

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

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IAEA SAFETY STANDARDS

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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".

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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 be considered in order to ensure that the operating organization has a sufficient number of qualified personnel for safe operation of a nuclear 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.