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A Methodology to Evaluate the Effectiveness of Training in Nuclear Facilities

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A METHODOLOGY TO EVALUATE THE EFFECTIVENESS OF TRAINING IN NUCLEAR FACILITIES

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INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

The extent to which nuclear energy can achieve its potential of contributing to peace, health and prosperity throughout the world ultimately depends on the availability of competent, qualified and capable staff. The nuclear industry places very rigorous demands on such staff, who need to be highly trained owing to the complexity of the technology and the need for high standards of performance and conduct.

These requirements apply across the full range of nuclear activities and facilities — from new nuclear projects, to facilities in routine operation, to decommissioning and waste management. The workforce involved across this spectrum of activities must be able to support routine activities and be in a position to respond to emergencies. These requirements make it vital that individual staff members have the necessary competencies to ensure safe and reliable operation of nuclear power plants.

The IAEA recommends that the systematic approach to training (SAT) be used for the training of plant personnel. SAT provides a logical progression from identification of the competencies required for performing a job, to the development and implementation of training to achieve those competencies, to the subsequent evaluation of training. The use of SAT 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 plant safety and efficiency. Evaluating the effectiveness of training is essential to support not only an organization’s nuclear safety objectives, but also its overall performance management.

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1. INTRODUCTION

1.1. BACKGROUND

The nuclear industry has a long and proud tradition of providing training to develop the competence of its personnel to ensure safe operation over many decades, representing a significant resource commitment. Training processes have evolved and, particularly after the accident at Three Mile Island, the industry increased its focus on the systematic approach to training (SAT), which is now the industry standard. The focus of training had previously been on ensuring safety and compliance with regulatory requirements. With increased deregulation and the associated pressure on costs, training must be seen to be adding real value. High performing organisations no longer view training mainly as a means to maintain compliance, but as a strategic performance management tool to help the organisation deliver its business objectives which, of course, still include safety as key.

In order to achieve this, training must be clearly linked to business objectives. Training needs to be "owned" and supported by line managers, especially senior management, and its impact on performance must be measured and monitored. Evaluating the effectiveness of training programmes is key. There are typically three stages of evaluation:

- A self-assessment methodology;
- A peer review/support process;
- Independent validation by a body of experts.

These are normally sequential steps and many organisations will complete only the first stage. However, all peer review processes such as World Association of Nuclear Operators peer reviews and IAEA Operational Safety Review Team (OSART) missions consider aspects of training within their broader peer reviews and Member States are encouraged to invite peer reviews specifically for the training area. Several Member States (e.g.the United Kingdom and the United States of America) have taken this process one stage further and conduct a validation (accreditation) process, in which training arrangements are reviewed by a body which is totally independent of the facility management. This has the advantage of giving a more objective view of the quality and effectiveness of training within the facility.

The evaluation process is typically based on a set of performance-based objectives and supporting criteria, which in this publication are referred to as standards and conditions (SACs).

1.2. OBJECTIVE

The objective of this publication is to present a set of training standards and conditions, based on the internationally accepted SAT methodology [1], which can be used by any nuclear facility to objectively evaluate the quality of its training, learning and development[1] infrastructure, processes and programmes. The publication also offers guidance and options for peer review processes, including IAEA assistance, and guidance on creating independent validation bodies, although the main focus is the self-assessment methodology as this is key to self-awareness and improvement.

[1] In the remainder of this publication, the term training is used as an umbrella to include formal or on-job training, learning and development activity intended to establish or improve individual competence and therefore performance.

The SACs focus mainly on training resources, infrastructure and process, rather than addressing the detail and content of training programmes. This is based on the logic that if the inputs to the training processes are appropriate and correct, then the outputs (training programmes) will also meet the requirements of the SACs.

These SACs have been reviewed to ensure they are consistent with, and complementary to, other internationally recognised evaluation processes that also include training aspects.

1.3. SCOPE

This publication and the SACs that it contains are intended to be applicable for all nuclear facilities, from fuel cycle facilities through nuclear power plants to nuclear waste facilities. Depending on the scope of a facility's activities and the size of the organisation of which it is a part, the evaluation guidance may be applied at the level of an individual training programme, at departmental level, at facility site level or even at a corporate/organisational level, especially if training provision is centralised for multiple sites. Users should determine which level is appropriate given their circumstances.

1.4. STRUCTURE

This publication is divided into several sections. Section 2 addresses the issue of moving the training philosophy from one of ensuring safety through compliance, to one of using training as a strategic business improvement tool. Section 3 presents the standards and conditions that are recommended for the evaluation of training effectiveness, which are supported by the IAEA safety bases in Appendix 1. Section 4, supported by Appendix 2, provides guidance on the self-evaluation process, both in terms of the process and examples of the evidence to be looked for when conducting a self-evaluation. Section 5 describes the peer review process, including the option of IAEA or other support, Section 6 discusses the benefits of independent validation, and Section 7 provides a summary and conclusions.

2. TRAINING FOR PERFORMANCE IMPROVEMENT

2.1. THE SYSTEMATIC APPROACH TO TRAINING – LESSONS LEARNED

The nuclear industry has for many years been using SAT as the preferred model for satisfying its training requirements. The SAT process and its application are described in detail in an IAEA publication and the application of the SAT model is generally well understood in the industry [1]. However, there has been a tendency to focus on the model itself and the associated training processes, rather than on achieving outcomes and improving performance. This has led to a number of concerns including:

- Training not being seen as part of the core business;
- Senior facility management not being involved in training and not having expectations for or from training;
- Insufficient resources being allocated to training;
- Lack of understanding and ownership of training by line management;
- Training performance indicators not being focused on learning and performance outcomes.

These, and a number of other training indicators identified in recent years, have led to a recognition of the need to change the focus of training.

2.2. TRAINING AS A STRATEGIC PERFORMANCE IMPROVEMENT TOOL

In order to maximise the effectiveness of, and benefit from, training, it needs to be used as a strategic tool to enhance both worker and facility performance. The main elements necessary to achieve this include:

- Training must be a core part of the organisation's business;
- Senior management must ensure the sustainability of training by allocating appropriate resources and setting direction in terms of performance expectations and results;
- Training performance indicators should be focused on learning and performance outcomes;
- Training must be owned by line management who should be actively involved in the SAT process;
- Critical, active and effective self-assessment and corrective action programmes should be in place for training.

The analysis, design, development, implementation and evaluation (ADDIE) cycle of SAT needs to be fully integrated into the facility's everyday activities and this is underpinned by three key principles:

- Involvement of managers, leaders and workers (consultation);
- Systematically derived initial and continuing training programmes (process and performance);
- Performance improvement (results).

2.2.1. Ownership and involvement of managers, leaders and workers

It is important that all levels of management are fully engaged in the training processes of the facility. This includes first line supervisors through section heads and departmental managers, and leadership (senior management, including training managers). There are different ways of achieving this, but a number of organisations have established a training committee structure, which includes training staff and line management. These committees are responsible for identifying and agreeing training needs; providing appropriate resources, including subject matter experts; developing solutions; and reviewing the effectiveness of the solutions. Different models exist for the structure of these committees, but they typically include at least a working level committee to oversee and implement specific training activities and programmes and a strategic committee, involving senior management, to provide direction and ensure training activities are helping to meet the facilities business objectives. Further examples and guidance on training committees can be found in [1].

The use of consultation forums and committees is arguably the most important element of a SAT–based training model. The direct involvement of managers, leaders and the workforce in the development and approval of training programme content ensures engagement and ownership of training and responsibility for performance of their teams and people. It enables the workers to have a real and direct input into their professional and personal development by empowering them and recognising their significant role in driving and delivering performance improvement. It also fosters the appropriate behaviours in the leaders and workforce, reinforcing self–improvement as part of the organisation's nuclear safety culture [2].

2.2.2. Systematically derived initial and continuing training programmes

All training programmes, both initial and continuing, should be systematically derived, using the ADDIE cycle of SAT. The training programmes should be designed by the line organisations with the support of the training function as the experts in the SAT processes. They

should be reviewed to ensure they meet the business needs of the facility and formally agreed by the programme owners. They should also be subject to systematic review to ensure they continue to meet the needs of the business.

The implementation of the SAT-based training approach requires ongoing commitment from the leaders and workers and the training functions to keep the model running effectively. It requires expertise to support the ADDIE methodology, both from the training function and the line organisations. The organisation needs to understand the SAT model and how it works to get the return on the investment required by the model.

2.2.3. Performance improvement and results

The primary focus of the SAT model should be to drive performance improvements and results in individuals and the nuclear facility rather than being compliance based. However, the correct application of the SAT model would ensure all the necessary risk activities are identified through the analysis of training needs and included in any subsequent training programmes. These performance improvements should include protecting and enhancing nuclear safety margins, which should in turn be included in the facility's business objectives. Appropriate performance indicators should be identified to track how effective the training is in improving safety and business profitability.

2.3. THE GRADED APPROACH TO SAT

One of the major challenges faced by most organisations when applying the SAT model is the appropriate level of rigour with which the model is applied for various job positions in a nuclear facility. In the interests of efficiency, a 'graded' approach may be adopted. This approach is often based on the safety or commercial significance of the job or task under consideration. This evaluation may be based on the importance of the job in terms of safety, equipment reliability or the complexity of the job performance requirements. For example, the highest grade of SAT, including a full job and task analysis, would be applied to positions which have a direct impact on reactivity control in the facility (e.g. operations personnel, chemists).

There are numerous training models deployed across the industrial world, all of which seek to ensure that employees are suitably qualified and experienced to carry out their work to a desired standard. The choice of using the SAT based training model is based on the ability to identify the specific tasks and activities that can impact nuclear safety, specifically those tasks and activities that, if not conducted correctly, will have a direct impact on nuclear safety and nuclear reactivity controls. Training people is expensive and represents significant costs; if not applied and managed in the right way, it will become a cost burden that adds no safety or economic value to the business.

To ensure an optimal return on investment, there is a need to apply a graded approach to the implementation of a SAT based model across the broad spectrum of positions, roles and responsibilities. This is a challenging process and will require the experience of training and line personnel who have been actively involved in implementing the SAT approach. Some roles and positions will require a detailed and thorough implementation of all the ADDIE cycle stages, others will not. This grading of approach needs to be based on the consideration and weight of the nuclear safety risks as a priority, and in some circumstances followed by the commercial business risk to the facility. The level of implementation of the ADDIE cycle is the most challenging aspect of trying to determine how to grade the SAT approach. More information on the graded approach to SAT can be found in [1].

3. TRAINING EFFECTIVENESS EVALUATION STANDARDS

In order to objectively evaluate the effectiveness of the training arrangements at a facility, the IAEA has developed a set of five standards covering the three key SAT principles identified in Section 2.2. Each of these standards is supported by a set of underpinning requirements, or conditions, which will help identify if the intent of the standards is being met. The conditions which support the standards are listed in Appendix 1. In addition to reviewing whether the SAT process is being appropriately applied, the standards evaluate the extent to which training is being used to improve performance, the level of involvement of line management, the competence of the staff involved in training processes and whether the training is actually delivering individual and facility performance improvement:

- *Standard 1:* Senior managers use training as a strategic tool to support the achievement of the facility's safety, performance and commercial goals:
  - Standard 1 is about using training as a performance management tool. Managers demonstrate understanding of the link between competence and performance. Training objectives and activities are linked to the goals of the organisation. Senior management invest in, and promote, training as a means to improving performance;
- *Standard 2*: Managers at all levels are responsible for the competence and qualification of their staff and take ownership of training programmes:
  - Standard 2 is about ownership and ensuring an effective partnership between the line organisation and the training staff. Managers take responsibility for the competence of their staff and work effectively with training staff to ensure the qualification of personnel;
- *Standard 3*: Initial and continuing training programmes are based on the systematic approach to training, each step graded as appropriate to job safety or performance risk:
  - Standard 3 is about the application of SAT to all training activities and programmes, both initial and continuing, to ensure that workers are always competent to perform the tasks to which they are assigned. There is an expectation that worker performance will improve over time and that this will be reflected in facility performance. It recognises that the rigour of application of SAT may be based on the safety or performance requirement of the assigned tasks;
- *Standard 4*: All personnel involved in training activities are competent for their assigned roles:
  - Standard 4 is about ensuring that all personnel involved in the training process have a good understanding of SAT, particularly as it applies to their roles in the process. Where personnel have specific roles in the training process, this is reflected in their roles and training profiles and they are competent and qualified to carry out these roles;
- *Standard 5*: Training is reviewed to confirm its impact on the facility's safety, performance and commercial goals:
  - Standard 5 is about ensuring that training effectively supports facility performance. Training performance is monitored at the highest level in the facility. Trainer and trainee performance is evaluated, and action is taken to remedy any shortcomings. . Facility performance is monitored to evaluate overall training effectiveness. Self-evaluation is used to enhance training performance and effectiveness.

These standards have been developed to be consistent with other major peer review processes that consider training, such as WANO peer reviews and IAEA OSART and SALTO reviews. The standards are performance based and are also designed to support compliance with IAEA Safety Standards in the area of training and competence. Where applicable, Appendix 1 also includes the IAEA safety base(s) for each of the conditions.

4. SELF-EVALUATION OF TRAINING EFFECTIVENESS

The process of self-evaluation is one of the cornerstones of continuous improvement as an integral part of the management system. Self-evaluation is the first step in the evaluation of training effectiveness and has many benefits, including:

- It helps participants to get a better understanding of the standards and expectations of the processes, as well as the processes themselves;
- It provides a picture of actual, rather than intended, process implementation and performance;
- It helps to identify potential performance problems before they become actual gaps;
- It helps to identify areas for further performance improvement;
- It provides managers with a tool to measure actual performance;
- It gives confidence to external stakeholders that a facility is striving for excellence rather than just compliance.

The primary goal of the IAEA in developing these standards and conditions was to provide a set of internationally recognised criteria by which Member States could objectively benchmark their training programmes and processes. Hence these standards and conditions are an ideal basis for undertaking self-evaluation. Effective self-evaluation can be a challenging process and requires a level of maturity that may not be present in all organisations, and therefore external support may be required. When conducting this self-evaluation, it is important to consider the other two stages of training effectiveness evaluation, even in this initial stage.

4.1. SELF-EVALUATION GUIDANCE

This chapter provides guidance and suggestions to be used in a self-evaluation of training effectiveness to help facilities determine whether they are meeting the training standards. It is recognised that the management and implementation of training processes and programmes will differ from facility to facility and will depend on many factors, including:

- Organisational arrangements, including accountability, funding, centralisation, etc.;
- Phase of the facility lifecycle;
- Standalone or fleet operation;
- Regulatory requirements;
- National education and training infrastructure and practices;
- Existing monitoring and oversight arrangements.

How these standards are met may vary from facility to facility. However, the supporting conditions should be sufficiently flexible to determine whether a standard is being met, as the focus is on *what* should be achieved rather than *how* it should be done. It is also recognised that many organisations may require further assistance in determining *how* to meet the conditions, and ultimately the standards. As a result, detailed information is provided in the form of a table in Appendix 2. In addition to the individual conditions, the table includes the following columns:

- Good practices;

- Examples;
- Explanations/evidence.

4.1.1. Good Practices

In the good practices column, an explanation is provided of the condition in practical terms. These are a set of measurable indicators which evaluators can use to determine the extent to which the condition is being met. They are based on real practice as observed in different Member States.

4.1.2. Examples

The examples column provides more specific examples relating to the good practice, providing more detail of the actions, tools and techniques that make up the good practice. Therefore, they provide more detail on *how* a condition could be met. As before, these represent different practices, as observed in the field, and show different ways of meeting a condition.

4.1.3. Explanations and Evidence

The final column provides more explanation, where necessary, to help an evaluator understand the context and scope of a condition. It includes examples of the kind of evidence that should be available to support the achievement of a condition. This information will also form an important part of the peer review process to be discussed in a subsequent chapter.

4.2. CONDUCTING SELF-EVALUATIONS

As stated previously, self-evaluation can be a challenging process and needs to be objective and unbiased in order to be effective. Having identified standards and conditions to benchmark against will help in this process but it must also be supported by proper procedures and competent evaluators. These procedures should include the roles and responsibilities of the different participants in the self-evaluation process and identify their training and competence requirements. Considering that training specialists, line managers and trainees all have an important role to play in the training process, they should all be represented in a self-evaluation team. Ideally, the evaluation of a training programme, or set of programmes, should be led by the programme owner(s), with support from training specialists.

The self-evaluation process should include, but not be limited to: observing training activities; interviewing senior, line and training managers and staff; and review of training facilities, equipment, materials and procedures.

In any quality system, the procedures and processes are as important as the final results, as consistency of results can only be guaranteed by effective procedures and processes. Therefore, when conducting a self-evaluation, it is important that the procedures/processes, as well as the respective results, are evaluated. An effective practice can only be recognised if it is based on a procedural requirement, otherwise there is no guarantee it will be repeated.

If a facility is conducting a self-evaluation for the first time, it may be helpful to consider conducting a pilot on a single programme, or suite of programmes, which is/are critical to business success, e.g. operations. Lessons learned from this pilot may then be applied to a broader self-evaluation. Based on the outcomes of this pilot, a facility can develop a schedule of self-evaluation to cover all training programmes.

The expected output from the self-evaluation process would be a report detailing the health of the training programmes and processes in meeting the SACs. It would typically include a

summary of the process, the identified findings, the actions planned to close the gaps, and any good performance items. This report is an important input into any subsequent peer review and independent validation activities.

4.3. SELF-EVALUATION FINDINGS AND ACTION PLANS

When considering the findings of a self-evaluation, a degree of expert judgement is often required to determine whether a condition has been met. Appendix 2 provides guidance to better enable an evaluator to make this decision based on training effectiveness. However, it should be stressed that it is not necessary to fully meet each condition for a standard to be met, and the evaluator must use their judgement to determine the potential impact of the findings on performance.

When the outcomes of the self-evaluation indicate a finding, there needs to be a clear statement, supported by evidence, documenting this result. Based on this information, it will be easier to identify what needs to be done, and by whom, to bring this condition to an acceptable level. Therefore, the most important output from the self-evaluation process is the action plan that lists for each condition considered 'not acceptable': 1) a specific action, or actions, needed to bring the condition to an acceptable level; 2) an 'owner' or person responsible for this action; and 3) the necessary resources and a timescale for completion. These action plan actions should then be incorporated into the facility's corrective action programme and tracked in the management system using the usual accountability processes.

Other outcomes of the self-evaluation are the identification of areas of good performance (strengths) as well as suggestions for further improvement. The self-evaluation report should include these in addition to any negative findings.

4.4. EVALUATING RESULTS

Following the evaluation of the conditions and the development of the action plan, the overall level of performance can then be evaluated against the standards. During this process, it is often more helpful to use a 'graded' approach to evaluation, rather than just pass/fail. For example, a four-grade approach, which can be applied at the level of conditions, standards or even overall evaluation, is shown below:

- Excellent (exceeds standard)
- Successful (standard fully met);
- Satisfactory, but with gaps/areas for improvement - action plan required;
- Below expected standard (backed by performance evidence) - action plan required.

In some cases, a more detailed grading is applied. Where a graded approach is used, this is often supported by a 'traffic light' visualisation, with excellent performance coloured blue, successful performance green, satisfactory amber and not acceptable red. When this is done at the condition level, it may provide a stronger visual indication of the overall performance for a standard.

Although the main purpose of the self-evaluation is to confirm the effectiveness of training and identify further performance improvement opportunities, there will always be pressure to give an overall result, or 'score'. However, it is the detailed findings at the condition level and the associated action plans for improvement, which should be considered the more important outcome.

4.5. FREQUENCY OF EVALUATIONS AND REVIEWS

After the initial evaluation of a programme(s), the facility needs to determine a review frequency to ensure training arrangements are maintained and continue to effectively support business objectives. While organisations are encouraged to make self-evaluation an ongoing activity within their continuous improvement culture, they will still benefit from a more formal periodic review. This is typically conducted initially every four years and then at a frequency as required by the initiating organisation. Such an evaluation will normally precede a peer review.

5. PEER REVIEW

One of the benefits of a self-evaluation approach is that the evaluators will generally be very familiar with the training processes and programmes they are evaluating, as well as their leadership, organisational arrangements and culture. However, their knowledge may be limited to their own organisation and, unless they have been involved in external training activities or national/international meetings or projects, they may have limited knowledge of good training practice.

The guidance provided in this publication is intended to reflect good international practice; however, using national or international peers to independently review the findings of a self-evaluation will help to increase the objectivity, as well as the credibility, of those results. Peer review team members can also be very helpful in providing suggestions to correct identified performance gaps.

5.1. IAEA SUPPORT

If an organisation is conducting a training effectiveness self-evaluation for the first time, it may be helpful to have some external support to provide training for the evaluators and to assist in conducting the process. The IAEA can provide expert missions to assist organisations in establishing a self-evaluation process and provide the necessary training prior to undertaking a first self-evaluation. It can also facilitate peer reviews to enable independent training experts to review and advise on the results of a self-evaluation.

5.2. PEER REVIEW OPTIONS

There is an element of review of training within the international peer review processes (IAEA, WANO), as already mentioned. However, these reviews are broader in scope and only address certain aspects of training. Using a peer review process as a follow-up can greatly enhance the benefits of the self-evaluation process. There are number of options for peer review and which one is most appropriate for an organisation will depend on the maturity of the self-evaluation process and the quality of its outputs. The three main options are:

- Internal peer review, where the team members belong to the same organisation but are independent of the facility being reviewed;
- External peer review, where the reviewers come from other organisations and the team can be considered completely independent of the organisation hosting the review;
- Mixed peer review, which is a combination of internal and external peers as defined above.

The main benefit of having external reviewers is that they will bring different experience and they will be better able to independently judge the quality and effectiveness of the training

programmes and processes. However, they will not have a detailed knowledge of how the training processes work at the facility being reviewed and will need some training to address this. Often, external reviewers will have participated in multiple reviews and will have much experience to bring to the process. Peer reviews are also a good opportunity to educate new individuals from outside the organisation about the evaluation and review process, giving them an understanding of the value of this process for their own organisations.

Organisations should carefully consider the timing and benefits of peer reviews, whether they are internal or external. If an initial self-evaluation identifies many areas for improvement, it is not appropriate to invite a review of this until corrective actions have been taken. Hence, peer reviews are typically requested when a facility believes its training programmes and processes to be effective, and wants to confirm this, or when it has specific problems which it is having difficulty in resolving and seeks external guidance. However, in the latter case, some form of support mission, either independently organised or facilitated through the IAEA, may be more beneficial.

5.3. OUTPUTS AND FREQUENCY

Following the peer review, a report will be produced that reviews the self-evaluation findings and action plans, any new findings identified as part of the peer review and higher-level recommendations for training and performance improvement. This report would also include any strengths or good performances which are identified to be of potential benefit to other organisations.

A peer review would typically be conducted after each formal periodic self-evaluation i.e. every three to four years.

6. INDEPENDENT VALIDATION

It may be helpful to have a facility's training programmes and processes formally validated (accredited) by a recognised independent body, similar to what is often done for university education programmes, as this gives a high degree of assurance of quality and consistency. This can be very effective in increasing regulatory confidence in a facility's objectivity and capability and can also be very positive from the perspective of the governing boards of the organisation, the local communities and general public, neighbouring countries and the international community.

This validation will require a competent review body to assess the results of the self-evaluation and peer review and, if satisfactory, to validate the programmes and processes that were evaluated. This stage in the process will also provide the opportunity to gain strategic advice on training and performance improvement due to the expertise and experience of such bodies. Two options for this are proposed below.

6.1. USING EXISTING INFRASTRUCTURE

The first option is to make use of any existing independent vehicle, such as a nuclear safety review board that is established to provide oversight and advise the senior management of the organisation on nuclear safety and other matters. Often, these boards include senior industry figures and have a high degree of nuclear competence and credibility. Extending the remit of such a board to validate training programmes is a cost-effective solution as the board and its associated infrastructure already exist.

A potential challenge with this option is that there may be limited training expertise among the review board members. In this case, extensive training in SAT, the standards and conditions, and the facility's self-evaluation methodology would be required for the board members. If this option is chosen, it is important to ensure that the board gives sufficient priority to the validation of training programmes.

6.2. ESTABLISHING A NEW BODY

The second option is to establish a completely new body dedicated to the review and validation of training programmes. A major advantage of this option is that individuals may be selected for this body based on their education and training expertise. It also gives the option to select national and international experts who are already engaged in similar activities in other organisations, which may add considerable value to the organisation, such as advising on strategic improvements.

This body would still require training in the standards and conditions, and the self-evaluation methodology used by the facility. Creating a new body would also have cost implications but these could be lessened by creating some form of a national or regional body that provides such a service to multiple facilities/organisations, which could share the set-up and operating costs. This option would require a structure, working arrangements and reporting methodology to be established for the new body.

7. SUMMARY AND CONCLUSIONS

A number of Member States have already adopted a process for training effectiveness evaluation as described in this publication. They are finding that this process supports achieving high margins of safety and improved performance in all aspects of a nuclear facility's lifecycle by assuring individuals have the necessary knowledge, skills and attitudes. These findings further emphasise the importance and value of using the SAT model.

Other Member States are encouraged to use this process to ensure the effectiveness of their training programmes, thereby improving facility and organisational performance. As more Member States conduct training effectiveness evaluations based on these standards and conditions, there will be the opportunity for more widespread benchmarking.

Using this process will support the use of training as a business and performance improvement tool. It can also improve training consistency and standardisation across the organisation, while demonstrating that the investment in training is producing results that are reliable and predictable.

In summary, this training effectiveness evaluation process provides confidence that people trained are competent and qualified to do their jobs and evidence that the training programmes continuously add value to the organisation.

APPENDIX I. IAEA TRAINING STANDARDS, CONDITIONS AND SAFETY BASES

I.1. STANDARD 1

Senior managers use training as a strategic tool to support the achievement of the facility's safety, performance and commercial goals (see TABLE 1~~TABLE 1~~).

TABLE 1.

No.	Condition	IAEA Basis
1.1	Senior management recognise, understand and promote the strategic benefits of training in delivering the facility's goals, setting appropriate expectations and behaviours for training.	"2.10. Senior management should establish and promote a set of principles to be used in decision making and promoting safety conscious behaviour. Examples of such principles used in some organisations are as follows: … (f) A questioning attitude is fostered. (g) Organisational learning is encouraged. (h) Training of personnel is encouraged." [3]
1.2	There is an overall training policy emphasising the importance of training in achieving the facility's goals.	"4.2 The operating organisation should formulate an overall training policy. This policy is the commitment by the operating organisation and facility 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 facility." [4]
1.3	Senior management ensures the necessary resources, facilities and infrastructure are in place to support the training policy and programmes.	"4.24. Adequate training facilities, including a representative simulator, appropriate training materials and facilities for technical training and maintenance training, shall be made available for the training of operating personnel." [5] "4.8. It should be the responsibility of the facility manager, with reference to each position important to safety, to ensure that: … —the training unit is provided with all necessary resources and facilities;

No.	Condition	IAEA Basis
		…" [4]
1.4	Senior management ensures that the competences required to achieve the facility's goals are identified, in place and sustained.	"4.23 Senior management shall ensure that competence requirements for individuals at all levels are specified and shall ensure that training is conducted, or other actions are taken, to achieve and to sustain the required levels of competence." [2]
1.5	Senior management establishes training programmes for all personnel based on business needs, taking account of both current and future needs.	"6.16. The operating organisation should establish a training and qualification programme to ensure that the needs of the operating organisation are evaluated and that the qualification requirements for positions in the organisation are established…. For each category of personnel, there should be the requirement to develop and maintain appropriate competence through education, experience and formal training. 6.17. Training programmes, based on the specific needs of the organisation and the individual, should be established to develop and maintain the technical knowledge and skills of all personnel." [6]
1.6	Senior management establishes arrangements and processes to ensure the effective involvement of line managers and staff in the training process.	"2.15. …Managers and leaders throughout an organisation should set an example for safety, for example, through their direct involvement in training and in oversight in the field of important activities." [3]

I.2. STANDARD 2

Managers at all levels are responsible for the competence and qualification of their staff and take ownership of training programmes (see TABLE 2).

Standard 2 is about ownership and ensuring an effective partnership between the line organisation and the training staff. Managers are responsible for the competence of their staff and work effectively with training staff to ensure their needs are met.

TABLE 2

No.	Condition	IAEA Basis
2.1	Managers work in partnership with training personnel in all stages of the SAT process, from identification of training needs to evaluation of the effectiveness of training in delivering the facility's goals.	"4.18. The management of the operating organisation shall be responsible for the qualification and the competence of facility staff. Managers shall participate in determining the needs for training and in ensuring that operating experience is taken into account in the training." [5] "4.20. …Line managers should participate personally in the analysis of training needs, in the review and approval of training programmes and plans (as well as in the delivery of some parts of the training), and in the evaluation of the effectiveness of the training." [7]
2.2	Managers are responsible for the scope, content and quality of the training programmes for their staff.	"4.20. …Line managers should participate personally in the analysis of training needs, in the review and approval of training programmes and plans (as well as in the delivery of some parts of the training), and in the evaluation of the effectiveness of the training." [7]
2.3	Managers provide resources as required to support the training process, including ensuring the attendance of their staff at identified training.	"3.4 Managers should be held responsible for ensuring that individuals working under their supervision have been provided with the necessary training, resources and direction. These elements should be provided before any work begins." [7]
2.4	Managers observe and participate in the training of their staff.	"4.20. …Line managers should participate personally in the analysis of training needs, in the review and approval of training programmes and plans (as well as in the delivery of some parts of the training), and in the evaluation of the effectiveness of the training." [7] "2.15. …Managers and leaders throughout an organisation should set an example for safety, for example, through their direct involvement in training and in oversight in the field of important activities." [3]
2.5	Managers ensure that their staff are competent and qualified for the tasks to which they are assigned.	"4.18. The management of the operating organisation shall be responsible for the qualification and the competence of facility staff." [5] "3.4. Managers should be held responsible for ensuring that individuals working under their supervision have been provided with the necessary training, resources and direction. These elements should be provided before any work begins." [7]
2.6	Managers ensure the competence of contractors for which they are responsible.	"6.20. Consideration also should be given to the training needs of contractor personnel to ensure that they are qualified to perform their assigned tasks." [6]

No.	Condition	IAEA Basis
		"3.41. The contractors selected for specific safety related work should be required to provide documentary evidence that they staff have the appropriate training and qualification to perform the assigned work… 4.1. The operating organisation is responsible for training its own staff and ensuring that contractors' staff are suitably trained and experienced…" [4]

I.3. STANDARD 3

Initial and continuing training programmes are based on the systematic approach to training (SAT), graded as appropriate to job safety or performance risk (see TABLE 3).

TABLE 3.

No.	Condition	IAEA Basis
3.1	A performance review process is in place to determine a need for training.	"4.20. Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel (including, if necessary, external support organisations, including contractors)." [5] "4.9. The organisation's training plan should include: … —An evaluation of the effectiveness of the training, including individual performance, the performance results of the organisation carrying out the training, and the training process." [7]
3.2	Initial training programmes take due account of existing entry level education and qualifications.	"2.15. The description of the responsibilities and competences needed for each position should form the basis for the definition of the required qualifications and of the prerequisites for recruiting, training and continuing training of the individual persons." [6]
3.3	All training programmes and activities are developed based on the SAT model.	"4.20. Performance based programmes for initial and continuing training shall be developed and put in place for each major group of personnel (including, if necessary, external support organisations, including contractors). The content of each programme shall be based on a systematic approach." [5]

No.	Condition	IAEA Basis
		"4.13. A systematic approach to training should be used for the training of facility personnel. 4.14. A systematic approach to training should include the following phases: Analysis, Design, Development, Implementation and Evaluation." [4]
3.4	The extent of application of SAT is based on an assessment of the safety or performance risk.	"4.16. The operating organisation shall clearly define the requirements for qualification and competence to ensure that personnel performing safety related functions are capable of safely performing their duties." [5]
3.5	Facility modifications, operating experience feedback (OEF) and procedural, organisational, legislative and regulatory changes are reviewed for training impact and incorporated as necessary.	"4.18. ….. Managers shall participate in determining the needs for training and in ensuring that operating experience is taken into account in the training. 4.22. Operating experience at the facility, as well as relevant experience at other facilities, shall be appropriately incorporated into the training programme." [5] "4.4. A training plan should be prepared on the basis of the long term needs and goals of the facility. 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 facilities of the operating organisation; feedback of operational experience from other facilities; significant modifications to the facility or to the operating organisation; changes in regulatory requirements; and changes in the State's education system." [7]
3.6	Job performance requirements are analysed to identify all the required knowledge, skills and attitudes (KSAs) and initial and continuing training needs.	"6.17. Training programmes, based on the specific needs of the organisation and the individual, should be established to develop and maintain the technical knowledge and skills of all personnel. A systematic approach to training should be used which will enable a training programme for nuclear power facility personnel to be prepared, analysed, designed, developed and implemented on the basis of an analysis of the responsibilities and tasks of a job." [6]
3.7	Learning objectives for training are designed and developed to ensure they meet the required KSAs.	"6.17. Training programmes, based on the specific needs of the organisation and the individual, should be established to develop and maintain the technical knowledge and skills of all personnel. A systematic approach to training should be used which will enable a training programme for nuclear power facility personnel to be prepared, analysed, designed, developed and implemented on the basis of an analysis of the responsibilities and tasks of a job." [6]
3.8	Training methodologies, settings and equipment are identified by the SAT process.	"4.24. Adequate training facilities, including a representative simulator, appropriate training materials and facilities for technical training and maintenance training, shall be made available for the training of operating personnel." [5] "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 facility and its systems. Detailed

No.	Condition	IAEA Basis
		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. 6.6. 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. 6.7. A procedure should be in place for the periodic review, timely modification and updating of training facilities and materials, to ensure that they accurately reflect all modifications and changes made to the facility." [4]
3.9	Training is implemented and trainees are evaluated to confirm the required KSAs have been achieved.	"4.23. Senior management shall ensure that competence requirements for individuals at all levels are specified and shall ensure that training is conducted, or other actions are taken, to achieve and to sustain the required levels of competence. An evaluation shall be conducted of the effectiveness of the training and of the actions taken." [2] "4.9. The organisation's training plan should include: … —An evaluation of the effectiveness of the training, including individual performance, the performance results of the organisation carrying out the training and the training process." [7]

I.4. STANDARD 4

All personnel involved in training activities are competent for their assigned roles (see TABLE 4).

TABLE 4.

No.	Condition	IAEA Basis
4.1	All training staff and instructors, including part-time instructors and Subject Matter Experts (SMEs), have sufficient technical, SAT and pedagogical competence to implement their tasks.	"4.23. All training positions shall be held by adequately qualified and experienced persons, who provide the requisite technical knowledge and skills and have credibility with the trainees. Instructors shall be technically competent in their assigned areas of responsibility, shall have the necessary instructional skills, and shall also be familiar with routines and work practices at the workplace." [5]
4.2	The responsibilities of all personnel participating in the training process, including managers and SMEs, are reflected in their Job descriptions/competence profiles.	"2.61. Job descriptions should be developed for the different competences or types of work to define the total scope of each individual's job." [7] "Qualification requirements shall be established for the training instructors." [5]
4.3	All personnel involved in the training process understand their responsibilities in the SAT process.	"3.16. In order to understand and implement policies at the installation, managers at all levels should have: … (c) Skills in training, instruction, coaching, knowledge management and problem solving …" [3]

I.5. STANDARD 5

Training is reviewed to confirm its impact on the facility's safety, performance and commercial goals (see TABLE 5).

TABLE 5.

No.	Condition	IAEA Basis
5.1	Senior managers monitor, review and provide oversight to ensure the effectiveness of training.	"2.15…Managers and leaders throughout an organisation should set an example for safety, for example, through their direct involvement in training and in oversight in the field of important activities." [3]

No.	Condition	IAEA Basis
5.2	Managers are responsible for addressing the identified deficiencies in training and performance.	
5.3	Feedback following training, in addition to personnel and facility performance, are used to evaluate the effectiveness of training.	"4.9. …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. 4.14. A systematic approach to training should include the following phases: … —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 facility improvements." [4]
5.4	Training programmes are regularly reviewed and updated to incorporate changes to requirements and emerging needs.	"4.21. The training programmes shall be assessed and improved by means of periodic review. In addition, a system shall be put in place for the timely modification and updating of the training facilities, computer models, simulators and materials to ensure that they adequately reflect current facility conditions and operating policy, and that any differences are justified." [5] "4.21. The training plans of the organisation should be subject to ongoing review to determine their effectiveness. The training plans should be revised whenever necessary improvements or enhancements are identified on the basis of the results of the reviews." [7]
5.5	Training and other self-assessments are conducted regularly and their results used to support continuous improvement of personnel and facility performance.	"The operating organisation and the regulatory body should ensure that the effectiveness of their management systems is monitored and measured, and that self-assessments as well as independent assessments are conducted regularly for continuous improvement." [8]
5.6	To support continuous improvement, the facility benchmarks its training processes and programmes.	

No.	Condition	IAEA Basis
5.7	The facility assesses the level of return on its training investment.	

* The reference to Levels relates to the Kirkpatrick Evaluation Model, the model for evaluation widely accepted in the nuclear industry www.kirkpatrickpartners.com

I.6. BASES PUBLICATIONS

- GSR Part 2 Leadership and Management for Safety;
- GSR Part 4 Safety Assessment for Facilities and Activities;
- SSR 2/2 Safety of Nuclear Power Plants: Commissioning and Operation;
- SSG 16 Establishing the Safety Infrastructure for a Nuclear Power Programme;
- NS-R-2 Safety of Nuclear Power Plants: Operation;
- GS-G-3.1 Application of the Management System for Facilities and Activities;
- GS-G-3.5 The Management System for Nuclear Installations;
- NS-G-2.4 The Operating Organization for Nuclear Power Plants;
- NS-G-2.8 Recruitment, Qualification and Training of Personnel for Nuclear Power Plants.

APPENDIX II. GOOD PRACTICES, EXAMPLES AND EVIDENCE

The matrix presented below is intended to provide detailed guidance to personnel conducting a self-evaluation, as well as those participating in peer reviews and independent validation of the training programmes and processes. For each condition, under the good practices column, a set of measurable indicators are provided, based on real observation in Member States. In the next column, more specific examples are provided, including actions, tools and techniques used to support the good practices described. In the explanations and evidence column, suggested questions and actions are listed which should help an evaluator find the evidence necessary to make a judgement on whether a condition is met. The evidence column is not meant to be an exhaustive list and experienced evaluators will use a variety of means to identify supporting facts.

When conducting the process, evaluators should use all means necessary to identify facts to support a decision about whether a condition is met. Evaluators are expected to review training documentation including: training procedures; training materials such as lesson plans and student materials; and, training records, including line manager involvement in the process, instructor performance and examination and qualification results.

Evaluators should interview a variety of personnel from senior management and training staff to line managers, facility personnel and contractors, as appropriate. Evaluators should also observe training activities, paying particular attention to training performance and the training environment. In addition, evaluators should conduct 'walk downs' to review the training facilities, equipment, mock-ups and other training aids.

II.1. STANDARD 1

Senior Managers use training as a strategic tool to support the achievement of the facility's safety, performance and commercial goals (see TABLE 6).

Explanation: Standard 1 is about using training as a performance management tool. Managers demonstrate understanding of the link between competence and performance. Training objectives and activities are linked to the goals of the organisation. Senior management invest in, and promote, training as a means to improving performance.

TABLE 6.

No.	Condition	Good Practice	Examples	Explanations and Evidence
1.1	Senior management recognise, understand and promote the strategic benefits of training in delivering the facility's goals, setting	Business plans focus on strategic goals and any training required to support those goals is identified, solutions proposed and resources provided as needed.	– Senior managers include the importance of training as a topic in meetings with other managers and with individual workers. – Senior managers routinely observe worker performance in the field to	– Training itself may not be a facility goal but the competence of the workforce should be addressed. – There should be some linkage between facility goals and training, promoted by senior staff.

No.	Condition	Good Practice	Examples	Explanations and Evidence
	appropriate expectations and behaviours for training.		confirm that training is effective in establishing the required worker skills and behaviours. – Senior managers introduce key training events, reviewing purpose and expectations.	– Are there high-level performance indicators related to training? – Is there a senior level training champion?
1.2	There is an overall training policy emphasising the importance of training in achieving the facility's goals.	A written policy statement on training is available, signed by the senior manager, highlighting managers' expectations and assigning responsibilities. This may be a stand-alone document or part of a wider human resources policy statement.	A training policy statement might typically include some or all of the following issues: – Training is linked to meeting facility goals – All individuals are expected to attend scheduled training. – Absences from scheduled training require senior manager approval. – Each individual is responsible to ensure he or she is properly qualified to perform assigned tasks. It is also the responsibility of the supervisors assigning work to ensure that qualified individuals are selected to perform tasks. – Training facilities promote a professional learning environment. Simulators and laboratories replicate facility conditions as closely as possible.	– Do senior managers promote the linkage between training and facility objectives? – Does the policy include standards for training? – Do senior managers promote the standards and expectations? – Are personnel aware of the training policy and standards?
1.3	Senior management ensures the necessary resources, facilities and infrastructure are in place to support the training policy and programmes.	– Senior managers agree the scope of training facilities and infrastructure required to deliver effective training. – Senior managers conduct regular meetings with the training manager to ensure enough instructors are available to conduct the scheduled training. They also confirm that training material is available and suitable for use. – Senior managers regularly tour the training facilities to ensure they are	– Mock-ups and laboratories are used to promote training realism. Many facilities use mock-ups for reactor coolant pump seal replacement, steam generator inspections, diesel generator repair and electrical breaker maintenance. Some facilities use training laboratories to help technicians tune flow-loops and train chemists and health physics technicians on analysis techniques.	– Is the scope of training facilities, laboratories and mock-ups appropriate for the training being provided? – Are they up to date? – Is there a long-term training staffing plan? – Is there a dedicated training budget? Is it adequate for the training needs?

No.	Condition	Good Practice	Examples	Explanations and Evidence
		adequate and provide for a professional learning environment. They also use this opportunity to confirm that the simulator and laboratories accurately model facility conditions.	– Different kinds of simulators are used to support training, not just for operations staff. These simulators are usually fully functional and support fundamentals training, procedure development, emergency plan drill development, just-in-time training, updated core model testing following refueling outages, and validation of facility response prior to performing critical facility evolutions.	
1.4	Senior management ensures that the competences required to achieve the facility's goals are identified, in place and sustained.	– Written job descriptions and qualification requirements exist for all job positions. – A formal process exists to review facility and personnel performance, identify related training needs and review the effectiveness of the training in supporting the performance required. – Senior managers conduct regular meetings with line and training managers to confirm that a sufficient number of competent individuals are available to meet the facility's needs. – Senior managers discuss equipment and personnel performance issues with line and training managers to confirm that they are effectively collaborating to resolve these issues.	– Many facilities have a series of hierarchical training committees to identify training needs, agree and sponsor training programme content, monitor the effectiveness of training and maintain the strategic focus on how training supports the facility's goals and objectives.	– Are job descriptions comprehensive and up to date? – Are behavioural competences included? – Are human performance requirements included in training profiles? – Do training profiles include safety culture requirements? – Is there a formal process for line managers to approve job descriptions, qualification requirements and training programmes? – Do line managers have specific training targets and accountabilities?
1.5	Senior management establishes training programmes for all personnel based on business needs, taking account of both current and future needs.	– Succession plans exist for all senior and business critical positions and training plans reflect these succession requirements. – Long-term initial training schedules are based on projected hiring needs. A staffing plan (for example a 5-year projection of personnel needs) is used to ensure that training materials, facilities,	– Succession plans should cover at least a 1 to 3-year period, and many facilities have plans for up to 5 years. These plans should be fully resourced in terms of training activities and funding.	– Are succession plans in place? – What is their time span? – Are they up to date? – How/ how often are they reviewed? – Do they take account of major projects such as power upgrades, modernisation and life extension?

No.	Condition	Good Practice	Examples	Explanations and Evidence
		and instructors are ready to deliver training when needed. – Integrated strategic plans address such factors as personnel performance and performance trends, line and training organisation turnover rates, and anticipated regulatory requirements.		– Are these succession plans fully reflected in training projections and resource needs? – Do staff have individual training plans to ensure they can continue to develop and contribute?
1.6	Senior management establishes arrangements and processes to ensure the effective involvement of line managers and staff in the training process.	Senior management establishes and promotes the SAT methodology for the facility, regularly reviewing its implementation and the appropriate involvement of line managers, training experts and staff.	Many facilities have a series of hierarchical training committees to identify training needs, agree and sponsor training programme content, monitor the effectiveness of training and maintain the strategic focus on how training supports the facility's goals and objectives.	– How is the involvement of line managers in the training process ensured/ reviewed by senior managers? – What evidence exists for line managers' involvement in the SAT process? – Do line managers participate in training delivery? – Do line managers provide feedback on training provided?

II.2. STANDARD 2

Managers at all levels are responsible for the competence and qualification of their staff and take ownership of training programmes (see TABLE 7).

Standard 2 is about ownership and ensuring an effective partnership between the line organisation and the training staff. Managers take responsibility for the competence of their staff and work effectively with training staff to ensure the qualification of personnel.

TABLE 7.

No.	Condition	Good Practice	Examples	Explanations and Evidence
2.1	Managers work in partnership with training personnel in all stages of the SAT process, from identification of training needs to evaluation of	– Line managers are trained in SAT principles and practical approaches. They have a working knowledge of how the use of SAT supports facility performance.	– Basic SAT training is included in the training profiles of line managers – Line managers participate in training committee meetings where all aspects of the SAT process are discussed and agreed.	– Are minutes prepared for training committees? – Are the minutes timely, decisions documented, and actions tracked to closure?

No.	Condition	Good Practice	Examples	Explanations and Evidence
	the effectiveness of training in delivering the facility's goals.	– Line managers are personally involved in the analysis phase of SAT to ensure the correct identification of training needs. – Line managers regularly verify that initial and continuing training programmes meet facility needs. In particular, managers verify that the training material satisfies course objectives, instructional settings are appropriate for the training, and evaluation tools are accurate and reliable. – Line and training managers regularly meet to discuss current equipment and personnel performance issues to determine how training might be used to resolve those issues.	– Line managers are required to review and approve learning objectives and training material as well as training programme descriptions. – SMEs are trained and regularly participate in training delivery. – Line managers lead level 3 & 4 training evaluations, with support from training staff.	– Do line managers' training profiles include training on SAT? – Do line managers participate in self-evaluation?
2.2	Managers are responsible for the scope, content and quality of the training programmes for their staff.	– Line managers determine the content of training and training managers are responsible for developing training material and conducting training. A strong partnership exists between the line and training organisations to ensure high-quality training. – Line managers monitor training quality through personal observations of training, discussions with line supervisors and workers, and periodic observations of worker performance in the field.	– Line managers participate in curriculum review committees where learning objectives and training material content are reviewed and agreed. – Line managers are required to review and approve learning objectives and training material as well as training programme descriptions.	– Are SAT responsibilities included in job descriptions? – Are managers signing off training objectives and content? – Are line manager observations of training critical and adding value?
2.3	Managers provide resources as required to support the training process, including ensuring the attendance of their staff at identified training.	– The training manager ensures that the training environment promotes learning and supports a variety of instructional techniques. This includes suitable classrooms, simulators, laboratories and mock-ups designed and maintained to meet training needs. – There are sufficient, competent training staff to meet the training needs.	– The training organisation structure is clear, up to date and fully resourced. – There is a long-term training resource plan. – SMEs are trained and regularly participate in training delivery.	– Check training staffing levels. – Review training attendance records. – Check SME training records and qualification. – Conduct a walk down of training facilities and equipment. – Look for evidence of waiting lists in training programmes.

No.	Condition	Good Practice	Examples	Explanations and Evidence
		– All training is supported by high quality, approved training materials and equipment. – Line managers support the training manager in obtaining required resources. This includes temporarily supplementing the training staff with SMEs when necessary. Additionally, components that have been replaced in the facility are provided to the training staff.		
2.4	Line managers observe and participate in the training of their staff.	– Line managers frequently attend training sessions to observe the quality of the training and the interactions between the students and the instructors. Line managers provide training for their staff when appropriate. Line managers solicit feedback from the students about the quality of training and to identify additional training needs. – Managers regularly introduce training sessions, highlighting the importance and objectives of the training as well as setting their expectations for the training and the trainees. They encourage students to actively participate in the training and provide feedback that will improve the quality of the training.	– There is a system for recording manager observations and there are forms for managers to provide feedback. – Managers participate in training pilot sessions. – Managers promote training messages in the line organisation.	– Review manager feedback and check the quality. – Check training pilot records. – Check for records of manager observations.
2.5	Line managers ensure that their staff are competent and qualified for the tasks to which they are assigned.	– Following initial training and qualification, line manager approval is required before workers are allowed to independently perform a job task or function. – Qualification is granted based on the results of training, successfully completing examinations, and meeting experience requirements. New staff who	– There is a qualification management (QM) system, visible to line managers and staff, which maintains the training and qualification records of all staff. – Managers use a skills matrix to monitor skill levels in their teams to manage team competence and identify potential gaps.	– Confirm nature of QM system and whether it is integrated into, or compatible with, the work management system. – Check qualification records for staff. – Check existence and quality of observation records.

No.	Condition	Good Practice	Examples	Explanations and Evidence
		have worked at other facilities may be credited for training and evaluation based on a review of their career history and confirmed knowledge and skill. – Training exemptions are based on criteria that have been agreed by both line and training managers. – Line managers regularly observe workers in the facility to verify they retain proficiency in their work. During these observations, they look for negative performance trends that could be corrected by training. – Line managers are involved in determining the content of continuing training to address declining performance.	– There is a task observation process, with records, for managers to observe their staff. – Managers have training in task observation techniques. – Training contracts are in place with staff for completion of their required training.	– Check whether qualification is linked to completion of training.
2.6	Line managers ensure the competence of contractors for which they are responsible.	– Line managers confirm that contractors are trained and qualified to perform assigned tasks. – Before contractors are allowed to work in the facility, they are trained on applicable facility policies, procedures, and lessons learned from industry events. They are also trained on any applicable changes or new information that becomes available during the work.	– This confirmation is often achieved by a joint training and line manager review of a contractor's work history, a personal interview with the contractor, contacting prior customers, and observations of that contractor's performance in the facility. – If an event involving work similar to that being performed occurs at another site or if the procedure governing administrative control of the work changes, contractors are trained on this new information. – Contracting managers are involved in the procurement process. – Contractors are subject to a task observation process similar to staff.	– Check for the existence and application of national trade standards. – Have managers signed off the contract procurement? – Review contractor competence requirements and verification process. – Review contractor training records. – Have all contractors completed general employee training/site access training? – Have managers provided contract performance feedback?

II.3. STANDARD 3

Initial and continuing training programmes are based on the systematic approach to training (SAT), graded as appropriate to job safety or performance risk (see TABLE 8).

Standard 3 is about the application of SAT to all training activities and programmes, both initial and continuing, to ensure that workers are always competent to perform the tasks to which they are assigned. There is an expectation that worker performance will improve over time and that this will be reflected in facility performance. It recognises that the rigour of application of SAT may be based on the safety or performance requirement of the assigned tasks.

TABLE 8.

No.	Condition	Good Practice	Examples	Explanations and Evidence
3.1	A performance review process is in place to determine a need for training.	– Performance indicators are used to review human performance and trends are monitored. – A performance-based needs analysis process is used to identify whether training, or an alternative solution such as better tools, or procedure or equipment change, is appropriate. – Competent personnel (line managers, experienced workers, subject matter experts and instructors) participate in identifying training needs.	– A root cause/human performance review process is used to identify training needs. – Clear standards are provided for management review of analysis products. Training committees monitor changes and take appropriate actions if their programmes are affected by: • Engineering changes • Regulatory changes • Policy changes • New processes • New facility/equipment	– Check whether a performance review process exists. – Check the use of performance indicators and trending. – Check the existence/quality of root cause analysis reports. – Check whether human performance training is provided for managers and staff.
3.2	Initial training programmes take due account of existing entry level education and qualifications.	– The entry level requirements, including qualifications and prior training/ experience, are specified for all training activities, based on the job and task analysis, and are consistent with the content of the training. – Managers review and validate that prospective candidates have the required skill and knowledge.	– Partnerships with local educational institutions (colleges, universities, trade schools) can aid in candidate selection, by ensuring candidates meet the entry level requirements. If these partnerships are established, managers should regularly review the content and delivery of education or training at these institutions to ensure high quality instruction is maintained and prerequisites continue to be met.	– Are programme pre-requisites specified? – Is there evidence of these pre-requisites being met and recorded?

No.	Condition	Good Practice	Examples	Explanations and Evidence
3.3	All training programmes and activities are developed based on the SAT model.	– Written procedures exist describing how SAT is applied at the facility, which also identify the roles and competence requirements of all personnel involved in the training process. – Analysis is commensurate with the importance of training to nuclear safety, reliability, and the complexity of the job requirements. – Learning objectives satisfy the job performance requirements with respect to task, the conditions under which the task is to be performed, and the applicable quality standard. – All personnel involved in the training process are trained in the application of SAT as appropriate for their roles.	– Line and training managers review each of the training programmes to verify that the systematic approach to training was properly applied. – Training programme performance is regularly reviewed to confirm that it is effective in conveying to students the skills, knowledge, and attitudes needed for successful job performance.	– Are SAT procedures comprehensive and up to date? – Check the quality of SAT application records. – Check for confirmation that learning objectives meet job performance requirements.
3.4	The level of application of SAT is based on an assessment of the safety or performance risk.	– Training policies and procedures provide flexibility in applying the systematic approach to training. The extent of application of the various elements of SAT is based on the importance of the job to personnel and nuclear safety, to equipment reliability, and to the complexity of the job performance requirements. – Analysis is commensurate with the importance of training to nuclear safety, reliability, and the complexity of the job requirements. – Existing training material may be used as a starting point to efficiently develop new training materials.	– For tasks that are very complex or have a direct effect on nuclear safety (e.g., reactivity manipulations, emergency core cooling tasks, etc.), formal analysis is expected. This might include benchmarking and very detailed discussions between line and training individuals to understand and fully consider all aspects of the task. – For less complex or less safety significant tasks, less analysis detail is needed. – For some relatively simple or administrative tasks that carry little risk of personnel injury or equipment damage, the SAT application can be streamlined	– Do SAT procedures reinforce the graded approach? – Is there documentation supporting the proper application of the graded approach?
3.5	Facility modifications, operating experience	– Facility and personnel modifications, document and procedure changes and	– Design change processes include a training department review of	– Do facility modification procedures require a training signoff?

No.	Condition	Good Practice	Examples	Explanations and Evidence
	feedback (OEF) and procedural, organisational, legislative and regulatory changes are reviewed for training impact and incorporated as necessary.	infrequent facility evolutions with training implications are identified and training is delivered in a timely manner. – Continuing training schedules are built with sufficient flexibility to accommodate adding emerging changes that need to be communicated quickly.	proposed design modifications to determine the effect on training. Any new training needs that are identified are delivered before the modification is commissioned. – Training personnel review all incoming industry operating experience documents, procedures, and other organisational or regulatory changes to determine if existing procedures or training material are affected. If so, training and line management are informed, and training material is designed and developed or modified, then delivered to the appropriate workers. – The modification budget includes the cost of developing and delivering training as well as any necessary training facility modification (i.e., simulator hardware or software, or facility mock-ups).	– Review documentation for recent modifications, changes and OEF to determine if training programmes were affected and changes implemented. – Is training directly involved in the OEF review process?
3.6	Job performance requirements are analysed to identify all the required knowledge, skills and attitudes (KSAs) and initial and continuing training needs.	– Job, task, and needs analysis are conducted to identify training needs, based on agreed procedures. These procedures include clear standards for collecting, analysing, and reviewing job and task information. – Job task analysis (JTA) and/or job competence analysis (JCA) is/are used to identify the KSAs required for individual job positions or job families. – Subject matter experts (SME) as well as training experts are involved in conducting/reviewing the analysis phase.	– A panel of SMEs is used to assist training personnel when selecting tasks for analysis and determining whether tasks will be selected for initial, continuing, or just-in-time training. The panel also helps determine the levels of difficulty, importance, and performance frequency for selected tasks to establish refresher training frequency. – Training procedures include analysis templates and job aids to help analysts capture important job and task related data.	– Review task lists and DIF (difficulty/importance/frequency) ratings and compare to initial and continuing programme content. – Evidence of reviews of task lists and DIF ratings. – Documentation of analysis process and decisions taken.

No.	Condition	Good Practice	Examples	Explanations and Evidence
			– Training committees periodically review and update the task lists and DIF (difficulty/importance/ frequency) ratings to ensure refresher training is properly specified and conducted in a timely manner.	
3.7	Learning objectives for training are designed and developed to ensure they meet the required KSAs.	– Learning objectives are based on the required KSAs, as identified in the analysis phase. – Learning objectives identify observable and measurable trainee action or behaviour, as well as the conditions under which the action is to occur and the standard to which the action is required to be performed. – Test items are developed to closely match the objectives and test at the same level of complexity as the objective itself. – Learning objectives are sequenced within each training setting, based on their relationships to each other.	– Complex test items are required to distinguish whether a student truly understands a concept or is merely repeating back an expected response. – If a learning objective requires a student to "explain" a concept, an essay response is more appropriate than filling in a blank or selecting from multiple possible answers. – Sequencing of learning objectives is important because some objectives build on others. Generally, simple objectives are covered first, followed by more complex objectives.	– Review of task to training matrices to ensure that identified tasks are addressed by learning objectives. – Review lesson plans and examinations to ensure alignment between objectives taught and level of KSAs required.
3.8	Training methodologies, settings and equipment are identified by the SAT process.	– Training settings are matched with learning objective requirements. – Training material supports the objective and the training setting and includes sufficient guidance for the instructor to implement various training strategies, such as questioning students to measure understanding or injecting relevant operating experiences at the right point in the lesson. – Training settings are selected early in the process because they affect the development of learning objective conditions and standards.	– If a student is to demonstrate knowledge, a classroom lecture may be specified. If a student is to demonstrate skill or capability, a laboratory or simulator setting is more appropriate. – Some training settings are more expensive than others and may require coordinating schedules. Problems with proper coordination can significantly delay training delivery. – Although on-the-job training best replicates facility conditions, excessive use of this setting may disrupt essential	– Check that training settings and equipment are identified in the training documentation. – Check that appropriate settings and training equipment are being used for the delivery of training.

No.	Condition	Good Practice	Examples	Explanations and Evidence
		– A full-scope simulator and appropriate laboratories, mock-ups, workshops and part-task simulators are provided for those objectives which require a high fidelity of training settings.	facility operations or result in training delays.	
3.9	Training is implemented, and trainees are evaluated to confirm the required KSAs have been achieved.	– Training procedures support effective training implementation. These procedures include guidance for determining whether programme prerequisites and learning objectives have been met, as well as instructor preparation activities, training setting preparation requirements, and training feedback collection. Procedures also describe how training is to be conducted in the various settings. – Lesson plans guide the instructor in the delivery of the learning material. – Instructor performance is evaluated by both line and training management. Constructive feedback is provided to improve instructor performance. – Trainees are tested to ensure they have met the requirements of the learning objectives. – Post-training evaluations are used to measure training effectiveness in an on-the-job setting.	– Tests and answer keys are kept secure to prevent compromise. – Typically, about 6 months after training, former students are asked to reflect on how well training has prepared them to perform their assigned work. Line supervisors are also asked to provide feedback on how training has supported or improved worker performance. This feedback is incorporated into future training sessions. Remedial training is designed and delivered if necessary. – Facility performance indicators are used to confirm that problems which resulted in training have been adequately resolved. If the problems have not been resolved, they are re-analysed to determine if additional training or other management initiatives are needed.	– Check the completeness and quality of training procedures and documentation. – Review samples of training materials. – Observe samples of training delivery and assessment. – Review exam bank questions to confirm test items match learning objectives in terms of scope and level. – Review remedial training plans for individuals who did not meet the required standard(s).

II.4. STANDARD 4

All personnel involved in training activities are competent for their assigned roles (see TABLE 9).

Standard 4 is about ensuring that all personnel involved in the training process have a good understanding of SAT, particularly as it applies to their roles in the process. Where personnel have specific roles in the training process, this is reflected in their role and training profiles and they are competent and qualified to carry out these roles.

TABLE 9.

No.	Condition	Good Practice	Examples	Explanations and Evidence
4.1	All training staff and instructors, including part-time instructors and Subject Matter Experts (SMEs), have sufficient expertise and pedagogical competence to implement their tasks.	– Training staff are both technically and pedagogically (teaching) qualified for the areas in which they provide training, respected by facility personnel, and capable of providing high-quality instruction. – The qualification of SMEs and contract personnel are verified to ensure they have the necessary technical knowledge and instructor skills to provide the training. – Training staff are provided with opportunities to maintain their technical competence and support their professional development.	– Training staff support SMEs that do not possess the necessary instructor skills by remaining present during the training session. – Such opportunities could include rotational assignments to line departments during routine operations and outages and exposure to supervisory responsibilities.	– Review training and qualification requirements and records for staff with training roles.
4.2	The responsibilities of all personnel participating in the training process, including managers and SMEs, are reflected in their job descriptions/ competence profiles.	– Training procedures describe the roles and responsibilities of all training and line staff, including managers and SMEs. – Any training responsibilities are included in the job descriptions and training profiles of line managers and staff, including SMEs.	– Line managers' responsibilities typically include communicating expectations for worker performance in the facility and in training, addressing performance weaknesses, identifying training needs, approving training materials, observing and providing feedback on worker and instructor performance, awarding qualifications, and providing training oversight. – Workers are typically expected to identify additional training needs or	– Review job descriptions for staff with training roles. – Check if training procedures include the respective responsibilities of line and training staff.

No.	Condition	Good Practice	Examples	Explanations and Evidence
			requests, act as subject matter experts as appropriate, participate in training when scheduled, achieve relevant learning objectives, apply training to the assigned job and provide constructive feedback.	
4.3	All personnel involved in the training process understand their responsibilities in the SAT process.	– Initial training for all staff includes an introduction to SAT. – All staff with a specific role in the training process receive initial and continuing training, based on their role, and are qualified for that role.	– Training programme owners and training committee members receive SAT training appropriate to their roles.	– Interview appropriate staff to confirm their knowledge of SAT appropriate to their role. – Observe staff performing their training roles to confirm competence.

II.5. STANDARD 5

Training is reviewed to confirm its impact on the facility's safety, performance and commercial goals (see TABLE ~~TABLE~~).

Standard 5 is about ensuring that training effectively supports facility performance. Training performance is monitored at the highest level in the facility. Trainer and trainee performance is evaluated, and action is taken to remedy any discrepancies. Facility performance is monitored to evaluate overall training effectiveness. Self-evaluation is used to enhance training performance and effectiveness.

TABLE 10.

No.	Condition	Good Practice	Examples	Explanations and Evidence
5.1	Senior managers monitor, review and provide oversight to ensure the effectiveness of training.	– Senior managers determine and monitor training effectiveness indicators. – The performance of training is part of senior managements' strategic agenda and is a regular item on facility management meetings.	– Many facilities have a training advisory committee or training oversight committee, chaired by senior management to assess training effectiveness and recommend improvements. These committees are often supported by lower level committees, involving line managers in reviewing and overseeing specific programmes.	– Is there a policy that directs this process? – How are results measured? – What are the statistics of the facility performance? – How has training improved the business? – Do managers intervene to make decisions, rather than the committees?

No.	Condition	Good Practice	Examples	Explanations and Evidence
			– Appropriate performance indicators are identified, monitored and followed up. – Consistent feedback is provided throughout the training process.	– What is being targeted for improvement? – discuss with senior managers through interviews. – Review the observation programme (need to check what the results are). – Check senior managers' involvement in the evaluation committee.
5.2	Managers are responsible for addressing the identified deficiencies in training and performance.	– Managers' job profiles include training responsibilities such as: approving training analyses, agreeing training programme descriptions, undertaking regular work and training observations and monitoring training performance. – Managers follow up on identified training weaknesses, providing expert support to improve training as appropriate. – Metrics are established before the training and then evaluated after the training.	– Many facilities have mid-level committees where managers participate in the implementation of the SAT process, participating in and reviewing outputs from the analysis phase, agreeing training programme content and receiving/giving feedback on training effectiveness.	– Results of external or internal reviews. – What deficiencies were identified and what has been done? – How did senior management address issues found in these reviews? – Is there a corrective action programme and how involved are management? – How do managers use the committees to address and manage their actions? – Are observation and coaching regarded as major responsibilities? – Who is the training programme owner – are they aware of the status of the programme? – Are there weaknesses or gaps in competencies and performance? – Effectiveness of the actions and close out issues – is management involved?
5.3	Feedback following training, in addition to personnel and facility performance, are used to evaluate the effectiveness of training.	– Instructors and training managers observe student reactions during training and trainees are asked to provide feedback on training (Level 1*). – Trainees are tested to ensure the training is effective and the trainees have acquired proficiency with the objectives (Level 2*). – Line managers observe the actual performance of trainees in the workplace,	– Typically, facilities use training feedback sheets (sometimes referred to as 'happiness' sheets) during training to obtain trainee reaction. – Various tests including written, oral and performance based, are used to confirm trainee learning. – Feedback is given after feedback – analysis is made and reported back to	– What feedback mechanisms or evaluation plans are used on site? – What criteria are used to determine whether to use Level 3* and Level 4* feedback? – How has training changed as a result of the observations - example where training was modified?

No.	Condition	Good Practice	Examples	Explanations and Evidence
		post-training) and provide feedback to the training organisation (Level 3*).	individuals about what actions were taken from the feedback provided.	
5.4	Training programmes are regularly reviewed and updated to incorporate changes to requirements and emerging needs.	– Senior management have procedures and mechanisms in place to monitor the performance of training programmes. – Regular self-assessments are conducted, and the results of these assessments are included in the facility's corrective action programme to track implementation and closure. – Training staff are required to review proposed facility/procedure changes to determine the impact on training.	– Training programme performance and self-assessment results are reviewed in the facility's strategic training committee. – There is a formal process and schedule for the review of training programmes. – There is a process for reviewing the training impact of modifications to site or plant procedures.	– Is there an up to date schedule for reviewing training programmes? – Is there evidence of changes made to training as a result of routine reviews? – Is there a time limit for implementing identified changes to training? Is it being met? – Is there a backlog of identified change needs? – Are changes to regulatory requirements reflected in training programmes? – Who is the training programme owner – are they aware of the status of the programme?
5.5	Training and other self-assessments are conducted regularly, and the results are used to support continuous improvement of personnel and facility performance.	– Regular self-assessments are conducted, and the results of these assessments are included in the facility's corrective action programme to track implementation and closure. – Training self-assessments use facility performance targets, in addition to training performance indicators, to determine training effectiveness.	– Peer review findings and regulatory audits are compared with self-assessment findings for benchmarking – Training aspects are included in operational performance self-assessments	– Check self-assessment schedule to confirm that it is comprehensive and up to date. – Check quality of previous self-assessments? What were the findings? What actions? Trends? – What happens to self-assessment results? – How are they reviewed?

5.6	To support continuous improvement, the facility benchmarks its training processes and programmes.	– The facility uses peer review processes to verify the effectiveness of its training programmes and identify opportunities for improvement
		– Benchmarking of training processes and programmes with other facilities is used to support continuous improvement.
			– Site has several levels of benchmarking:
			  – internally between programmes,
			  – with other nuclear facilities,
			  – with non-nuclear facilities.
			– Benchmarking programme has clear objectives.
			– Line managers participate in peer reviews.
				– Review results of benchmarking to determine if the objectives were met.

No.	Condition	Good Practice	Examples	Explanations and Evidence
5.7	The facility assesses the level of return on its training investment.	– Facility management uses appropriate performance indicators to measure the impact of training on facility performance (Level 4*).	– The facility has specified targets and performance indicators in place to measure training ROI.	– Review the targets and performance indicators to determine training effectiveness.

* The reference to Levels relates to the Kirkpatrick Evaluation Model, the model for evaluation widely accepted in the nuclear industry www.kirkpatrickpartners.com

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LIST OF ACRONYMS

ADDIE	analysis, design, development, implementation and evaluation
DIF	difficulty/importance/frequency
IAEA	International Atomic Energy Agency
JCA	job competence analysis
JTA	job task analysis
KSAs	knowledge, skills and attitudes
OEF	operating experience feedback
OSART	operational safety review team
QM	quality management
SACs	standards and conditions
SALTO	safety aspects of long term operation
SAT	systematic approach to training
SMEs	subject matter experts
WANO	World Association of Nuclear Operators

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