work in controlled areas. The amount of training to be provided on each topic should be commensurate with the individual's position and duties. The basic principles of safety culture should be taught to all employees, and refresher training on general topics should also be periodically provided.

5.2. Training programmes for most positions at a nuclear power plant should include on the job training, to ensure that trainees obtain the necessary job related knowledge and skills in their actual working environment. Formal on the job training provides hands-on experience and allows the trainee to become familiar with plant

routines. However, on the job training does not simply mean working in a job and/or position under the supervision of a qualified individual; it also involves the use of training objectives, qualification guidelines and trainee assessment. This training should be conducted and evaluated in the working environment by qualified, designated individuals.

5.3. Training programmes should include training in new technologies which are introduced to improve practices and results in operation and maintenance. Suitable staff should be trained in root cause analysis and the assessment of human factors, with the aim of creating, over a period of time, a pool of staff who can evaluate events objectively and make recommendations on how to avoid their recurrence.

5.4. Safety culture should be inculcated effectively in all staff involved in safety related activities. All training programmes for specific plant activities should make reference to safety culture (see also paras 3.4, 3.5 and 4.6). In particular, the need for a questioning attitude, a rigorous and prudent approach and an adequate capability for communication should be emphasized in connection with all safety related activities at the plant. Training programmes should stress the need for an understanding of safety issues, should include consideration of the possible consequences for safety of errors and should deal specifically with ways in which such errors may be avoided, or corrected if committed.

5.5. All persons likely to be occupationally exposed to ionizing radiation — that is, not only radiation protection staff — should receive suitable training in (a) radiation risks and (b) the technical and administrative means of preventing undue exposure and applying the ALARA (as low as reasonably achievable) principle.

5.6. Training programmes for managers and technical specialists, control room operators and senior technicians should provide a thorough understanding of the basic principles of nuclear technology, nuclear safety and radiation protection, of the design intents and assumptions, and of the theoretical basis for plant activities, together with the necessary on the job training. The training programme for other operators and technicians and for craftspersons should have a more practical orientation, with explanations of the theoretical and safety related aspects.

5.7. Personnel specified by the operating organization should be made familiar with the features of safety analysis as part of their training programme. Training and assessment of plant operators should ensure their familiarity with the symptoms of beyond design basis accidents and with the procedures for accident management. Simulators should represent the way in which an accident would evolve. If the

available simulator facilities are inadequate, computer based training, classroom training and plant walkthroughs should be used to explain the consequences of an accident involving a seriously degraded reactor core.

5.8. Specific training should be conducted in conjunction with modifications to the plant, to ensure that the appropriate operation and maintenance personnel are familiar with the modified systems and are sufficiently knowledgeable and skilled to operate and maintain modified equipment in a safe and reliable manner.

5.9. Details of training programmes or their separate modules (for example, on the job training for maintenance personnel, simulator training for operators) should be made available to the regulatory body if required.

5.10. Aspects of training programmes that are specific to different functional groups of personnel are described in paras 5.11–5.34. However, these should not be considered a complete set of topics to be presented to these groups of personnel in the training programmes.

TRAINING PROGRAMMES FOR MANAGERS AND SUPERVISORY PERSONNEL

5.11. Training programmes for managers and supervisory personnel should emphasize the concept of safety culture, including training in making successful presentations of safety related messages to subordinates. This will assist managers and supervisory personnel in promoting among their staff an awareness that safety should be considered a primary objective in their day to day activities. The pre-eminence of safety over production needs should be emphasized.

5.12. The training of senior operations and management staff should emphasize the special problems of managing a nuclear power plant with its exceptional demand for safety and the need for familiarity with emergency procedures. Special attention should be paid to gaining the benefits of feedback of operational experience and root cause analysis of events that are generic or that occur frequently at the plant.

5.13. Managers and supervisory personnel should have mastered their particular technical skills through long experience and basic training in the nuclear field. They should have a thorough understanding of all the relevant standards, rules and regulations. They should also have a good overall knowledge of the plant and its systems. Individuals in positions of responsibility for emergency preparedness should be specially trained for their emergency duties.

5.14. Training programmes for managers and supervisory personnel, and for their potential successors, should include courses and seminars on managerial and supervisory skills, coaching and mentoring, self-assessment techniques, root cause analysis, team training and communication.

5.15. The career development of managerial staff should include involvement with external groups, networks and bodies at the national and international level, with a view to increased co-operation for the mutual benefit of participants. This aspect is of particular relevance to those plants where there are difficulties with external relations owing to their geographical remoteness or their technical or organizational differences with respect to other plants.

TRAINING PROGRAMMES FOR OPERATIONS PERSONNEL

5.16. The formal training of operators should cover relevant areas of technology to the levels necessary for the tasks to be performed. It should instil a thorough theoretical and practical knowledge of plant systems and their functions, layout and operation. Participation in the pre-operational phase and the startup of a new plant is a valuable opportunity for such training. Emphasis should be placed on systems that are of safety significance. The results of any probabilistic safety assessment of the plant should be used to demonstrate the importance of plant systems in preventing plant damage or severe accidents. The training should emphasize the importance of maintaining the plant within the operating limits and conditions, and the consequences of violating these limits. The importance of maintaining reactivity control and core cooling at all times, including the period when the plant is not in operation, should be stressed.

5.17. Control room operators should also be trained in plant diagnostics, control actions, administrative tasks and human factors such as attitudes and human–machine and human–human (teamwork) interfaces. Shift supervisors should additionally be trained in supervisory techniques and communication skills. Their training should, in general, be more broadly based than that of other operators.

5.18. Operators should also be trained to be aware of the locations of all significant amounts of radioactive material in the plant, and of the controls to be applied to them.

5.19. Operators should be trained in routines for normal operation of the plant and in the response of the plant to changes that could cause accidents if not counteracted. The training programme should improve the diagnostic skills of the

trainees. Operating procedures for normal operation and for anticipated operational occurrences and, as far as practicable, severe accident conditions should be included in the programme and should be practised at the simulator, so that the trainees recognize the negative consequences of errors or of violations of procedures.

5.20. Field operators should receive training commensurate with their duties and responsibilities. All personnel in this category should have detailed knowledge of the operational features of the plant and hands-on experience. This knowledge should cover both the control rooms and the plant as a whole.

5.21. Since shutdown or low power operating states contribute significantly to the risk of core degradation, the training for plant maintenance, plant modification, low power operating states or shutdown should be emphasized. It should be noted that these situations sometimes place the plant in unusual system line-ups and make extra demands on the knowledge and skills of the operations staff. Training in advance of these activities can reduce the risks to the plant and to workers.

TRAINING PROGRAMMES FOR MAINTENANCE PERSONNEL

5.22. Training programmes for maintenance personnel should emphasize the potential consequences for safety of technical or procedural errors. Experience of faults and hazards caused by errors in maintenance procedures and practices at the plant, or at other plants and in other industries, should be reviewed and taken into account in the training programmes as appropriate.

5.23. Training programmes for maintenance personnel should cover the plant layout and the general features and purposes of plant systems as well as quality assurance and quality control, maintenance procedures and practices including surveillance and inspection, and special maintenance skills. An appropriate emphasis should be placed on safety culture in all aspects of the training for maintenance personnel.

5.24. Controls should be established to ensure that maintenance personnel are qualified to operate the equipment on which they are assigned to work. This qualification could be based on training given by the component manufacturer, training on equipment mock-ups or on the job training under the supervision of experienced staff. Maintenance personnel should have access to mock-ups and models for training in those maintenance activities that have to be carried out quickly and cannot be practised with actual equipment.

5.25. Past incidents relating to poor maintenance practices should be recreated in the training on a mock-up that can reproduce complex situations (involving difficulties with technique, access or radiation exposure). The reaction capabilities of maintenance personnel in these situations and the lessons learned from experience can thus be evaluated. Such training can be used to develop and improve competences in technical areas and human factors.

5.26. The concept of 'just in time' training can be considered a cost effective way to accomplish some of the training of maintenance personnel. Specific task oriented training should be included in the work schedule and should be provided shortly before the relevant task is performed (weeks or days prior to performing the work).

TRAINING PROGRAMMES FOR OTHER TECHNICAL PERSONNEL

5.27. Personnel involved in chemistry, radiation protection, nuclear engineering or other technical functions should undergo qualification and receive training as appropriate to their jobs and responsibilities. Their training should be determined by a systematic approach as described in paras 5.16–5.26 for operators and maintenance personnel.

5.28. Technicians may be assigned to carry out work similar to their own at other plants or with equipment suppliers. Emphasis should be placed on the development of specific skills, with classroom training limited to essentials. In some cases, laboratories and simulators may need to be established to impart basic and specific skills. Consideration should be given to having training courses organized by equipment suppliers, particularly suppliers of safety related equipment.

5.29. Craftspersons should undergo general employee training and overall plant training. The main objective should be to impart and develop the basic and specific skills required for work on the installed equipment. Methods to achieve this objective could include attaching persons to suppliers of equipment and components and to construction groups. Some basic skills may also be developed with the help of simulators.

5.30. In addition to the training described above, some technical personnel including managers and technical specialists, technicians and craftspersons may require additional technical knowledge and skills that are not normally recognized as basic to safety, but which provide these personnel with extra tools in the promotion of safety. Achieving these training goals may involve cross-training in other jobs at the plant, computer literacy in a variety of programs and just in time special training for special projects.

TRAINING PROGRAMMES FOR THE TRAINERS

5.31. Training instructors, on and off the site, should have the appropriate knowledge, skills and attitudes in their assigned areas of responsibility. They should thoroughly understand all aspects of the contents of the training programmes and the relationship between these contents and overall plant operation. This means that they should be technically competent and show credibility with the trainees and other plant personnel. In addition, the instructors should be familiar with the basics of adult learning and a systematic approach to training, and should have adequate instructional and assessment skills.

5.32. All staff of the training unit, as well as simulator and technical support engineers, technicians and instructors, should be given training commensurate with their duties and responsibilities. In all cases the training should be subject to some form of quality control. Instructors should also be allowed the time necessary to maintain their technical and instructional competence, by secondment or attachment to an operating plant on a regular basis, and by continuing training.

5.33. Personnel in the on-site training unit should also be properly trained in matters concerning the policies of the operating organization, in particular safety management and safety culture, regulatory requirements and quality assurance.

5.34. Training provided by external organizations should be evaluated to ensure that it meets the needs at the plant and that its quality is consistent with the standards of the on-site training unit.

REVIEW AND MODIFICATION OF TRAINING PROGRAMMES

5.35. The training plan should be periodically reviewed and modified as necessary. The review should cover the adequacy and effectiveness of the training with respect to the actual performance of employees in their jobs. The review should also examine training needs, training programmes, training facilities and the training materials necessary to deal with changes to regulations, modifications to the facility and lessons learned from experience in the industry.

5.36. The internal review of training undertaken at the plant or by the operating organization should be an integral component of the on-site training system. The review should cover all stages of the training system, the analysis of training needs, and the design, development and implementation of the training programmes. Training records should also be reviewed. Such a review should be undertaken by

persons other than those directly responsible for the training. Plant managers should be directly involved in the evaluation of training programmes. Close co-operation should be maintained in the training evaluation process between the plant management, individual departments and the training unit.

5.37. Operating experience should be considered when reviewing and modifying training programmes. Examples of sources of information on the effectiveness of training programmes and on factors influencing training needs are as follows:

— new plant equipment;
— new or revised procedures;
— new regulatory requirements;
— feedback from:
  • employees
  • supervisors
  • trainees
  • instructors
  • programme evaluations;
— plant or industry events, root cause analysis and corrective actions;
— problems in the training process, including failure of trainees in the assessments;
— deficiencies in the performance of personnel;
— new job standards or training standards;
— team issues (relating to command, control and communication);
— the need for maintaining operational expertise and corporate memory.

5.38. There may be cases where a change in the training programme (or modification of the plant reference simulator) would be appropriate before modification of the plant or of a plant procedure in order to provide adequate training for operations personnel. Training programmes should be reviewed and training needs determined for any plant modifications or changes. Trainers should also regularly visit plants and work areas to observe the performance of employees, in order to improve their understanding of specific training needs.

5.39. A system should be established which routinely provides information to the training unit on proposed plant modifications or changes in plant procedures, so as to allow for an appropriate follow-up action. This is particularly important in relation to simulator training. The time needed to modify simulator hardware and software can be significant; hence, an effective system should be in place for the transfer of information on approved proposals and details of the subsequent implementation, if timely training is to be provided.

5.40. Activities and practices in operating and maintenance, and compliance with industrial and radiological safety standards, should be monitored to identify any problems due to incorrect or insufficient training.

5.41. Operating organizations should make every effort to analyse events in order to identify underlying root causes relating to human factors. The results of such analyses should be fed back as appropriate into relevant training programmes. Plant event reports and industrial accident reports can identify tasks in which inadequate training may be contributing to equipment damage, excessive unavailability, unscheduled maintenance, a need for repetition of work, unsafe practices or a lack of adherence to approved procedures. This information should be supplemented by means of interviews with those concerned.

5.42. Trainees and trainers can provide useful feedback for improving the training programmes. A questionnaire completed by trainees and trainers after major training elements should focus on the effectiveness of the training and on ways in which it could be improved.

5.43. On the basis of the results of evaluations, an action plan to improve and correct the training programmes should be developed and implemented. This may lead to improvements in the conduct of training or to changes in the training programmes.

5.44. An independent review of the plant's training plan should be carried out by external organizations. The external review should be considered complementary to the internal evaluation in giving a different perspective to the evaluation of training programmes. The results of the external review should be integrated with the results of the internal evaluation, to identify necessary changes and improvements in the training programmes.

6. TRAINING FACILITIES AND MATERIALS

6.1. Adequate facilities should be available for classroom training, computer based training and individual studies. Appropriate training materials should be provided to help the trainees understand the plant and its systems. Detailed technical information to be used as reference material should also be available at the training facilities. The effectiveness of classroom training should be enhanced by the use of visual aids.

6.2. Consideration should be given to the use of computer based multimedia training packages and distance learning techniques.

6.3. Representative simulator facilities should be used for the training of control room operators and shift supervisors. Simulator training should cover normal, abnormal and accident conditions.

6.4. In some States, central training facilities are available and have proved to be beneficial. The use of training facilities located in other States may involve the additional need for trainees to learn a foreign language and to master different systems of drawing standards and component identification. The use of non-reference plant simulators, on the other hand, creates an additional need to ensure, by examination or another method, that trainees are aware of the limited usefulness of some of the information given in training on a device with an instrument configuration and performance characteristics that are different from their actual working environment.

6.5. Even if off-site training facilities are to be used, a training unit should still be included in the plant organization. The training unit should advise the plant manager on all matters relating to training, co-ordinate training activities on the site, ensure proper liaison with off-site training facilities, and collect records of the satisfactory completion of initial training and continuing training of individuals.

6.6. Maintenance and technical support personnel should have access to workshops, laboratories and facilities that are equipped with mock-ups, models and actual components that enable them to be trained in activities that cannot be practised with installed equipment (because of high dose rates, for example).

6.7. A procedure should be in place for the periodic review and timely modification and updating of training facilities and materials, to ensure that they accurately reflect all modifications and changes made to the plant.

7. AUTHORIZATION

7.1. Formal authorization is the granting of written permission, usually by a regulatory body or other entity as may be designated by a State, to perform specified activities and to discharge specified responsibilities, or the document granting such permission.

7.2. The term authorization, as used in this section, indicates both authorization by the operating organization and the formal authorization issued by the regulatory body.

7.3. In some States, the regulatory body requires documented evidence of the competence of persons not authorized by the regulatory body whose duties may have a significant, though not necessarily immediate, bearing on safety.

7.4. The operating organization, in discharging its responsibilities for safe operation, should establish procedures by which persons controlling or supervising changes in the operational status of the plant, or with other duties having a direct bearing on safety, should be authorized before they are allowed to perform these duties. In States where formal authorization by the regulatory body is required for specific plant positions, this formal authorization is required to be obtained before the incumbent may be authorized by the operating organization to commence the duties assigned.

7.5. The procedures referred to in para. 7.4 should provide for an assessment of the competence of persons to be authorized. This competence should specifically include a thorough knowledge of the established safety rules and regulations, knowledge of the particular plant and its safety systems, and the knowledge and skills necessary to perform the assigned duties safely.

7.6. Persons occupying positions referred to in para. 7.4 should hold a formal authorization issued by the regulatory body or by another entity (see para. 7.2) acknowledged by the regulatory authority as the competent authority. In some States, a proposal as to positions for which personnel are required to be authorized by the regulatory body has to be submitted to the regulatory body for approval.

7.7. Work on safety related structures, systems or components carried out by contractor personnel should be authorized and monitored by a representative of the operating organization who meets the competence criteria established for such work.

7.8. As a minimum, the persons who occupy the following positions should be formally authorized:

(1) The shift member(s) designated to directly supervise operation of the plant or of the unit and who decides on safety related measures during normal operation, incidents or accidents, gives commands to the shift and is responsible for the safe performance of the unit (that is, the shift supervisor and the deputy shift supervisor, who may take over these functions).
(2) Operators who handle safety related instrumentation and control equipment (that is, the reactor control room operator).

7.9. In addition, consideration should be given to making it a requirement for persons in designated positions such as plant manager, heads of operations and

maintenance, directors in technical support and engineering, and certain categories of operators (other than reactor control room operators) to be formally authorized in accordance with national regulatory policies.

7.10. In the assessment of an individual's competence as a basis for an authorization, documented and approved criteria should be used. These criteria should include, but are not limited to, the following areas:

— knowledge of the established safety rules and regulations as appropriate for the job;
— technical, social, administrative and management knowledge and skills as appropriate for the job;
— required education, training and experience;
— measurements of job performance.

In addition, medical fitness for duty should be required.

7.11. If an authorized individual moves to a different plant or to a different position in the same plant for which an authorization is also required, plant specific requirements should be satisfied before the new position is assumed.

7.12. Consideration should be given to the need for periodic re-authorization as well as for re-authorization of individuals who are to resume authorized duties after an extended period of absence. The authorization is generally subject to periodic reviews (at intervals of 2–3 years) of the competence of the authorized person and may be withdrawn, or may not be extended, if the required conditions are no longer met. Renewal or extension of the authorization should, in all cases, be subject to acceptable results of a recent medical examination.

7.13. Particular consideration should be given to re-authorization if a person in a safety related assignment has been away from that assignment for some time and changes in the plant, in procedures or in other factors have occurred, since this could represent a threat to safety. Such a re-authorization can be approached in a graded fashion, and time and expense could possibly be saved by means of targeted training and assessments.

Appendix I

ATTITUDES AND SKILLS FOR SAFETY CULTURE

The following are examples of the specific attitudes and skills that should be taken into consideration in selecting personnel for safety related positions at a plant, in addition to the qualification requirements and the training programmes to be undergone.

(a) Attitudes:

— pre-eminence of safety over production;
— recognition and demonstration of the operating organization's commitment to safety;
— knowledge of safety issues in terms of general plant and personnel safety, as well as a detailed and current knowledge of the specific safety issues of the work assignment.

(b) Communication abilities:

— interfacing with staff at the plant;
— interfacing with external organizations or groups;
— informing the staff and management of plant conditions;
— conducting group presentations or meetings;
— writing operational reports, procedures and other documents;
— reporting problems and identifying solutions.

(c) Teamwork and team building abilities:

— promoting teamwork and applying team skills (person–person interfacing);
— demonstrating respect for individuals;
— requesting necessary assistance and guidance.

(d) Management and supervisory abilities:

— enforcing standards of safety performance;
— using mentoring, coaching and teaching methods with subordinates and trainees;
— demonstrating initiative and perseverance;
— applying informed judgement;

— motivating subordinates;
— supervising subordinates;
— counselling subordinates;
— conducting performance appraisals of personnel;
— providing constructive feedback;
— applying assertiveness skills;
— planning and organizing work.

(e) Leadership skills:

— demonstrating composure during abnormal events and emergencies;
— assisting colleagues in need of support;
— advocating and demonstrating an attitude of safety awareness;
— promoting a constructive, questioning attitude;
— exhibiting a positive, constructive attitude;
— establishing an environment that encourages the reporting of problems to supervisors.

(f) Analytical abilities:

— applying fundamental means of problem solving;
— establishing priorities;
— recognizing risks and possible consequences.

(g) Psychological features:

— skills in stress management;
— capacity to recognize aberrant behaviour of colleagues and subordinates;
— self-control;
— insight;
— positive personal traits and characteristics suitable for working in a team and in stressful situations.

Appendix II

ASPECTS OF SAFETY CULTURE IN INDIVIDUALS

The following are examples of aspects of safety culture in individuals [9] that should be taken into consideration in selecting personnel for safety related positions at a plant, in addition to the qualification requirements for safety related jobs and the contents of the training programmes for personnel involved in safety related activities.

(a) A questioning attitude before commencing any safety related task:

— understanding the task;
— understanding personal responsibilities;
— appreciating the safety significance of the task;
— understanding the responsibilities of others;
— an appropriate attitude towards unusual circumstances;
— being prepared to seek assistance;
— anticipating what may go wrong;
— assessing the possible consequences of failure or error;
— preplanning for any measures intended to prevent failures;
— preplanning of personal actions in the event of a fault.

(b) A rigorous and prudent approach to working at the plant:

— understanding the work procedures;
— complying with the procedures;
— being alert to unexpected occurrences;
— stopping and thinking if a problem arises;
— seeking help if necessary;
— demonstrating orderliness, timeliness and housekeeping skills;
— proceeding with deliberate care;
— forgoing shortcuts.

(c) A communicative approach to other staff:

— obtaining useful information from others;
— transmitting information to others;
— reporting on and documenting the results of work, both routine and unusual;
— suggesting new safety initiatives.

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GLOSSARY

authorization. The granting by a regulatory body or other governmental body of written permission for an operator to perform specified activities. The term authorization is also sometimes used to describe the document granting such permission.

commissioning. The process during which systems and components of nuclear power plants, having been constructed, are made operational and verified to be in accordance with the design and to have met the required performance criteria. Commissioning may include both non-nuclear and nuclear testing.

licence. A legal document issued by the regulatory body granting authorization to perform specified activities related to the siting, design, construction, commissioning, operation or decommissioning of a nuclear power plant.

licensee. The holder of a current licence.

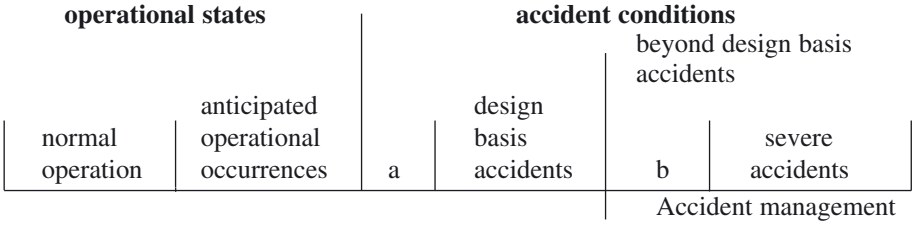
operating organization. The organization applying for authorization or authorized to operate a nuclear power plant and responsible for its safety.

operating personnel. Individual workers engaged in the operation of a nuclear power plant.

operation. All activities performed to achieve the purpose for which a nuclear power plant was constructed. This includes maintenance, refuelling, in-service inspection and other associated activities.

operational limits and conditions. A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of a nuclear power plant.

plant states.



a: Accident conditions which are not explicitly considered design basis accidents but which are encompassed by them.

b: Beyond design basis accidents without significant core degradation.

accident conditions. Deviations from normal operation more severe than anticipated operational occurrences, including design basis accidents and severe accidents.

accident management. The taking of a set of actions during the evolution of a beyond design basis accident:

— to prevent the escalation of the event into a severe accident;
— to mitigate the consequences of a severe accident; and
— to achieve a long term safe stable state.

anticipated operational occurrence. An operational process deviating from normal operation which is expected to occur at least once during the operating lifetime of a nuclear power plant but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety or lead to accident conditions.

design basis accident. Accident conditions against which a nuclear power plant is designed according to established design criteria, and for which the damage to the fuel and the release of radioactive material are kept within authorized limits.

normal operation. Operation within specified operational limits and conditions.

operational states. States defined under normal operation and anticipated operational occurrences.

severe accidents. Accident conditions more severe than a design basis accident and involving significant core degradation.

regulatory body. An authority or a system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

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