Nuclear Power Plant Personnel Training and its Evaluation
A Guidebook
Executive Summary

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1996
NUCLEAR POWER PLANT
PERSONNEL TRAINING
AND ITS EVALUATION

A Guidebook

Executive Summary
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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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NUCLEAR POWER PLANT PERSONNEL TRAINING AND ITS EVALUATION

A Guidebook

Executive Summary

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 1996
FOREWORD

A central challenge and requirement for ensuring the safety and reliability of nuclear power is to attain and maintain the qualification and competence of nuclear power plant (NPP) personnel, which includes operations, maintenance, management and technical support personnel. The objectives of safety and reliability cannot be achieved solely by the quality of equipment and hardware, but depend critically also on sufficient numbers of personnel having the necessary qualification and competence to carry out their tasks and responsibilities.

The Guidebook on Nuclear Power Plant Personnel Training and its Evaluation recommends the use of the Systematic Approach to Training (SAT) for NPP personnel. The Guidebook is a revision and updating of the IAEA Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel (IAEA-TECDOC-525) and incorporates the experience gained worldwide since the publication of IAEA-TECDOC-525 in 1989.

The Executive Summary of the Guidebook is aimed especially at providing policy makers and top management with the main recommendations and information contained in the Guidebook. The Executive Summary is published by the IAEA in English, French, Spanish and Russian.

SAT is now recognized as the international best practice for attaining and maintaining the qualification and competence of NPP personnel and for the quality assurance of training. SAT can and should be adapted to suit the specific requirements and conditions of individual countries and NPPs, utilizing and building upon existing capabilities. It also incorporates aspects that promote a safety culture among staff and management. Regulatory bodies in a number of countries mandate or strongly recommend the use of SAT based training for NPP personnel.

Experience has shown that, to attain professional competence, SAT should comprise training to achieve both the necessary technical and human factors competencies. Thus, the new Guidebook emphasizes a broader concept of competence which includes not only technical knowledge and skills but also knowledge, skills and attitudes related to human factors. In addition to the training of operating personnel, the Guidebook deals with the role and responsibilities of management; the training of management and maintenance personnel; organizations involved in training; and more effective and efficient methods of SAT analysis. It also emphasizes and covers evaluation of the overall training process, as well as providing examples of SAT applications.

The Guidebook will prove especially useful for, and is addressed primarily to: nuclear power operating organizations establishing or upgrading their NPP personnel training systems; regulatory personnel responsible for setting requirements and/or evaluating NPP personnel training; and organizations (within or outside the operating organization) responsible for the development, implementation and evaluation of training programmes for NPP personnel.
This Technical Report was initially drafted by the IAEA Secretariat working with a small group of consultants. Further development of the document incorporated comments from ten Member States at four Consultants Meetings. The document was widely circulated for additional comments. The final draft was prepared by S. Birnie (UK), P. Billard (France), A.Yu. Kazennov (Russian Federation), T. Mazour (USA), P. Pianarosa (Canada) and F. Mautner Markhof of the Nuclear Power Engineering Section, Division of Nuclear Power, the IAEA officer responsible for this report. The final revision was reviewed and approved at the Advisory Group Meeting in which experts from 16 Member States and the CEC participated.

The IAEA acknowledges with thanks the extrabudgetary contribution of the United States Government for the project to develop the Guidebook. Appreciation is also expressed to all those who participated in the preparation of the Guidebook and to Member States for their support in providing experts from operating organizations, NPPs, training organizations and regulatory bodies to assist the IAEA in this work.
1. INTRODUCTION

1.1. PURPOSE OF GUIDEBOOK

One of the most critical requirements for safe and reliable nuclear power plant (NPP) operations and maintenance is the availability of sufficient numbers of competent personnel. Experience has shown that, in addition to the quality of the design and equipment, personnel competence is essential to ensure safety and reliability.

This Guidebook on Nuclear Power Plant Personnel Training and its Evaluation constitutes the recommendations of the IAEA on the use of the Systematic Approach to Training (SAT) for the training of NPP personnel. The Guidebook is a revision of IAEA-TECDOC-525, Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel. This new Guidebook incorporates the results of nearly six years of worldwide experience in the use of SAT for NPP personnel training since the publication, in 1989, of IAEA-TECDOC-525.

SAT is an approach to training that provides a logical progression from the identification of the competencies required to perform a job to the development and implementation of training to achieve these competencies, and the subsequent evaluation of this training.

In this context, NPP personnel includes those performing operating, maintenance, technical support and management jobs.

Experience has shown that SAT is the best method now available for producing fully auditable training programmes for NPP personnel. These programmes aim at developing competent personnel and at ensuring that their qualifications and competence are maintained. It is recognized and emphasized that SAT is not an end in itself but the most effective means of achieving the level of competence required for NPP personnel.

The Guidebook is addressed primarily to:

- Nuclear power operating organizations wishing to establish or improve the training systems for NPP personnel;
- Regulatory personnel responsible for setting requirements and/or evaluating NPP personnel training;
- Organizations (within or outside the operating organization) involved in the development, implementation and evaluation of training programmes for NPP personnel.
1.2. SCOPE OF GUIDEBOOK

1.2.1. Approach to training

The Guidebook addresses what SAT is and gives examples of SAT applications. Furthermore, it provides the basis for the transfer of knowledge to countries seeking to develop or upgrade their training for NPP personnel.

On the basis of experience gained worldwide, it is now agreed that SAT should be considered as a broad integrated approach emphasizing not only technical knowledge and skills but also human factors knowledge, skills and attitudes (KSAs). In this way, all of the requirements for attaining and maintaining personnel competence can be met. This also promotes and strengthens safety culture and quality culture, which should be fostered throughout the initial and continuing training programmes, as well as through other means.

The Guidebook places emphasis on such areas as: maintenance training, the role and responsibilities of management, emergency preparedness training, organizational aspects of training, and human factors KSAs required for competence.

In particular, this Guidebook provides an alternative to job and task analysis for the analysis phase of SAT. This alternative, referred to as job competencies analysis, does not require such large amounts of time, financial and human resources. The method permits, where appropriate, a streamlined analysis based on identifying competencies (groups of KSAs) associated with a given job.

The critical role of operating personnel has been rightly emphasized by every country with a nuclear power programme, and training programmes and resources have reflected this. Despite the fact that the competence of maintenance personnel is essential for reducing the frequency of events connected with equipment failures and other maintenance-related causes, maintenance training has received far less attention and resources to date. There is now widespread agreement that training for maintenance personnel must be improved through, among other things, the use of SAT to develop these training programmes or to bring them up to date.

1.2.2. Evaluation of training programmes

This Guidebook contains the IAEA’s recommendations and guidance on the overall evaluation of the entire training process including the organization and management of training.

The evaluation phase of SAT includes:

- Feedback from plant operational experience and industry wide operational experience;
- Reports from inspections and audits;
• Feedback from plant supervisors, training programme graduates, instructors and trainees;
• Observation of training and plant activities and other internal reviews.

Evaluation comprises not only internal evaluation by the operating organization but also independent (external) team review by experts not in the operating organization using agreed criteria, as well as regulatory inspections. The results of evaluation are used to confirm, improve or modify the training programmes and training process. Additionally, necessary plant improvements may be identified.

1.2.3. Quality assurance of training programmes

SAT has inherent quality assurance (QA) features, and its use, therefore, leads to an auditable training system. The implementation of SAT also assists NPP management to achieve QA of training. SAT is thus a valuable tool in the overall NPP QA programme. It must be emphasized, however, that neither SAT nor its QA features can be successfully implemented without the full support of upper level NPP management.

1.2.4. Introduction and use of SAT

The introduction of SAT will require adequate numbers of personnel having the necessary technical and teaching competence.

SAT is widely used or being introduced in almost all countries with major nuclear power programmes. It is a flexible approach which can and should be adapted to the specific needs, conditions and resources of individual NPPs.

For implementing a SAT based training programme, this Guidebook provides important recommendations and information. Nevertheless, it is not intended that the Guidebook alone should be sufficient for this purpose. It needs to be used in conjunction with expert advice and assistance as well as know-how transfer through technical visits of NPP and other training staff involved.

2. SAT METHODOLOGY OVERVIEW

This Guidebook provides guidance in the use of SAT methodology for the training of NPP personnel and a description of the activities, input and output of each phase of SAT. The experience of many countries and NPPs in the use of SAT has been taken into account in developing this guidance.
SAT Definition

An approach that provides a logical progression from the identification of the competencies required to perform a job to the development and implementation of training to achieve these competencies, and subsequent evaluation of this training.

SAT is a methodology which applies QA to training and thus assures NPP personnel competence. The use of SAT offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control. With a systematic approach to training, the competence requirements for all jobs in an NPP can be established and met. Furthermore, with SAT based training, it can be demonstrated that all required competencies have been attained.

Without SAT, there is the risk that important elements of training will be omitted, which would adversely affect the safety and reliability of the plant. There is also the potential that programmes will be too extensive for the needs of the job, with the consequent cost implications and loss of trainee motivation. Furthermore, the increased control and accountability features of the SAT process provide management as well as the regulator with the means of applying standard QA procedures and processes at any stage of the training process. The regulator may still require a certain number of examinations to license individuals in some specific positions. However, the requirement for the training process to conform with the plant QA programme provides management and the regulator with far greater confidence in the qualifications and competence of personnel than that provided by a purely examination driven assessment.

FIG. 2.1. Overview of the SAT process.
An overview of the SAT process is given in Fig. 2.1. SAT consists of five interrelated phases, which are:

ANALYSIS

This phase comprises the identification of training needs and of the competencies required to perform a particular job.

DESIGN

In this phase, competencies are converted into training objectives. These objectives are organized into a training plan.

DEVELOPMENT

This phase comprises preparation of all training materials so that the training objectives can be achieved.

IMPLEMENTATION

In this phase, training is conducted by using the training materials that have been developed.

EVALUATION

During this phase, all aspects of training programmes are evaluated on the basis of the data collected during each of the other phases. This is followed by suitable feedback leading to training programme and plant improvements.

Experience has shown that implementing procedures are needed for each of the SAT phases so that the process is implemented in such a way as to ensure quality and consistency. These procedures must specify in detail the steps to be taken to carry out the phase and identify the responsibilities and qualifications of personnel performing the work.

It is absolutely essential for instructors to have both technical and teaching competence.

Figure 2.2 shows how the SAT process is related to NPP operation.

To introduce SAT, the main inputs and prerequisites are:

• Firstly, plant management's recognition of the need for establishing, updating and/or improving NPP personnel training programmes;
• Secondly, plant organization and job descriptions;
• Thirdly, plant and operating and maintenance documentation, for example, system descriptions, operating instructions, emergency operating procedures, inspection manuals (as well as job descriptions and responsibilities for each job position).
The better the plant and operations documentation is, the more easily the development and implementation of SAT based training can be carried out.

In the case of an NPP in the planning stage, documentation from a reference plant (if there is one) or from a plant of similar design should be obtained.

For the development of training programmes, information is needed on a continual basis from:

- Plant documents
- NPP performance indicators
- Industry operational experience
- Equipment and procedure modifications.

Evaluation of training programmes will often identify needed improvements in plant procedures, equipment and organization. The overall goal of both the SAT process and the NPP is personnel with the necessary competence to operate and maintain the NPP. This relationship between SAT and the NPP is applicable to both new and existing plants.

Figure 2.3 provides a concise, coherent overview of SAT processes and products, and summarizes the most important inputs and outputs for each SAT phase from sources internal and external to the SAT process.
The Guidebook on Nuclear Power Plant Personnel Training and its Evaluation represents the official IAEA guidance on the training of NPP personnel using the systematic approach to training, and also provides information on SAT applications for the training of operating personnel, maintenance personnel, management, emergency preparedness and instructors, and on project management to introduce SAT based training.
3. THE ROLE OF MANAGEMENT

This section is primarily addressed to the management of the operating organization and to plant management. It describes the role and responsibilities of management for the training and competence of NPP personnel.

3.1. RESPONSIBILITIES OF THE OPERATING ORGANIZATION AND PLANT MANAGER

The operating organization is responsible for the recruitment and training of NPP personnel and for the definition of competence levels. Only qualified persons shall be entrusted with functions important to safety. These functions and the related duties and responsibilities shall be clearly indicated in the description of the operating organization. The responsibility for ensuring that individuals are appropriately qualified and remain so rests with the operating organization (for reference, see IAEA Safety Guide 50-SG-01, Rev. 1).

These responsibilities are generally delegated to the plant manager by the operating organization. In general, regulators hold plant managers accountable for discharging these responsibilities.

The operating organization management is responsible for providing the financial and organizational means to fulfil the goals of NPP personnel training in an efficient and effective manner.

The plant manager has the overall responsibility for, and plays an important role in, the development and implementation of training programmes to ensure the qualification and competence of NPP personnel. These responsibilities include: establishing qualification requirements, meeting regulatory requirements, monitoring training programmes, providing necessary resources, maintaining competence, and effective human resources policy and management.

While the plant manager is ultimately responsible for NPP personnel performance, he defines and assigns in writing many of these responsibilities to plant departments and then holds the managers of these departments accountable for carrying out their assigned responsibilities. These managers should then develop precise job descriptions for all positions within their departmental areas, detailing responsibilities and standards of performance for each position.

The attitude of plant management towards the training and qualification of NPP personnel is another important factor in safe and reliable plant operation. If plant management does not actively support and reinforce the standards for safety and quality established for training programmes, these standards will not be applied at the NPP. For example, if safety training teaches trainees the proper use of personnel protective equipment but these practices are not enforced in the plant, then the effectiveness of
all training and qualification programmes is reduced. This example also illustrates the relationship between training and safety culture. This relationship will be discussed in more detail in Section 3.4.

3.2. RESPONSIBILITIES FOR TRAINING

The responsibilities for providing training to attain and to maintain NPP personnel competence are assigned to a variety of groups (within and outside the plant). Many operating organizations have established training organizations to which some of these responsibilities are assigned. One of the reasons why operating organizations establish training organizations is that training requires specialized personnel. SAT evaluation provides an effective mechanism for determining that responsibilities for training are being met.

It is necessary for the training policy to define the responsibilities and authorities of the plant manager and those assigned by him to the plant department managers and to the plant training manager for all aspects of the training and qualification of NPP personnel. The division of responsibilities and authorities must emphasize clarity and appropriateness.

It is important to note that, depending on the specific organizational arrangement for training in an individual country, various tasks can be assigned not only to plant departments but also to a central training organization run by the operating organization. In some instances, training organizations external to the operating organization may be used. Whatever organizational arrangement exists for training, the final responsibility for personnel competence lies with the plant manager. (For further information, see IAEA Safety Series SS 50-SG-01, Rev. 1 on Staffing of Nuclear Power Plants and the Recruitment, Training and Authorization of Operating Personnel).

Plant manager responsibilities

- Define and assign responsibilities and authorities of all plant organizational units which report directly to the plant manager, including responsibilities for training and qualification of NPP personnel;
- Meet relevant regulatory and other requirements;
- Establish appropriate qualification requirements and standards of performance for all NPP jobs;
- Analyse training needs and develop overall training programmes;
- Understand the principles and good practices of training system development and implementation;
- Monitor, evaluate and control performance of all plant activities including those related to training and qualification;
- Recruitment, retention and career development of NPP personnel;
• Provide or arrange for, together with the operating organization, the necessary resources and staff to implement training policy and programmes, including the adequate training and compensation of trainers;
• Create a mechanism to involve qualified NPP personnel in training activities;
• Maintain personnel competence, e.g. through continuing training.

Plant manager responsibilities typically assigned to plant department managers

• Define job specific training needs;
• Determine which individuals should participate in training modules;
• Provide subject matter expert (SME) support for the analysis, design and development of training for NPP personnel;
• Approve the content and scheduling of all training programmes for NPP personnel;
• Provide on the job training (OJT) for their personnel based on approved training plans;
• Ensure that their personnel are provided all training needed for their job assignments;
• Assist in the implementation of training as SMEs and OJT instructors;
• Perform in-plant training;
• Make final decision on the qualification of their personnel considering the training organization’s assessments;
• Make job assignments based upon successful completion of required training and attainment of the required qualifications;
• Monitor the performance of training programmes;
• Perform regular competence checks;
• Identify emerging training needs for their personnel.

Plant manager responsibilities typically assigned to the plant training manager¹

• Co-ordinate all training for NPP personnel, including that provided by external sources;
• Lead the analysis, design and development of all training for NPP personnel including OJT;
• Procure and maintain all training tools, equipment, materials, including simulators and mock-ups;
• Provide a programme for training and qualification of all instructors in technical and teaching abilities, including those who provide training in the plant;
• Provide QA of training from internal and external sources;
• Assess trainees;

¹ Some tasks of the plant training manager may be assigned to external training organizations.
• Lead overall training evaluation and feedback process, with continual support from, and interaction with, plant departments for which training is provided;
• Provide periodic reports to the plant manager and plant department managers on the results of evaluation of training programmes;
• Maintain records on the training and qualification of all NPP personnel, contractors, and non-plant staff which have functions to perform at the plant.

3.3. TRAINING POLICY

The IAEA's Report on Safety Culture, INSAG-4, states that actions by individuals in any activity are shaped by requirements imposed at a higher level. At NPPs, these requirements are stated as policies. It is necessary that the operating organization formulate and promulgate an overall training policy — in the form of a written document — dealing with the training, qualifications and performance of NPP personnel. This policy is the commitment by the operating organization and the NPP to personnel training and an acknowledgement of the critical role of training for the safe, reliable operation and maintenance of the NPP. This section describes the characteristics of such a policy.

The operating organization should clearly define the responsibilities for all aspects of the training process. This information on responsibilities should be included in the training policy and in the written procedures for SAT.

For organizations which operate several NPPs, the overall training policy is formulated at the operating organization level, with individual NPP policies based on the overall policy. Policies at all levels need to be consistent with the overall policy and with each other, the policy at each level being based upon that of the level above. Also, in some countries, there are national level policies on which individual NPP training policies must be based.

The training policy should be consistent with (and may also refer to) other policies, such as those for:

• Safety
• Quality
• Human resources
• Environmental protection
• Recruitment of personnel
• Career development and motivation of personnel
• Co-operation to create the necessary plant attitudes.

Training policy should be based upon the longer term needs and goals of the NPP. However, the policy should be evaluated at regular intervals in order to ensure that it is consistent with current needs and goals. Factors which can change a training policy include: operational experience and events at the NPPs of the operating organization or at other plants, significant backfitting of the plant, commissioning or decommissioning of a plant, NPP reorganization, and modifications in the national education system.
The training policy should reinforce the principle that training organizations exist only to serve the needs of the plant(s) which they support, and that the training process must be flexible and responsive enough to keep pace with organizational and technological changes, and with national and international operational experience.

There must be regular and mutually co-operative interactions and communications between the plant organization and the training organization, including the use of plant personnel for specific training functions.

The essential components of a training policy are the following:

- Goals and scope of training;
- Responsibilities for training;
- Monitoring, evaluation and control of the performance of training.

The internationally agreed requirement for all personnel whose work may have an impact on safe and efficient NPP operation and maintenance is that they are qualified for, and competent to perform, their jobs, on the basis of their education, training and experience. SAT is now recognized worldwide as the best method of ensuring that personnel are appropriately qualified, because it:

- Identifies all the training needed for achieving competence;
- Provides QA of training and thus builds quality into training and qualification programmes;
- Provides tools for management to monitor, evaluate and control continually the effectiveness of training provided and the competence of NPP personnel.

It is recommended that the overall training policy or other high level document of the operating organization require the use of SAT for training personnel whose jobs impact safe and reliable NPP operation.

It is recognized that NPPs have differing requirements for their training programmes, which will need to be reflected in the training policy. For example, there are different NPP approaches to the use of outside contractors for maintenance of equipment. Some NPPs rely almost totally on their own employees for the performance of all maintenance, including outages, while other NPPs routinely use outside contractors, particularly for outage support. Those NPPs which make use of such contractors need to specify in their training policies how the quality of outside contractor personnel work will be ensured, for example by auditing the qualifications of these personnel. Also, the training policy should be adapted to the characteristics and quality of the national systems for theoretical and practical education.

The training policy needs to include the requirement to monitor, evaluate, control and report on training programme performance/quality and to identify organizational responsibilities for this. This is a necessary but not sufficient condition for the effective monitoring of training programmes. The plant manager and plant department managers need to make it clear to their personnel through their actions that they consider the
success of the training programmes to be their responsibility, even though much of the
training is provided by the training organization.

SAT is an ideal management tool for monitoring and controlling the quality of
training and other human performance activities, because inherent in the SAT process
is continual evaluation of the training programmes as well as assessment of the per-
formance of the trainees and job incumbents.

It is essential for training policy to be known, understood and supported by all
persons concerned. It is sometimes beneficial to have plant department managers and
the plant training manager take part in developing the training policy and implement-
ing procedures as a way of facilitating their acceptance of the policy.

Procedures for plant and training organizations concerning the development,
implementation and evaluation of training programmes must be governed by, and aim
at achieving, the goals of the training policy. These procedures then serve as an agree-
ment between the plant organization and the training organization and define the train-
ing that must be provided, and its quality. SAT provides a mechanism to elaborate this
agreement in a way that is consistently and clearly defined, on the basis of job specific
training needs.

The overall NPP training policy goals and scope should determine the training
requirements. It is sufficient to define a limited number of important goals.

Training policy and human resources policy

To be most effective, the training policy needs to be consistent with the human
resources policy (in some organizations, training is part of the human resources
policy). The human resources policy addresses areas such as recruitment and selec-
tion, career planning and development, and retention of personnel.

A gap between the competencies required for adequate job performance and the
actual performance of job incumbents can arise owing to:

- Changes in the jobs;
- Loss of training opportunities that previously existed such as plant
  commissioning;
- Loss of personnel through retirement.

Identifying and measuring this gap, which can be done by using SAT, is useful
for anticipating future personnel needs in human resources policy.

Therefore, training policy and human resources policy must be co-ordinated to
anticipate change and future personnel needs.

Constant striving to improve production efficiency, safety and reliability (and
thus quality) has led to an increasing emphasis on training for human factors in areas
such as communication, teamwork, reliability, man–machine interfaces, management/
supervision, and analytical methods. This emphasis on human factors has led to a need
for greater integration of training and human resource management activities.
It is well known that training is not effective unless trainees are motivated to learn. Job stability is an asset that the operating organization must use to find the right balance between internal promotion and external recruitment so as to sustain professional motivation. Thus, there are two inseparable, complementary components in motivating NPP personnel:

- Providing these personnel with career development prospects;
- Ensuring a positive connection between individual aspirations and the needs of the operating organization/NPP.

The career path should take into account the individual’s professional evolution in the job.

3.4. TRAINING AND SAFETY

It is important that the training and safety policies be co-ordinated. Training is an ideal way to promote safety culture and should therefore be fully encouraged and supported by plant management. Safety culture is a combination of attitudes on the priority of safety, together with KSAs about appropriate safety practices. The principal contributions which can be provided by training to the implementation and enhancement of safety culture are:

- Training programmes to explain the general attributes of safety culture;
- Job specific training to improve KSAs related to safety practices.

While general training programmes are useful, experience has shown that job specific training programmes can make an even more important contribution to safety culture.

Important for safety culture is knowledge about:

- Job specific safety issues such as use of appropriate safety equipment;
- Risks associated with task performance;
- Non-technical aspects of the job, such as use of proper work control methods.

These safety issues can be identified through SAT based analysis of training needs and can then be included in an integrated manner in job specific training programmes. This transforms safety culture from an esoteric concept to concrete actions that are integral to job performance. As indicated earlier, the appropriate attitude toward attaining, maintaining and enhancing safety is also necessary. Training on job specific safety aspects will only be successful if management reinforces safety culture through requiring its implementation as a routine part of job performance.
3.5. OPERATING ORGANIZATION INTERFACE WITH THE REGULATOR

One of the regulator's responsibilities is to ensure that NPP personnel who perform tasks important to safety are qualified to perform these tasks.

One of the principal objectives of NPP personnel training and qualification is to meet the relevant regulatory requirements. Among the most common regulatory requirements with respect to NPP personnel are those requiring licensing/authorization of control room operators and their supervisors. Other common regulatory requirements include training and qualification regarding safety related topics such as radiation protection and industrial safety.

SAT provides a mechanism for the operating organization to demonstrate to the regulator and, if required, to the public that personnel are competent. SAT is able to do this because it includes analysis of the job to identify needed competencies, training programmes based on achieving these competencies, and evaluation to ensure and demonstrate that these competencies have been achieved, as well as feedback from plant operation that identifies additional competencies that are needed.

The regulator needs to make independent determinations that NPP personnel are qualified to perform their assigned tasks. In making these determinations, it is very valuable if both the regulator and the NPP can agree upon the standard to which job performance and training programmes are to be evaluated. Where the regulator has accepted SAT as the appropriate approach to training NPP personnel, and this is the case in many countries with nuclear power programmes, the regulator will in general also accept the SAT methodology as a basis for its own evaluation of training programmes.

It is important for the NPP and training organizations to open the entire training process to the representatives of the regulator. These regulatory representatives should be encouraged to observe all aspects of training programme development and implementation. They should also be encouraged to share with plant management their questions and concerns about what they observe. The NPP can use these observations as inputs to the overall training programme evaluation process and can demonstrate to the regulator that its observations and concerns were appropriately taken into account.

Regulators in many countries already require or strongly recommend that SAT be used for NPP personnel training. In such cases of SAT based training, regulators have shifted their focus from prescribing detailed curricula in particular areas to an independent evaluation of the training identified as required and provided by the NPP.

Also, in those countries where SAT based training has been endorsed by the regulator, licensing examinations for selected positions, such as control room operators and shift supervisors, should be based on the operating organization's or NPP's job analyses and should be consistent with the related training objectives and the associated training materials.
4. THE ROLE OF TRAINING ORGANIZATIONS AND THE ORGANIZATION OF TRAINING

This section is primarily addressed to training organization managers and specialists and also to plant department managers and supervisors who interface with training organizations.

4.1. ORGANIZATION OF TRAINING

The operating organization must define all responsibilities for the training of NPP personnel, which should be included in the training policy document and in the written procedures for SAT. Various organizational arrangements for training have been used by different operating organizations.

The plant manager is ultimately responsible for ensuring that all the personnel involved in safety related work are competent. Therefore, the plant manager is responsible for ensuring that the personnel are adequately trained.

The plant manager will assign responsibility for certain aspects of the training process to other persons and/or organizations. Sometimes, nearly the whole training process is implemented by NPP staff and sometimes most of it is implemented by a central training organization run by the operating organization or by external organizations. Figure 4.1 presents a typical organizational arrangement for NPP personnel training.

![FIG. 4.1. Typical organizational arrangements for the training of NPP personnel.](image-url)
4.2. **INTERFACES BETWEEN PLANT MANAGER AND TRAINING ORGANIZATIONS**

For some NPPs, training organizations report directly to the plant manager. The plant training manager and plant department managers are peers. In this case, the plant manager is responsible for resolving conflicts between the potentially competing priorities of the training organizations and plant departments. For example, there may be times when, owing to their departments’ workloads, plant department managers may not feel they can release their personnel either for receiving or for conducting scheduled training. If plant departments and the plant training manager cannot resolve such issues, the plant manager must do so.

For other NPPs, the training organizations do not report to the plant manager. They may be in entirely different operating organization units that only come together at the highest levels of the operating organization. In this case, there is the same need for communication and conflict resolution as described above, but the mechanisms for resolving conflicts will require the involvement of higher level management of the operating organization.

The plant training managers should assist plant manager(s) in carrying out their responsibilities for establishing and disseminating policies and procedures concerning NPP personnel training and qualification. These policies and procedures must be plant documents and not training organization documents. This makes it clear to plant department managers that these policies and procedures apply to their departments and that the procedures have the full support of the plant manager.

The plant manager often assigns to training organizations the task of establishing a training programme evaluation process, and of collecting the information needed to implement this process. Assignment of responsibilities and duties between the training organizations and the plant in the evaluation process should be clearly stated, on the basis of training needs identification and QA procedures. It is important that the results of the training programme evaluation process be provided to the plant manager in a clear and concise manner, and that the information be provided in a format that encourages appropriate actions by the plant manager and plant department managers.

Also, during outages, some plants will utilize outside contractor personnel to perform maintenance work. The plant training department, together with other plant departments for which the specific work is to be performed, will review the qualifications of contractor personnel and determine if any training has to be provided.

It is necessary to have sufficient information flow from the NPP to the training organizations, to keep training programmes up to date so that they can meet plant training needs. Such information includes:

- Notification of plant events
- Changes in procedures
- Experience feedback
4.3. INTERFACES BETWEEN PLANT DEPARTMENTS AND TRAINING ORGANIZATIONS

Training organizations should understand that the only reason for their existence is to provide a service to plant departments. Therefore, they must be responsive to the needs of the NPP. The relevant individuals in plant departments and training organizations should establish communication mechanisms that ensure they maintain close contact and co-operation. For example, plant department managers should have their subject matter experts review and approve the technical content of relevant training materials. The scheduling of training programmes should be done on a co-operative basis with the NPP and not unilaterally by training organizations.

It is extremely important that instructors keep up their technical knowledge by regular participation in the work at the plant and, as a result, maintain their credibility with trainees and plant personnel. At some plants, during outages, all training centre training is suspended and instructors are integrated into the appropriate plant departments to assist with the outage. This represents good practice as it provides assistance to the NPP while providing continuing OJT for instructors and maintaining contacts.

On the job training is an area where effective interfaces between plant departments and training organizations are particularly needed. Typically, NPP personnel conduct OJT and OJT assessments, while the training organization:

- Prepares OJT materials (with support from the relevant plant departments);
- Trains the OJT instructors/assessors in teaching/assessment techniques;
- Maintains OJT records.

4.4. INTERFACES AMONG ORGANIZATIONS AND PERSONNEL WITH TRAINING RESPONSIBILITIES

For many NPPs, there is more than one organization to which responsibilities have been assigned for providing NPP personnel training. Plant policy or procedures need to define clearly the responsibilities and interfaces among those organizations/personnel that perform the various types of training.

There is almost always a plant training manager who reports either directly to the plant manager or to another manager in the operating organization or NPP. The following training activities are usually assigned to organizations and personnel who report to the plant training manager:
• Job specific OJT;
• Classroom/laboratory training on general safety topics such as radiation protection, industrial safety, labour laws, QA and fire protection;
• Job specific theoretical training;
• Job specific simulator training (e.g. operator training on a full scope control room simulator);
• Job specific laboratory/workshop training (e.g. instrumentation and control laboratories);
• Training on vendor specific equipment (e.g. overhaul of electrical generators).

Job specific OJT will obviously be conducted in the plant, while for many NPPs the other training tasks are performed by one or more training centres, either near the plant or at some regional location.

Some operating organizations use external training organizations to provide specific training modules or to augment training organization staffs. These external training organizations often report directly to the plant training manager or his designate. External training organizations should be subject to the same standards and QA requirements as NPP/operating organization personnel involved in providing training.

5. IAEA ACTIVITIES AND TECHNICAL CO-OPERATION IN NPP PERSONNEL TRAINING AND QUALIFICATION

5.1. DEPARTMENT OF NUCLEAR ENERGY, DEPARTMENT OF TECHNICAL CO-OPERATION, DEPARTMENT OF NUCLEAR SAFETY

IAEA assistance to, and cooperation with, Member States in the area of nuclear power including NPP personnel training is provided primarily through the Department of Nuclear Energy, the Department of Technical Co-operation and the Department of Nuclear Safety. Technical co-operation should meet overall national goals related to safe, reliable nuclear power and should have a significant impact on, and relevance to, national nuclear power programme needs and priorities. The Department of Technical Co-operation is responsible for all matters related to the programming and administrative implementation of projects and other assistance, while the Department of Nuclear Energy and the Department of Nuclear Safety are responsible for the technical aspects of assistance in NPP personnel training and qualification, including the technical implementation of projects.

The main objective of all activities of the IAEA in NPP personnel training is to increase a country's capability of providing qualified, competent NPP personnel
through appropriate training. Technical co-operation projects and other assistance aim at introducing, improving or updating programmes and facilities associated with NPP personnel training, including relevant nuclear related education. Technical co-operation and requests for assistance are generally initiated by Member States through project proposals. Regional projects are usually proposed by the Department of Technical Co-operation. If a project is approved, there are various delivery mechanisms for project implementation which include expert missions, seminars, workshops, fellowships, scientific/technical visits, training courses (interregional, regional, national) and provision of equipment.

The Guidebook on Nuclear Power Plant Personnel Training and its Evaluation — and, in particular, SAT — represents the official Agency guidance and recommendations related to NPP personnel training and qualification, and is thus used in implementing Agency activities.

In the Department of Nuclear Energy, the programmes of the Division of Nuclear Power, in particular the Nuclear Power Engineering Section (NPES) of this Division, support the development of safe, reliable nuclear power including the transfer of knowledge and experience which enables individual countries and NPPs to provide SAT based training for attaining and maintaining the competence of NPP personnel. Project related and other assistance is provided not only in NPP personnel training and qualification, but also in planning nuclear power programmes, NPP project management, QA, instrumentation and control and NPP maintenance. The NPES and other relevant technical sections/divisions of the Agency facilitate the transfer of knowledge and experience to Member States through: the development of publications (guidebooks, databases, standards); specialists meetings; co-ordinated research programmes; and the technical implementation of technical co-operation projects, missions and training courses.

Enhancing NPP personnel training capabilities and self-sufficiency is supported through activities of the Department of Nuclear Energy, the Department of Nuclear Safety and the Department of Technical Co-operation related to:

- Transfer of know-how and experience on the introduction and use of SAT to develop, implement and evaluate training programmes;
- Training courses;
- Upgrading education and training systems for professional and technician level personnel;
- Training of trainers;
- On the job training;
- Training advisory missions;
- Training centre development;
- Upgrading of training related facilities;
- Provision of equipment.
in technical subject areas such as:

- Human resources development including SAT;
- Nuclear power and safety;
- QA;
- Radiation protection;
- Nuclear fuel cycle and waste management.

It is in the best interests of the receiving country/organization that there be accountability associated with technical co-operation and the provision of assistance, to ensure the most efficient and effective use of resources. Projects must be identified, designed and developed very carefully with evaluation and feedback built into them from the beginning. Thus, there must be clearly defined objectives and performance indicators to permit meaningful and regular evaluation during and at the end of a project, to determine whether the assistance has been provided in an effective, efficient manner and has had the intended impact.

5.2. OSART MISSIONS

The IAEA Operational Safety Review Team (OSART) programme provides, on request by a Member State, advice and assistance to enhance the safety of nuclear power plants during construction, commissioning and operation. The OSART programme, initiated in 1982, is not restricted to any particular group of Member States, whether developing or industrialized, but is available to all countries with NPPs under construction, commissioning or in operation.

The purpose of the OSART programme is to assist Member States in enhancing the operational safety of specific NPPs and to promote the continuous development of operational safety within all Member States by the dissemination of information on good practices.

OSARTs thus focus on the safety and reliability of plant operation. They review the operation of the plant and the performance of the plant's management and staff rather than the adequacy of a plant's design. Factors affecting plant management and the performance of personnel, such as organizational structure, management goals, and the qualification of personnel are reviewed. Adequacy of programmes and performance related to operational activities are given particular attention. Guidelines used by the teams to review plant programmes and performance are based on best international practices and are applied in light of the experience of the entire team.

Specifically, the following issues are reviewed on the training and qualification of NPP personnel: training organization and functions/tasks; training programmes; training facilities, equipment and materials for: control room operators and shift
supervisors, field operators, maintenance personnel, technical support personnel, radiation protection personnel, chemistry personnel, management and general employees.

OSART review teams generally use the IAEA Guidebook on Nuclear Power Plant Personnel Training and its Evaluation as the basis for evaluation of training and qualification programmes.

5.3. ASSET MISSIONS

The IAEA Assessment of Safety Significant Events Team (ASSET) service assists Member States by advising them on enhancing operational safety through an effective policy of prevention of incidents at NPPs. Although good design, manufacture and construction of a NPP are prerequisites, safety ultimately depends on the competence and qualifications of NPP personnel and on the professional attitude with which they carry out their duties. ASSET missions concentrate on these aspects in assessing the policy for the prevention of incidents against successful policies in other countries; and in exchanging, at the working level, ideas for improving policy.

An ASSET review is undertaken at the request of operating or regulatory organizations of a Member State but it is not a regulatory type of inspection to determine compliance with national requirements. An ASSET review can complement national efforts by providing an independent, international assessment which may identify areas for improvement that have been overlooked.

ASSET reviews are instrumental in identifying root causes related to human factors and their implications for training. Especially for root causes related to equipment failure, further analysis can yield a deeper human factors related root cause in many cases, which requires feedback of the results of the deeper insights into the training process.

The final goal of an ASSET review is to provide conclusions on the appropriateness and completeness of the planned and implemented corrective actions. Generic lessons are drawn and suggestions are offered, when necessary, to improve plant management control on prevention of incidents, thus enhancing the overall level of operational safety.
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