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MEANS OF EVALUATING AND IMPROVING THE EFFECTIVENESS OF TRAINING OF NUCLEAR POWER PLANT PERSONNEL

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FOREWORD

In 1996 the IAEA published a guidebook on Nuclear Power Plant Personnel Training and its Evaluation, which constitutes the recommendations of the IAEA with respect to development, implementation and evaluation of training programmes. The IAEA Technical Working Group on Training and Qualification of Nuclear Power Plant Personnel recommended that an additional publication be prepared to provide further details concerning the effectiveness of NPP personnel training.

As the nuclear power industry continues to be challenged by increasing safety requirements, a high level of competition and decreasing budgets, it becomes more important than ever to have some methodology of ensuring that training contributes a value to the organization. The actual determination of training effectiveness is not an easy task because of the many variables associated with personnel performance. For example, for training to make a difference in job performance, line management should be involved prior to training delivery to identify what performance is desired, but not being achieved. Then, training is developed to meet desired performance, which is followed by practice and continued management reinforcement. Because of these other variables, it is very difficult to prove that training had a sole contribution to performance improvement, but rather one of many contributors needed for performance improvement. The difficulty to isolate training as a sole contributor has been documented in a number of research studies over the recent years.

Due to these limitations, a base assumption must be made in order to use any methodology for training effectiveness evaluation. That assumption is that there are some basic principles for developing training and if training programmes are developed and maintained using these principles, then the training provided should be an effective tool to improve the line organization performance. By monitoring various types of training effectiveness indications, weaknesses can be identified and improvements made. These improvements should support an overall improvement in plant performance. Strengths can also be identified to further strengthen the positive aspects of the organization.

This report provides information on methods and practices used to evaluate and improve the effectiveness of training. This should result in: plant performance improvement, improved human performance, meeting goals and objectives of the business (quality, safety, productivity), and improving training programmes. This publication is available in two formats — as a conventional printed publication and as a CD-Rom which also contains original contributions in the original language by Member States.

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EDITORIAL NOTE

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CONTENTS

1. INTRODUCTION

1.1. PURPOSE

The purpose of this report is to provide information on methods and practices to evaluate and improve the effectiveness of training and assistance for nuclear facility managers to establish and maintain effective training programmes for NPP personnel. In this context, the term *training effectiveness* means that *training provides significant added value to NPP operations* by improved *safety, quality and production*.

While it is abundantly clear that training can provide added value, a measured, isolated, determination of training effectiveness is difficult because personnel performance depends not only on training, but also on many other factors such as supervision, procedures, job aids, pre-job briefings, management expectations, and the experience and motivation of the workforce. To isolate and identify the value added by training requires either statistical separation of the actual performance data or institute work controls to try to isolate the training effects alone. Neither of these is practical in the day-to-day management of training or the actual operation of a nuclear power plant.

A different approach is needed. Therefore, based on the individual and collective experience of many years of NPP operations, it is asserted that principles of effective training can be discerned and that if training programmes are developed and maintained using these principles, training will make effective contributions to improved personnel performance. Under this premise, indicators can be monitored to provide evidence of the overall training effectiveness, strengths and weaknesses can be identified, and reinforcements or improvements can be made.

This publication also contains several examples to identify and improve the effectiveness of NPP training programmes. In their respective NPPs, these examples demonstrate that effective training programmes are reflected in improved personnel performance, improved plant performance, and therefore, the achievement of NPP goals and objectives.

1.2. SCOPE

This report is intended to support those primary nuclear facility jobs that have a potential for severe consequences resulting from poor performance or human error. Those disciplines are typically operations, maintenance, radiological protection, chemistry, engineering, and select supervisory positions. Other training programme areas or disciplines can be monitored depending on the needs of the facility.

The *management of effective training* provides the overall structure needed to ensure that nuclear training programmes have processes in place to support safe operations. While recognizing that all elements of the suggested *principles of effective training* may not always be implemented effectively, organizations that monitor effectiveness and strive to improve weaknesses are consistently the best performers.

In addition to listing examples of training effectiveness indicators, a list of *warning flags* noted by the Institute of Nuclear Power Operations (INPO) in the US is provided. Developing indicators associated with these warning flags will assist organizations in avoiding these weaknesses.

The *evaluation methods of training effectiveness* lists the elements of systematic training programmemes and how each element is typically evaluated. These elements are directly related to one or more of the *principles of effective training*. Then, a method to monitor each of these elements is used as an indicator of the overall training effectiveness. It is necessary to use these indicators together, as single evaluation elements by themselves do not measure effectiveness of later performance, but only whether the outcome of the designated training activity was achieved.

1.3. TERMINOLOGY

The terms used in this report that may require explanation are presented in Annex B.

2. MANAGEMENT OF EFFECTIVE TRAINING

2.1. OVERVIEW

NPP line managers and supervisors bear the primary responsibility to assure that people perform their jobs safely and effectively. Training personnel must be responsive to the needs of the organization, working hand-in-hand with line managers and supervisors to ensure that training needs are properly analyzed, and that training is developed and implemented in the most effective and efficient way possible. The training organization must actively and continually communicate with the line organization, and the principles cited below are not intended to be a replacement for the fundamental need for communication.

The *principles of effective training* stated below are intended to assist NPPs in establishing and maintaining effective training programmes that produce well-qualified, competent personnel to operate and maintain the NPPs in a safe and reliable manner. Details of these principles are shown in the IAEA-Technical-Reports Series-380 and related DOE and INPO documents. Each *principle* is supported by *elements* that further elaborate on some of the specifics to be considered. These *principles* can be considered individually, but collectively the *principles* provide a framework for the overall management of effective training.

2.2. PRINCIPLES OF EFFECTIVE TRAINING

The facility is organized, staffed and managed to provide training that supports the facility mission

Training requires a strong commitment from NPP line management to support training programmes that contribute to fulfilling company goals and objectives. The training mission must be clear, and individual roles and responsibilities need to be defined. NPP management must effectively direct and adequately support training activities.

Line managers are responsible for the effective conduct of training and qualification programmes. They ensure that the content and conduct of the training and qualification programmes to produce competent and professional workers and supervisors. Line and training managers ensure that personnel attend required training or participate in timely makeup training.

A systematic approach to training is used as the primary management tool for establishing training programmes and conducting training activities. Once established, training programmes are used to train and qualify personnel. Personnel entering initial training programmes possess expected entry-level knowledge, skills, and experience. Personnel complete designated training and qualification requirements prior to being assigned to work independently or are directly supervised. Exemptions from training are rare, but are granted only when supported by an assessment of prior education, training, and experience.

Training activities are funded and staffed adequately to implement and maintain the training programmes. Training facilities, equipment, and materials effectively support training activities. Training records are maintained to support management information needs and to provide required historical data.

The training staff possesses the technical and instructional knowledge, skills and attitudes to fulfill their assigned duties

Training managers, instructors, and programme development personnel possess and maintain the educational, technical, and experience qualifications required for their respective positions.

The instructional skills training programme develops the necessary instructor capabilities to fulfill training programme requirements in all applicable training settings. Trainers are evaluated on their ability to teach, supervisors are encouraged to follow up the appropriation of the skills of their trainers by frequent on the job observation during and after their initial training.

Personnel who conduct on-the-job training and evaluations are cognizant of utility policies, procedures, methods, and standards for conducting effective on-the-job training and task performance evaluations. When subject matter experts are used on an occasional basis as instructors, qualified training personnel ensure training quality through appropriate assistance and monitoring.

Instructional skills and technical competencies of instructors are evaluated regularly in applicable training settings. Continuing instructor development maintains and improves needed technical and instructional knowledge and skills and addresses weaknesses resulting from evaluations of instructor performance. To maintain their level of skills, trainers must refresh their plant knowledge by regular periods of work or observation in the plant.

The training programme content for competent job performance is identified and included in the training programmes.

The training programme content provides the trainee with the knowledge and skills needed to perform functions associated with the position for which training is being conducted. The content of initial training prepares trainees to perform independently the duties and tasks for which they are being trained. The content of continuing training is selected to maintain and improve incumbent job performance.

Industry guidance and associated training materials are used in conjunction with a systematic development process to establish and maintain the training programme content.

New or modified tasks selected for training are analyzed to identify new knowledge and skills to be included in the training programmes.

The initial training programme incorporates the necessary knowledge and skills to prepare trainees for task or duty area qualification. Plant personnel, training staff, and other subject matter experts, as appropriate and as needed, develop and maintain a valid plant specific task list as the basis for the training programme.

The continuing training programme maintains and improves the knowledge and skills of job incumbents and is based, as appropriate, on programme evaluation feedback, changes in regulatory requirements, changes in job scope, results of external evaluations and inspections, changes in plant procedures, changes in plant systems and equipment, industry operating experience, plant operating experience, equipment and personnel performance trends, pre-job training on tasks that are critical, and pre-job training on tasks that are infrequently performed and/or require a high level of proficiency.

A systematic process is used to determine job performance requirements, specify training programme content, prepare supporting training materials, and maintain the training programme.

Training is conducted in a setting suitable for the particular training content.

Trainee mastery of job-related knowledge and skills is achieved through effective instruction. Trainee performance is evaluated in a reliable and valid manner.

Classroom, individualized instruction, laboratory simulator, and on-the-job training are sequenced effectively to provide completion of prerequisite knowledge and skills prior to receiving training on more advanced knowledge and skills.

Instructors are prepared to deliver effective and consistent training.

Individualized instruction, when used, provides the trainees with sufficient guidance and supporting materials.

Trainees are evaluated regularly using written, oral, and/or performance examinations and quizzes. Remedial training and reevaluation are provided when performance standards are not met satisfactorily.

Training programmes are evaluated and modified to ensure they remain consistent with the necessary job function.

A systematic evaluation of training completeness and effectiveness is conducted. The results are used to modify the content and conduct of training programmes.

Comprehensive evaluations of training programmes are routinely conducted to identify programme strengths and weaknesses. Improvements and changes to initial and continuing training programmes are systematically initiated, tracked, and incorporated in a timely manner.

Feedback from managers, supervisors, trainees, and former trainees is used to evaluate and modify training programmes. Improvements and changes to initial and continuing training

that could enhance the safety and reliability of plant operations are solicited from plant personnel.

The conduct of training is monitored and evaluated regularly in all settings.

Trainee performance measured during training is used to evaluate and modify the training programmes.

2.3. WARNING FLAGS

Careful analysis of deficient training programmes by INPO resulted in identification of common problems, which were identified and grouped into the following seven categories cited as *warning flags*, presented at the IAEA Specialists Meeting on Evaluating the Effectiveness of Training for Nuclear Facility Personnel held in Pasco, Washington, USA in 1999.

Lack of line management ownership

Strong involvement and participation of training and line management are vital components of robust training programmes. Conversely, weak ownership of training programmes has contributed to degraded training effectiveness. An indicator of weak ownership of the training programme may be infrequent monitoring and observation of training activities. Direct observation of training activities is a necessary input to the manager on the health of the training programme.

Weak self-assessments

Most stations perform self-assessments to identify weaknesses and areas for improvement in their training programmes. However, problems have resulted from these self-assessments being less aggressive or less critical than necessary to identify problems. Contributing to these problems may be that training or line managers do not participate or properly direct the self-assessment. As a result, problems not identified tend to grow and amplify themselves until they are self-evident and have caused significant degradation in the training programmes.

Student dissatisfaction

Often, student dissatisfaction with training results in students not participating in the training, not asking questions, or not providing comments. Instructors should be aware of this sort of passive feedback. Managers observing training can identify these behaviors. Students may provide feedback after training that the material presented was not applicable to them or to their jobs. These comments may indicate a weakness in providing training to address actual job performance.

Isolationism

Learning from others is a necessary component of a robust training programme. Stations without benchmarking or other methods of learning from other stations often do not recognize

when degradation begins in training content, methods, or other programme attributes. One method used to learn from other stations is to participate in evaluations or peer reviews through INPO or WANO.

Weak use of a systematic approach

Often, training is not part of the strategy for improving plant performance. In these cases, there is a poor link between known human performance problems and training being provided. In addition, some stations created new positions as a result of organizational changes. These new positions required new knowledge or skills, but the analysis was not considered as part of the change process.

Insufficient line management training expertise

A working, practical knowledge of training processes and content by the responsible managers is necessary to maintain a robust training programme. When plant line managers do not fully understand their responsibilities for their training programmes, they rely on the training manager to identify and address training related weaknesses. The training manager is normally not able to provide this level of support for all the training programmes.

Distractions from training

The complete text for this warning flag is “Distracting activities that focus management attention away from training.” Every station has many varied concerns and activities, in addition to training, that must be managed in accordance with appropriate priorities. However, significant degradation in training programmes has resulted when a major station problem or regulatory issue caused management attention to be focused exclusively on that issue.

In general, the problematic aspects of the training warning flags do not appear instantly, but rather develop over time. Several diverse factors influence their development. These factors were examined to identify the early signs that weaknesses were developing and to what degree. Table 1 below lists the precursors relative to each of the training warning flags. The precursors are more subjective than the warning flags and should be used with that understanding.

When used appropriately, the training warning flags can provide an effective framework for self-assessments of training programmes. The precursors provided for each training warning flag may be used as subjective means in identifying early indicators of developing problems in training programmes. Considering the training warning flags when making changes to training programmes and processes may help maintain the effectiveness of the training provided.

2.4. OWNERSHIP AND RESPONSIBILITIES FOR EVALUATING THE EFFECTIVENESS OF NPP PERSONNEL TRAINING

Line management must own the evaluation of NPP personnel training effectiveness, like training itself. However, all participants must be fully accountable for the quality and effectiveness of their activities in the training process. From corporate and executive management to plant personnel, each professional should be able to assess whether they and those reporting to them are trained effectively to carry out their responsibilities and tasks

proficiently. NPP managers and supervisors must also be able to evaluate that training standards set by regulatory and accreditation bodies for NPP personnel are effectively met. Cognizant work group managers are ultimately responsible to make a final determination that subordinate personnel are receiving effective training.

Table 1. Training Warning Flags and Precursors to Degraded Training Effectiveness

TRAINING WARNING FLAGS	PRECURSORS
1. LACK OF OWNERSHIP – Satisfactory plant personnel performance is given as the primary basis for confidence that training is being done well. – Line managers infrequently observe training and seldom provide meaningful comments or verify that expectations are met. – The training staff assumes little responsibility for plant performance. – The line staff assumes the training organization has sole responsibility for training performance. – Training managers do not effectively communicate training deficiencies to appropriate levels of line management	– First line supervisors infrequently attend continuing training with their employees. – Instructor development is assigned a low priority. – Other duties assigned or expected of instructors impede development efforts. – Communication between the line and training organizations is limited or ineffective. – Management observations of training do not offer improvements or constructive criticism. – Weak training management does not communicate training needs or weaknesses to line or utility management. – Strong training management carries most training responsibilities relieving line to do other activities. – Morale in the training organization is low. – Housekeeping is degraded in classrooms, labs, and shops. – Training performance indicators are inadequate or are not used. – Training management has not reviewed performance indicators for applicability to current training needs. – Continuing improvement in training effectiveness is not pursued because indicators show satisfactory performance.
2. WEAK SELF-ASSESSMENTS – Self-assessments seldom identify weaknesses because reviews are not self-critical. – Line management does not actively participate in self-assessment activities. – Follow-up is not done to evaluate the effectiveness of corrective actions. – Problems identified in one programme are not considered in other programmes.	– Personnel assigned to conduct self-assessments are not knowledgeable of training processes, programmes or requirements. – An environment conducive to the open identification and discussion of weaknesses does not exist. – Self-assessments are assigned a low priority.

TRAINING WARNING FLAGS	PRECURSORS
– Self-assessments seldom include observations of training activities. – Self-assessments do not consider industry training and qualification lessons learned. – Self-assessments do not identify training recurring weakness trends previously identified from internal assessments and external evaluations. – Ongoing evaluations of training miss weaknesses that are subsequently identified during comprehensive self-assessments.	– Weaknesses identified in self-assessments are not resolved or used for programme improvements. – Expectations for self-assessments are not defined. – Process for conducting self-assessments is not well defined.
3. STUDENT DISSATISFACTION – Student attendance at scheduled training is frequently low. Makeup training is not completed or is conducted at a lower standard than the originally scheduled training. – Students complain that training provided does not apply to their jobs. – Students do not actively participate in class activities or discussions. – Student feedback is generally negative, not provided, or contains little useful information.	– Instructors do not follow lesson plans and do not initiate revisions for recognized problems. – Instructor skills and knowledge are poor. – Instructor development is assigned a low priority compared to other instructor duties. – The quality of training materials is poor. – The process for revising training materials is cumbersome, slow, and difficult. – Review process for training materials requires several signatures such that responsibility for training material quality is diluted. – The exam failure rate is very high or very low. – Very old lesson plans are used. – Expectations for exam use and difficulty are not defined.
4. ISOLATIONISM – Training staff rarely interacts with staffs at other plants, and lessons learned from other plants are rarely factored into training. – The utility seldom provides peer evaluators to support accreditation and evaluation team visits. – Utility staff interface with the Academy training coordinator is minimal.	– Information from past evaluations or assistance visits is not used. – Industry experience is not effectively used in training programmes. – Recognition of industry practices or available information is lacking. – Difficulty in making contact or spending quality time with training or line personnel.
5. WEAK USE OF A SYSTEMATIC APPROACH – Training is not considered in the strategy for improving plant performance. Training provided does not correlate with known human performance problems. – The training staff does not actively seek	– Corrective actions for human performance problems are narrow and concentrate on individuals rather than processes. – Line managers do not view training as a resource for addressing human performance

TRAINING WARNING FLAGS	PRECURSORS
solutions to plant problems, either through awareness of human performance issues or analysis of plant events for training needs. – Training impacts are not considered following significant procedure or equipment changes. – New positions are developed or existing positions significantly modified without consideration of training needs.	weaknesses or improving performance. – Station personnel and trainers are unfamiliar with industry operating experience relative to their work. – New training programmes do not use a systematic approach in their development. – Training is not appropriately used as a corrective action in addressing human performance or plant performance problems. – Supervisor or worker input is not used in determining the content of continuing training. – Human performance problems are occurring especially in newly hired workers. – Organizational changes are made without consideration of training needs
6. INSUFFICIENT TRAINING EXPERTISE – Cumulative knowledge, skill, and experience of the training staff have declined, including understanding of accreditation standards. – Training managers are assigned with little training experience and do not receive timely training. – Line managers lack sufficient understanding of how to apply a systematic approach to training to improve plant and worker performance.	– Management and leadership development activities are weak, ineffective, or are given a low priority. – Contractors are used in supervisor or management positions. – The qualifications or traits needed for training management positions are not recognized or defined. – Senior management expects that training management alone is responsible for solving training problems. – Management personnel are rotated to various positions without training and development in areas to be managed. – Turnover in management positions is high.
7. DISTRACTIONS – Continuing training is suspended during prolonged outage periods. – Major regulatory challenges, significant plant performance issues, and extensive support of plant activities take the focus off of training. – The training staff is assigned to responsibilities outside of training for extended periods.	– Training is assigned a low priority in comparison other plant activities. – Training personnel are assigned collateral duties that detract from their training and development responsibilities. – Training requests for line assistance or personnel are not considered. – The quality of training materials is poor. – The backlog of training material revision requests is high and/or is growing.

The systematic approach to training (SAT) serves as a management tool to support the effective development, delivery, and evaluation of training. If elements of the SAT are not implemented, the effectiveness of training will be adversely affected. The proper implementation of the SAT includes the process for evaluating effectiveness, including the clear definition of corresponding responsibilities. An evaluation of training effectiveness is an integral part of SAT. Section 3 of the entire publication will elaborate the various levels of training effectiveness evaluation.

Openness and teamwork is critical to fully integrate information and support from self-assessment and performance improvement systems such total quality management, quality assurance, human performance evaluation and development, human resource management, configuration management, root cause analysis and others into an effective training programme and to ensure adequate resources are budgeted.

The effectiveness of training cannot be evaluated without reliable data and information that correctly identifies performance problems and improvement opportunities as training rather than a number of other human performance factors such as inadequate direction, procedural deficiencies, design inadequacies, or non-training associated human performance deficiencies. If NPP personnel improperly conduct an activity that they have been adequately trained to accomplish correctly, it is NOT necessarily a training deficiency and attempts to deal with it as such may divert attention from proper corrective actions.

Plant managers, training managers, and training staff shall ensure related “triggering events” and available information taken into consideration while evaluating training programmes, e.g. plant operating experience; industry-wide experience; changes to the regulations, the plant systems, documentation, organizational structures; reports from inspections and audits; exam failures; significant plant events; problems in teamwork, command, control and diagnostics; inputs from trainees, evaluators, instructors, supervisors and job incumbents.

The responsibilities for evaluating the effectiveness of NPP personnel training are assigned to a variety of groups within and outside the plant. The division of responsibilities must emphasize clarity and appropriateness, and should be supported by the overall process of plant and corporate quality assurance and control. The following responsibilities are assigned to the participants in training effectiveness evaluation but may vary from country to country and be dependent upon specific organizational arrangement:

Corporate and NPP line management:

Corporate and executive management

- Possess a working knowledge of the key elements of effective NPP personnel training and ensure all managers and supervisors have a working knowledge of SAT evaluation methods and techniques;
- Establish specific performance objectives and criteria for measuring the effectiveness of training;
- Establish clear expectations for training effectiveness by other internal and external training organizations, centers and contractors;
- Periodically review assessments of NPP personnel training effectiveness;
- Select and develop key senior managers to achieve expertise in evaluating the effectiveness of NPP personnel training;

- Integrate training requirements into the budget planning process;
- Provide resources necessary to assure training is proficiently accomplished and evaluated for effectiveness. Review training investments and compare to budgeted amounts to ensure adequate resources have been provided and used effectively and efficiently.

NPP top manager (vice president, general manager, or plant manager)

- Ensure that procedures on training evaluation include assessing the effectiveness of training are available and used properly;
- Monitor overall NPP performance against established goals and objectives such as safety, quality, production, and cost. Evaluate whether problems and opportunities indicate the need to initiate additional training or to upgrade that currently in place. Ensure that training is NOT used to address performance shortfalls caused by factors that are not training related;
- Ensure that measurable performance criteria and supporting training effectiveness indicators are developed and communicated to the line managers and training organization;
- Ensure NPP personnel assigned to evaluate the effectiveness of training are competent to perform evaluation activities;
- Systematically review and evaluate training effectiveness information and data to assess the effectiveness of training of NPP personnel. This should include training provided by outside/external training organizations/centers or by contractors;
- Ensure independent reviews of training effectiveness are conducted periodically by external organizations;
- Periodically observe classroom, on-job, and other training for effectiveness;
- Provide direction and oversight of NPP managers and supervisors who institute the routine evaluation of the effectiveness of NPP personnel training and a systematic approach to initiate improvements;
- Establish and maintain boards or committees to evaluate the training implications of NPP personnel performance;
- Allocate resources necessary for comprehensive evaluation of training effectiveness. Provide direction and adequate resources to NPP managers and supervisors to ensure sufficient information and data is collected to reliably evaluate the effectiveness of training of NPP personnel;
- Assign training programme coordinators. Ensure responsibilities include the co-ordination of training programme effectiveness evaluations.

NPP managers and supervisors

- Systematically review and evaluate training effectiveness information and data to assess the effectiveness of training of NPP personnel;
- Maintain close attention to NPP changes such as physical configuration, policies and procedures, information systems, organizational structure, goals, and objectives. Evaluate the effectiveness of training provided early so that improvements can be initiated in time to promote efficient implementation;
- Periodically observe classroom, on-job, and other training for effectiveness. Ensure training integrates the expectations that each individual fully embrace respect for the reactor core, the safety systems, and absolute expectation to comply with safety procedures;

- Personally monitor and coach personnel in the plant. Identify and document problems and opportunities to identify new training needs. Conversely, insure that human performance problems that are NOT training-related are detected and addressed appropriately. Attempts to address non-training human performance problems using training can seriously impede correcting problems;
- Ensure self-assessments of personal, functional, and process performance includes an evaluation of the effectiveness of training;
- Make determination as to the qualification of the personnel.

Plant personnel

- Identify activities for which training is needed or has not been adequate;
- Participate as requested in a review of SAT analysis and design data and training material and tools;
- Feedback needs for training to appropriate supervisory personnel;
- Provide input for assessing the effectiveness of training.

Training manager and staff:

Training manager

- Routinely communicate the evaluation of the effectiveness of training to senior plant management;
- Implement an instructor evaluation and development system;
- Monitor the conducting of training, feedback from trainees and instructors, and plant performance to assess the effectiveness of NPP personnel training. Use this information and that provided by NPP training review committees/training advisory boards to institute additional training or upgrades to address noted deficiencies;
- Maintain close attention to NPP changes such as physical configuration (SSC's), policies and procedures, information systems, organizational structure, goals, and objectives. Evaluate the effectiveness of training provided early so that improvements can be initiated in time to promote efficient implementation;
- Evaluate methods to deliver training more effectively and efficiently. For example, computer based methods that are equal or superior to classroom delivered training that has been shown to be effective should be considered;
- Evaluate opportunities to leverage economies of scale in the delivery of training. Computer based training, taped presentations, and video links to multiple audiences can be effective for some refresher training, informational sessions, and in situations where personal interaction with the trainees is not critical;
- Establish a system to control and track the implementation of training development recommendations (TDRs).

Training staff

- Identify, collect (or ensure the collection) of data and information useful in the evaluation of the effectiveness of NPP personnel training;
- Analyze and evaluate training effectiveness information and data to identify areas where training to be improved;
- Resolve pertinent comments received from trainees and evaluators promptly;

- Systematically document effectiveness information and report improvement suggestions to the training manager or training supervisors;
- Support the training manager in identifying and assessing efficient and cost effective methods to deliver effective training.

Training co-ordinator (can be line or training staff)

- Interact frequently with NPP personnel and trainees to evaluate the effectiveness of training. Conduct follow-ups with students to obtain candid feedback and suggestions to improve the content and delivery of training,
- Conduct post-training evaluation, generic trends, strengths and areas for improvement, and write periodic reports based on available internal data and information,
- Provide feedback to line and training management and to training review committees on the effectiveness of training and suggestions for improvements,
- Identify improvement opportunities that leverage economies of scale within and with other organization to improve the efficiency and effectiveness of training delivery,
- Ensure closure of recommendations generated by evaluation activities including course critiques.

Trainees

- Assess and provide a feedback on the value of training received in providing useful knowledge and skills;
- Assess the response of the organization to requested training;
- Evaluate the benefits of training versus the time and effort expended. Feedback recommendations for increasing the efficiency of the delivery of training;
- Routinely meet to formulate recommendations needed to improve the effectiveness of training;
- Collect and analyze NPP performance information to evaluate the effectiveness of training;
- Verify that recurring training problems are identified and preventive measures are planned and implemented.

3. EVALUATION METHODS OF TRAINING EFFECTIVENESS

This section elaborates on the principles of Section 2 by describing several methodologies that can be used to carry out various aspects of training effectiveness evaluation.

3.1. INTRODUCTION

Training evaluation is a critical component of analyzing, designing, developing, and implementing an effective training programme. This section addresses the key elements of determining training effectiveness through evaluation activities.

The National Academy For Nuclear Training document ACAD 88-002 states: “Training evaluation determines a training programme's effectiveness in meeting its intended purpose, which mainly is producing competent employees. Programme evaluation focuses on the results of the training programme and not on the process of training. The key to conducting an

effective training evaluation is to first identify the questions to be answered by the evaluation. Should the programme be modified? What performance gains are being realized? Is the need for training being addressed in the best way possible?"

Determining a training programmes' effectiveness is critical to the success of a nuclear facility. Training based on a sound analysis of job specific criteria has a strong foundation that should yield effective results. This report addresses how an organization can determine if its training can be effective before it has been developed and whether it has been effective after it has been delivered.

Several key elements of training programme effectiveness that should be addressed are:

(1) Training design and development;
(2) Training delivery; and
(3) Training implementation.

The first element requires correctly designed and developed training. However, even though properly designed and developed to a defined set of job relevant criteria, if the recipients are already qualified to do the job, this training will not be effective, resulting in a waste of time and resources. The second element is addressed using a defined set of activities and methods to evaluate training delivery effectiveness. The third element is critical to help management allocate resources most effectively. This element addresses activities and methods that will ensure that training to be developed is needed and that it has resulted in improved performance.

This section will address these three elements and methods and activities to determine whether training is the appropriate solution to a plant or personnel deficiency. Activities and methods will then be introduced to evaluate the effectiveness of training after it has been delivered.

This section also addresses evaluation activities and the analysis of indicators. A training effectiveness matrix is included to address the necessary elements associated with measuring training effectiveness. This matrix provides a structure for an organization assess its own training evaluation procedures and activities.

The training effectiveness matrix is based on the work of Donald L. Kirkpatrick, who introduced a four-level approach to training evaluation in 1959 (Appendix A). These four levels have become commonly known as: customer satisfaction (internal and external) – level one, learner performance – level two, training process performance – level three, and returned value – level four evaluation. The Training Effectiveness Matrix introduced in this section is a tool developed though the combined efforts of the International Atomic Energy Agency (IAEA), the United States Department of Energy, industry best practices, input received from an IAEA specialist meeting and from a survey distributed to member states.

3.2. TRAINING EFFECTIVENESS

The determination of training effectiveness should address three categories:

(1) Training activities;
(2) Evaluation activities; and
(3) Training effectiveness indicators.

The best way to determine that training has been effective is to fully understand the reason why the training has been developed. The reason to develop and implement training is a key factor in determining that a training course or programme will be effective in addressing performance deficiencies. If the reason for training was not clearly identified prior to training development, it could lead to training that is not appropriate to correct the performance deficiency. Establishing a valid need for training is the foundation upon which an organization can determine training effectiveness.

If there is a valid need for training, and training addressed that need, when training has been effectively implemented indicators will validate that the training addressed the need for training and whether the desired results were achieved.

Once a valid training need has been identified, programme content is then developed. During the development process ongoing evaluation activities that monitor training needs should be used to update training development.

3.2.1. Reason for training (training "needs")

If a clear need for training has been identified, an organization should be able to determine that the training is effective. The "need" for training should be documented along with the reasons behind it. Without a clearly defined need, an organization may not be able to determine its training effectiveness. There are several ways to identify and document training needs. From best practices and input received by the International Atomic Energy Agency a method that has been effective is provided in the following sections.

The method is known as "table top training needs assessment/analysis." The United States Department of Energy and other Member States have used this or similar methods that have been effective in determining whether training is appropriate to address the performance need before devoting the resources to develop training materials. With this information, sufficient baseline information is available to develop the training and to document the set of performance deficiencies that exist. This method clarifies job specific performance deficiencies that are then used to design the training programme. This method should be employed before a training programme is developed. It is also useful after training has been developed to verify the validity of training needs.

3.2.2. Before training programme development

For training to be effective, it must address or preclude a deficiency such as human performance, policy, procedure, facility, or equipment. If training can be traced to a deficiency and training was instrumental in eliminating that deficiency, then that training was effective. However, it is important to understand that a performance deficiency may not exist *because* training has been effective. For example, a nuclear power plant developed and implemented a comprehensive training programme on lock-out/tag-out of equipment. After developing and implementing the training, an evaluation concluded that there was no need to continue the training because there were no deficiencies. What the evaluators had not recognized was that training had prevented deficiencies from occurring.

The following example illustrates what can happen when training is developed without determining if a performance deficiency exists: An audit finding at a nuclear facility determined the mechanics were not trained on the firewater protection system. After

examining the mechanics training records, the audit team could not uncover any evidence of this training. Findings were sent to the training department manager who directed the lead training developer to develop training for the mechanics on the firewater protection system. The training developer asked the training manager if he would help him organize training needs assessment with the mechanics. The training manager did not believe enough time existed to do an analysis before the finding needed to be corrected and declined the request.

Because of the time constraints, the training developer decided to seek subject matter expertise. The subject matter expert told the trainer that the reason mechanics were not trained on the fire water protection system is that they did not work on the system because it was maintained under contract by another organization. When the training manager was provided this information, he contacted the regulatory agency that performed the audit and the audit finding was removed. Had the training been developed, time and resources would have been wasted. The training developer contacted the right people in time to avoid performing unnecessary work.

Individuals at any level of an organization can search their training history to identify training that was unnecessary. Individuals responsible for developing training should periodically conduct needs assessments with the goal to achieve more effective training.

3.2.2.1. The table top needs assessment/analysis process

The table top needs analysis works best when a skilled facilitator organizes a focus group of select individuals who possess job specific skill and knowledge who get together around a table to determine training needs. They review existing performance deficiencies and emergent training requirements. An interesting result of table top needs analyses conducted within the USA Department of Energy is that less than 25 percent of recommended solutions to address performance deficiencies were found to appropriately addressed only using training related activities. This is a major reason as to why training organizations are reassessing training needs as training costs are growing and the return on training investments is often challenged. When budgets are reviewed, the effectiveness of training organizations is often questioned. Training needs analysis is an effective tool to ensure the appropriate allocation of training resources and to justify reasonable training expenditures.

The three documented outputs from a table top needs assessment/analysis are:

(1) A validated list of job requirements (task statements or competencies), which represent what job incumbents are required to do in order for that job or task to be performed correctly.
(2) A validated list of performance deficiencies, complete with a list of causes and or barriers related with each of these deficiencies.
(3) A validated list of training and or non-training related recommendations to address the performance deficiencies or needs.

The process consists of six steps and can take from less than one day to a maximum of three days. A detailed description of this process can be found in Appendix B.

3.2.3. After a training programme has been developed

After a training programme has been developed and is implemented, a training organization can also determine effectiveness using many of the techniques described in 3.2.2.1 above and Appendix B. This section will address how to use the table top needs assessment/analysis process to improve existing training.

A focus group is formed as detailed in 3.2.2.1. The main difference is that rather than determining a need/reason for training, the group will focus on determining whether the training was effective. This is accomplished by employing an approach such as the nominal group technique (NGT) that is discussed in Appendix C. The group does not need to be as large as the one described in Section 3.2.2.1. It should consist of at least 2 job incumbents (who have received the training), 1 workforce supervisor, 1 training specialist, and 1 skilled facilitator.

The mission of this focus group is to look back on the training they received to see if it made a difference to them or made the work easier to perform. This process will not take much time to accomplish, probably less than one day, because the training received addressed only a portion of their job requirements. The process is started by a facilitator or group member who introduces the NGT ground rules (Appendix C) and asks the group to examine the training learning objectives to determine whether they are relevant to the corresponding job requirements. Members vote yes or no on a piece of paper independently of the other group members. The facilitator records the results on a flipchart pad, chalkboard, or dry erase board. The group is then asked to analyze the results and to conclude whether the learning objectives supported the job requirements. If they did not, then the training was not likely to be effective in addressing any deficiency. If the learning objectives were related to the job requirements, the group develops a list of deficiencies that existed before the training was presented. If none are identified, training may not have achieved results. If a valid list of deficiencies is determined, each member of the group develops a list of benefits training achieved for each deficiency. The result is a summary of training that achieved results and was effective. This analysis can provide excellent feedback to either revise or discontinue training.

This process can also be accomplished for an entire training programme but would be very labor intensive. A more efficient approach is to institute this process before a training course or programme is developed.

3.3. STUDENT PERFORMANCE (REACTION & LEARNING)

Student performance is clearly important in determining training effectiveness. In the Kirkpatrick approach to evaluating training (Appendix A), Kirkpatrick describes four levels of evaluation that are useful in evaluating student performance. Additionally, the United States Department of Energy “Training Performance Indicator Matrix”, described in Section 3.11, is based on the Kirkpatrick Model, and addresses the four levels of evaluation in more detail.

Student reaction, part of Kirkpatrick’s level one evaluation, assesses how well the trainee liked or disliked the training. This is accomplished through verbal and written feedback. This level of evaluation provides a training organization with documented evidence of how well the trainee liked or disliked the training. While this is very useful information, it is not enough to determine training effectiveness.

Student performance, Kirkpatrick's second level evaluation, is also a measure of student learning. One useful technique is to assess the student before training, during training, and after training. These assessment activities inform both the student and the instructor how well the student mastered the objectives, and how well the instructor presented the training. This evaluation is necessary but not sufficient to determine training effectiveness. However, it will yield important indicators.

"Test item analysis" will also yield a useful set of effectiveness indicators. One method uses a pre-training test post-training. This method is time consuming and seldom used, but done correctly it provides very useful indicators of training effectiveness. The value of a pre-training test is that it may show that students already possess mastery of some of the training objectives. Also, if the students do poorly on the pre-training test, and do well on the post-training test, then strong indication of training effectiveness is provided.

With the use of a variety of assessment activities, the results can yield more accurate indicators. If all you do is administer written assessment activities, you will only be able to measure specific levels of knowledge. Additional activities can include oral and performance assessments using field conditions and simulator settings that provide additional indicators of effective training. Well designed written, oral, and performance also support the identification of warning flags such as those provided in Sections 2.9.5 and 2.9.6. Warning flags indicate that additional effort is needed to determine and correct problems that impede effective training.

Test item analysis measures knowledge or skills at that moment. Additional evaluation is needed to determine that the training sustained improved job performance long after the training took place.

3.3.1. Training settings

Training should be conducted in a setting that is conducive and appropriate for learning. For training of NPP personnel the most commonly used training settings include the following:

- Classroom;
- Simulation;
- On-the-job training (OJT);
- Laboratory or workshop;
- Computer-based training (CBT);
- Web-based training (Internet);
- Self-study.

Alternating between OJT, classroom, CBT, simulator and other training settings enhances learning, retention, and helps maintain trainee motivation. Varying the training setting is an excellent way to accommodate different learning styles.

For some jobs it may be advisable to organize training modules around a group of related tasks that represent only a portion of the total job. In this way, NPP personnel can be qualified to perform useful work before completion of the full programme. Applied to maintenance training, personnel may become trained and qualified to perform maintenance on

plant equipment that is not contaminated before they receive full radiological protection training.

Personnel responsible for training design, development and implementation should have knowledge of the strengths and limitations of training settings and select that best fulfill training objectives and are compatible with the:

- Level and ability of trainees;
- Type of material to be learned;
- Training resources required; and
- Training aids required.

Alternative training settings should also be identified when constraints require compromises, particularly when the desired setting has adverse effects on plant operation (e.g. taking plant equipment out of service for OJT). To ensure the most useful available training setting can be used, particular attention should be given to:

- Timely availability of plant facilities;
- Access opportunities provided by the plant operating conditions including outages to perform on-the-job training;
- Availability of a plant specific or other type of simulator;
- Availability of classroom facilities;
- Availability of laboratory facilities; and
- Scheduling trainees to ensure class sizes are optimized.

Selection of the training setting should consider the fidelity (accuracy in reproducing actual task conditions) required for effective training. For this purpose, tasks can be divided into three categories:

1. Tasks requiring complete replication

Tasks in this group have two characteristics:

(1) They are important for plant safety and reliability, and
(2) They cannot be trained to required standards in any other way than by complete replication.

Examples of such tasks for control room operators are those associated with responding to abnormal or emergency conditions. Full scope replica simulators and actual plant facilities/equipment are training tools that provide complete replication for training such tasks. Similarly, for maintenance personnel, the plant or full-scale mock-ups provide complete replication. Training programmes for tasks associated with the maintenance and calibration of reactor protection systems make use of simulators that provide complete replication without jeopardizing plant operation.

2. Tasks requiring less than full scope replication

Selection of the most realistic training setting to achieve training objectives is not always necessary. A less expensive or less time consuming setting may be used such as part-task simulators, laboratories, or workshops that satisfactorily evaluates student performance although it does not duplicate the job environment.

3. Training objectives that can be grouped and taught independent of individual tasks

These areas may be addressed in the classroom, self-study, CBT or Web based training. Also, this training may be used to prepare for training on the simulator, laboratory, mockups or OJT.

3.3.2. Evaluation activities

Three evaluation activities that can be used to address a variety of training settings are:

(1) Written exams: Written examinations can be used to evaluate each of the training settings, however, they are best suited to measure knowledge and sometimes attitudes;

(2) Oral exams: Oral examinations can be used to evaluate each of the training settings, however, they are more appropriate for settings, which include hands-on training activities. Oral examinations are the best evaluation methods to measure communication skills, and to test attitudes as well as higher levels of knowledge; and

(3) Performance exams: Performance examinations can be used to evaluate skills, and are the best evaluation methods to measure actual performance to job specific criteria.

3.3.3. Analysis of indicators

There are a number of performance indicators that can indicate effectiveness of how the training was in each of the training settings. An elemental indicator for written exams is the number of people who passed. However, this indication by itself is not sufficient to indicate effective training. Test item analysis provides a more substantial indication of effective training and indicates that training delivery was weak, test items were inadequate to measure knowledge, or individuals taking the examination do not take tests well. Test item analysis should not be the only method used to evaluate training effectiveness.

Analyzing indicators associated with testing activities include assessing whether the first level of Kirkpatrick's model (customer satisfaction) indicates training effectiveness. These indicators are constructed during the process of using written, oral, and performance examinations and are important factors in determining training effectiveness. Also, attention to warning flags that are provided in Section 2.9.5 and 2.9.6 of this report and provide additional indication of potential training problems. Although warning flags do not indicate effective training, they are useful to alert managers and supervisors that training may not be effective. Examples of warning flags for these types of evaluation activities could include:

- Student dissatisfaction, that could indicate deficient instruction, facilities, training setting, equipment, etc.;

- Poorly developed evaluation activities, that could indicate deficient instructor/developer skills, lack of oversight in the development or administration of evaluation activities, etc.; and
- Poor or inadequate evaluation policies, procedures, and practices;

These warning flags should be identified, examined, and evaluated throughout the evaluation process by competent individuals trained to identify and report evaluation related.

3.4. TRAINING COURSE EVALUATION

3.4.1. Evaluation activities

Training course evaluation takes evaluation to a higher level that corresponds to both level 1 and 2 feedback of the Kirkpatrick Model (Appendix A). This more focused evaluation includes both student reaction and student learning to identify effectiveness indicators. These indicators and a summary of training accomplished are documented. This evaluation provides a *more* substantial analysis of effective training, but is not sufficient to determine that a training programme or course has been effective.

This analysis provides evidence whether entry level requirements have met and the use of pre-tests and post-tests can provide an excellent measure of whether training positively impacted student comprehension and retention.

3.4.2. Analysis of indicators

Training effectiveness evaluation summaries based on indicators and feedback from students, peers, instructors, and student supervision should be documented and reported. Corrective actions should then be implemented to address both good and poor results to provide more effective training.

By reviewing test results, comments from students, comments from student's peers, and comments from student's supervision, a training organization can get a good indication of training satisfaction and immediate retention. These indicators should be used with the warning flags detailed in Sections 2.9.4 and 2.9.5, to determine training effectiveness through customer satisfaction (level 1) and student performance (level 2).

3.5. TRANSFER KNOWLEDGE/SKILLS/ATTITUDES TO JOB

3.5.1. Evaluation activities

Transfer of knowledge and or skill to the job after training provides an excellent indicator of training effectiveness and takes the evaluation process as described in the Training Effectiveness Model to the 3rd level of Kirkpatrick's evaluation model. This type of evaluation provides higher level performance indication for training effectiveness. This level involves line management in the evaluation process. Managers observe work in the field that is performed by students who have recently completed the associated training. This feedback provides excellent training effectiveness indicators. Line manager observations of field performance before the training takes place improves the validity of subsequent observations and yield more accurate indication of effective training.

The value of this level of evaluation is that this feedback not only reveals effective training, it can also uncover training that has not been effective and input for revising training programme or course. The effectiveness of these level 3 indicators is related directly to the number of observations performed. More observations by many individuals improve the validity and reliability of these indicators. This level of evaluation is very good but time consuming for line managers and supervisors. It is important for the training organization to persuade line managers of their value and to train them of good observation methods.

3.5.2. Analysis of indicators

Important factors to consider in analyzing training effectiveness indicators related to transferring learning to the field are: the number of observations, who conducted them, comments made on the observations, job incumbent performance indicators, and the warning flags that are provided in Section 2.9.5 and 2.9.6. These indicators provide excellent feedback on the effectiveness of training and are essential to determine associated job performance improvement long after the training has taken place. These indicators also indicate student level of comprehension, retention of knowledge, skill, and attitude.

3.6. TRAINING COURSE EFFECTIVENESS

3.6.1. Evaluation activities

Training course effectiveness evaluations are internal training programme reviews of indicators to measure effectiveness of the training process. These activities look at the training approach used but focuses on results more than on process. They focus on determining that the right objectives are used to teach the right people using the right instructors with a systematic approach. Items addressed in this evaluation activity include assessing:

- Consistency between training policy and existing training programme;
- Line management and or training management self assessments;
- Overall training programme evaluations;
- Instructor evaluations dealing with attitude, skill, knowledge, and ability.

3.6.2. Analysis of indicators

Indicators used during these analyses should include such reviews of the number of training courses reviewed by the training staff versus those scheduled and how corrective actions were handled and the results. This indicates training management’s ownership of the process. These activities could reveal areas of concern such as those covered by the warning flags in Section 2.9.1 and 2.9.2.

This is a high level of evaluation and requires rigor, time and resources to accomplish. However, close co-ordination between the training organization and line management provide excellent indicators of training effectiveness.

3.7. PLANT PERFORMANCE

3.7.1. Evaluation activities

Plant performance results are excellent indicators of training effectiveness. They are most effective when clearly defined plant performance deficiencies are identified prior to training. The table top process introduced in Section 3.2.2.1 can be used to develop a list of performance deficiencies provided knowledgeable and experienced people actively participate.

The training effectiveness model indicates that plant performance indicators, like production (number of scrams, duration of outage, duration of in-service inspection, etc.), quality of work performed (equipment failures and re-work or call-back rates, etc.), and safety (number of events, accumulated dose rates, and number of injuries), provide excellent indicators of training effectiveness.

3.7.2. Analysis of indicators

These indicators should be reliable measures of training effectiveness. A comprehensive evaluation process that is properly structured, organized, and staffed will be able to show whether the overall training programme is effective. The table top process described in Section 3.2.2.1 can streamline this activity and yield good results. Trends, required changes of equipment, procedures, and regulations and indications of the warning flag provided in Section 2.9.1 and 2.9.7 should become evident.

3.8. RETURN ON INVESTMENTS

3.8.1. Evaluation activities

Return on investments (ROI) can also yield useful indicators of training effectiveness. However, the difficulties in separating effects of the numerous variables that contribute to excellent performance make this type of evaluation difficult to verify. The process requires dedicated attention to detail and the statistical analyses of business data. Data that could be analyzed include:

- Training budget and variances;
- Number of courses taught and number of students attending;
- The total cost per student;
- Reduction of overall maintenance costs after training workers;
- Equipment availability and reliability since training.

3.8.2. Analysis of indicators

These indicators, tracked before and after training, can reveal training effectiveness. However, thorough analysis is laborious and lengthy and most training organizations do not perform these analyses. Most of the evaluation activities described above can also be accomplished using the table top process described in Section 3.2.2.1.

3.9. DATA COLLECTION

3.9.1 Types of data

Analyze data directly related to the objectives of the training programme. Most companies collect the data needed to evaluate training but often fail to recognize the value to assess training effectiveness. The outcome of some programmes that produce “hard” skills such as technical training is observable and can be measured. The speed and quality of an assembly line operator before, during, and after a training programme can be measured. However, ”soft” skills such as behavioral outcomes associated with effective management are less obvious and measurable. Demonstrating that a manager delegates effectively or is a strong motivator is often difficult to determine. Therefore, the following sections are provided in two categories: *hard data*, and *soft data*.

3.9.2. Hard and soft data comparison

Hard data are the primary measurements of improvement, presented in rational, undisputed facts that are easily accumulated. They are the most desired type of data to collect. Criteria for measuring the effectiveness of management primarily rest on hard data, such as productivity, profitability, cost and quality control. Because changes in these data may lag behind changes in the condition of the organization by many months, it is useful for management to supplement these measures with assessments of skill, motivation, satisfaction, and attitude.

A supervisory programme designed to build delegation and motivation skills should have an impact on hard data but it may be best measured by soft data. Soft data are difficult to collect and analyze but are useful when hard data are not available. The contrasting characteristics of the two types of data emphasize this point.

Hard Data	Soft Data
1. Easy to measure and quantify. 2. Relatively easy to assign cost values. 3. Objectively based. 4. A common measure of organizational performance. 5. Very credible in the eyes of management	1. Difficult to measure or quantify directly. 2. Difficult to assign cost values. 3. Subjectively based in many cases. 4. Less credible as a performance measurement. 5. Usually behaviorally oriented.

3.9.3. Hard data

Hard data can usually be grouped into four categories (subdivisions): output, quality, cost and time. These data are measured in almost every organization. Examples of hard data are included in Appendix D. When they are not available, a common approach is to convert soft data to one of these four basic measurements.

1. **Output**: Most organizations have basic measurements of work output. Before-training and after-training work output changes are easily monitored.

2. **Quality**: Methods to measure quality are usually in place and training programmes designed to improve quality can be measured documented.

3. **Cost**: Training programmes that produce a direct-cost-savings can show a financial contribution. There can be as many cost items as there are accounts in an accounting system. Also, cost categories can be combined to develop combinations that may support more in-depth evaluation.

4. **Time**: A time savings may mean a project is completed sooner than planned, a new product was introduced earlier, or the time to repair equipment was reduced. Time savings translate into additional output or lower operating costs.

The distinction between these four groups of hard data is sometimes unclear because their effects may overlap. For example, accident or occurrence costs may be listed under the cost category, number of accidents listed under quality, and lost-time days due to an accident listed under the time category. This occurs because accidents represent a cost, are usually caused by someone making a mistake and are a reflection of the quality of work, and days lost from the job represent time costs to the organization. The distinction between the subdivisions is not as important as the awareness of measurements in these areas.

3.9.4. Soft data

When hard data do not exist, soft data may useful in evaluating training. Soft data are usually behavior based and difficult to measure accurately. Soft data are categorized into six areas: work habits, new skills, work climate, development and advancement, feelings and attitudes, and initiative. Appendix E provides examples of soft data. The following describes the six areas:

1. **Work habits**. Employee work habits are critical to the success of a work group. Poor work habits can lead to an unproductive and ineffective work group, while good work habits can boost the output and morale of the group. The most common and easily documented poor work habits include absenteeism and tardiness, and these can be tied to cost savings much easier than the other types of soft data. Training can be used to train supervisors on improving employee work habits. Systems to record employee work habits such as absenteeism, tardiness, and visits to the first-aid station can be implemented. Poor work habits may be documented by the employee's supervisor.

2. **New skills**. Skill building is an important area for training. The successful application of new skills might result in hard-data measurements such as a new employee learning a production procedure. They may also involve soft data measurements such as decision making, problem solving, conflict resolution, grievance resolution, and listening skills. The success of skill-oriented training relies on the frequency of use after training is completed. The frequency and extent of the use of new skills can be monitored and documented to provide additional data for evaluation.

3. **Work climate**. Work climate is important. Grievances, discrimination charges, complaints, and job dissatisfaction often result in reduced efficiency, less output, unionization drives, and employee resignations.

4. **Development/advancement**. There are two perspectives: (1) the development of participants who attend programmes; and (2) the extent managers and supervisors provide developmental opportunities for their employees. Promotions, transfers, pay increases, and performance ratings are typical data that can be used to measure development and advancement.

5. **Feelings/attitudes**. Almost every training programme is designed to get a favorable reaction toward the subject being taught. These reactions provide additional evidence of training effectiveness. Some programmes are conducted to change attitudes toward employees, the job, or the organization. Some programmes are designed to change the participant's perception of the job or other aspects of the work setting. In these situations the feelings and attitudes can be documented with questionnaires and surveys.

6. **Initiative**. In some training programmes participants are encouraged to try new ideas and techniques. The extent to which employees accomplish what they plan provides evidence of the success of the programme. Also, the employee's initiative to generate ideas and submit suggestions is indication training effectiveness.

As with the hard data, these categories overlap. Some items listed under one category could be listed in another.

3.9.5. Data collection (soft data vs. hard data)

The preference of hard data in programme evaluation does not mean that soft data are not valuable. A programme's success may rest on soft data measurements. For example, in a programme to reduce turnover, the following four key measures of success may be used:

(1) Trainee turnover;
(2) Interview to hire ratios;
(3) Participant's evaluation;
(4) Reduced litigation.

Most programmes use a combination of hard and soft data in the evaluation. A comprehensive evaluation would use several hard data and soft data measurements. For example, in a maintenance supervisor training programme, the following measures of success may be used:

- A reduction of costs associated with specific maintenance activities;
- Improvement in production equipment and processes;
- Changes in maintenance responsibilities and procedures;
- Improvement in training of maintenance employees;
  Changes in organization and personnel.

These changes included hard data (production and costs) and soft data (increased training, changes in procedures, and changes in the organization).

Soft data are usually best when evaluating behavior and skill outcomes. For example, in behavior modeling in building supervisory skills the evaluation of behavioral and skill outcomes rests almost entirely on soft data. Both hard and soft data are useful programme evaluation tools and a comprehensive programme will often use both.

3.9.6. Summary

Data can be grouped into two broad categories: hard and soft hard data is easier to obtain and quantify but is not always available. Soft data is subjective and difficult to measure but often available when hard data is not. A programme evaluation may use one or more methods to collect data, each with advantages and limitations. Appendix F presents an explanation of the most common data collection methods.

3.10. REPORTING / DOCUMENTING FINDINGS

3.10.1. Developing an evaluation report

The type of formal evaluation report depends on the detail needed by those who will use the information. Brief summaries of results with appropriate charts may be sufficient. For particularly significant programmes requiring extensive funding, a detailed report may be needed. A detailed evaluation report may contain the following sections:

- Management summary;
- Background information;
- Evaluation strategy;
- Data collection and analysis;
- Programme costs;
- Programme results;
- Conclusions and recommendations.

These seven sections result in a thorough evaluation report. Each is explained below in more detail.

3.10.2. Management summary

The management summary is a brief overview of the report explaining the basis for the evaluation and the significant conclusions and recommendations. It is designed for those individuals who are too busy to read a detailed report. It is usually written last but appears first in the report for easy access.

3.10.3. Background information

The background information describes why the evaluation was conducted and gives a general description of the evaluation. If applicable, the needs analysis that led to the evaluation is summarized. Programme objectives are presented as well as information on the programme content, length, course materials, instructors, facilities, and other specific items that provide a full description of how the programme was presented. The extent of detailed information depends on the audience needs.

3.10.4. Evaluation strategy

The evaluation strategy outlines the components that make up the evaluation process. It begins with the specific purposes of evaluation and is followed by an explanation of the evaluation. The instruments used in the design are also described and presented as exhibits.

Any unusual characteristics of the instruments designs are discussed, and the reasons for participant selection are outlined. Finally, other useful information related to the design, timing, and execution of the evaluation is included.

3.10.5. Data collection and analysis

This section explains the methods used to collect data. The data collected are usually presented in the report in both raw and finished formats. Next, the methods of analysis of the data are presented with interpretations. If appropriate, the analysis hypothesis is stated along with information on the confidence level of the supporting data.

3.10.6. Programme costs

Programme costs are presented in this section. A summary of the costs, by cost components (functional/process category) or by particular accounts, may be appropriate. For example, analysis, design, development, delivery, and evaluation costs are recommended categories for cost presentation. The assumptions made in classifying costs are contained in this section. Appendix G provides an example of how training programme costs can be determined.

3.10.7. Results

The evaluation results section presents a summary of the results with charts, diagrams, tables, and other visual aids. If applicable, conclusions about training value related to costs are presented. Programme benefits are also provided so that the section provides a complete picture of the evaluation.

3.10.8. Conclusions and recommendations

This section presents the overall conclusions based on all the material presented up to this point. If appropriate, brief explanations are presented on how each conclusion was derived. A list of recommendations or changes in the programme should be provided with brief explanations for each recommendation. The conclusions and recommendations should be consistent with one another and with the findings described in the previous section.

These components make up the complete evaluation report. The report can be scaled down if appropriate. The evaluation report should effectively communicate results.

3.10.9. Summary

This section presented the final step in the evaluation process. Communicating evaluation results is a crucial step in the overall evaluation process. If this step is not taken seriously, the full impact of the evaluation results will not be realized. The various target audiences should be considered and emphasis should be placed on clearly communicating to the senior training and line executives and managers. A standard report format should be used to promote consistency in communicating results.

3.11. TRAINING PERFORMANCE INDICATOR MATRIX

This section addresses a Training Performance Indicator Matrix that is based on the Kirkpatrick Model, initially developed by the United States Department of Energy, and revised by the IAEA to assist NPPs in measuring training effectiveness. The matrix is consistent with and supports the previous sections of this publication. Appendix H provides examples of training performance indicator questions.

3.11.1. Matrix description

The **Training Performance Indicator Matrix** reflects a system of indicators that measure both the merit and the worth of technical training and professional development in improving human performance. Decision makers find that deriving information from an indicator system is more useful than using a single indicator or a small group of indicators. Since the matrix illustrates such a system, it should be helpful in establishing or enhancing a training performance indicator system that improves monitoring and evaluation practices. Once familiar with the matrix, users will recognize that it provides a useful framework for measuring or evaluating any initiative to improve human performance, including human factors engineering, human performance incentives, or training designed to improve human performance. Table 2 graphically depicts the **Training Performance Indicator Matrix**.

The vertical axis represents the four main categories associated with Kirkpatrick's Model of the four levels of evaluation. This matrix details measurable training results; that is, what is measured.

1. ***Customer satisfaction*** results are measures of the reaction of internal and external customers to training and training results. Satisfying the needs and reasonable expectations of both internal and external customers means making the training, training products, and delivery services meet customer requirements. Internal customers are individuals within organizational systems who receive, use, or are affected by the training system output. External customers are those outside the organizational systems that receive, use, or are affected by the organization's output, including the training organization's products and services. Customer perceptions and opinions are measured concerning training products, services, and results. (Level I Evaluation)

2. ***Learner performance*** results are measures of applied skills and knowledge demonstrated prior to, during, and after training. Learners demonstrate, and trainers, supervisors, and peers observe, the skills and knowledge stated in the learning objectives or job performance requirements. Performance is measured before training, during the training process, and later when the learner has returned to the job. (Level II Evaluation)

3. ***The training process*** results are the measurable effects of applying training analysis, design, development, implementation, and evaluation procedures. These are the results of managing the systematic approach to training (SAT) processes. (Level III Evaluation)

4. ***Returned value*** results are measures, which demonstrate that training has contributed value to the organization. This returned value could include direct profit, cost savings, cost avoidance, improvements in efficiency and safety, etc. While it is not often possible to directly prove that training was the sole reason for the improvement or

savings, it is often possible to determine contribution training has made in this area. (Level IV Evaluation)

The horizontal axis represents when training effectiveness is measured or evaluated:

1. ***Prior to training intervention*** represents the activities leading up to the training intervention, including the activities of the training department or other organizations responsible for training personnel. For example, assessing the current job performance levels of targeted staff and conducting cost/benefit analysis to determine projected benefits of the training against projected costs.

2. ***During training*** represents the evaluation activities that take place during and immediately following training interventions. These activities include determining the quality of the training delivery, the level of learning demonstrated by the learners, the level of customer satisfaction with the training, and identification of actual costs, and areas for cost savings, cost avoidance, or cost reductions.

3. ***After training has taken place*** represents the evaluation activities conducted when the learner returns to the job after the training intervention. Internal aspects of this evaluation include the specific site, facility, or workstation the learner returns to. They also include the organization as whole, individual departments or divisions, and even the activities of the individual work area. External aspects include impacts on the nuclear industry, governmental or regulatory agencies, the environment, and societal needs and requirements that represent the public at large who may be impacted by the activities of the organization. These measures also include activities to identify and quantify the actual returned value, cost effectiveness, efficiency, and cost avoidance data that contribute to the viability and financial health of the organization. This section is further broken down to those areas that are internal to the organization and those that are external.

The sixteen primary cells represent the different types or areas of indicators for monitoring training effectiveness. The matrix attempts to distinguish among the types or areas of measurable results and evaluation categories, and presents a description for each of the sixteen areas.

Table 2. Training Performance Indicator Matrix

Evaluation Categories What is Measured	***When Measurement and Evaluation Occurs***			
	Prior to Training Intervention	**During Training**	**After Training Has Taken Place**	
Customer Satisfaction Measuring the results of learner's application of the knowledge, skills, and attitudes. Level I	Measures, documents, and records the current level of satisfaction with training-by-training staff or department and the operational systems where the employee performs the job.	Measures and analyzes the reactions and satisfaction of customers during training.	Measures and analyzes customer reactions and satisfaction at the facility, site, plant, or corporate level.	Measures and analyzes customer reactions and satisfaction at the industry, government, regulatory, and societal level.
Learner Performance Measuring the results of learner's application of the knowledge, skills, and attitudes. Level II	Measures, documents, and records the current level of learner performance on-the-job or preparation for entry-level job positions or training.	Measures and analyzes learner performance during training.	Measures and analyzes the level of learner performance on the job at the facility, site, plant, or corporate level.	Measures and analyzes the level of learner performance on the job at the industry, government, regulatory, and societal level.
The Training Process Measuring the results of systems approach to training processes and the management of training. Level III	Measures, documents, and records the current activities, impact, and performance levels of training staff, training department, or other organization system that provides training where the employees perform the work.	Measures and analyzes the quality of the training implementation, materials, and facilities.	Measures and analyzes the impact of results of training processes on facility, site, organizational, and corporate goals and objectives.	Measures the impact or results of training process on industry, government, regulatory goals and objectives, and societal needs or requirements.
Returned Value Measuring the expected and actual returned value. Level IV	Measures, documents, and records the current costs of providing training activities and performs analysis of proposed training interventions.	Identifies and documents areas for cost reduction and avoidance.	Measures the actual training cost effectiveness and cost efficiency and determines the value to the facility, site, plant, or corporate level.	Measures the actual training cost effectiveness and cost efficiency and determines the value to the industry, regulatory, and societal level.

3.11.2. Customer satisfaction

The evaluation of customer satisfaction focuses on how the customers of training, and the organization in general, perceive the quality of products and services. The reactions and perceptions of all customer groups to training and training results are monitored.

This evaluation category includes determining customer satisfaction on the quality and pertinence of training. It also measures customer satisfaction with training while training activities are in progress. Customers such as students, and their supervisors who observe training, complete training critique forms rating the quality of the instruction and instructor performance. Reactions from other customers, such as subject matter experts during training development and from instructors after they deliver training, also provide important feedback to the training system.

Customer satisfaction includes measures of the perceptions of training after students have completed training and are back in the job environment. Post-training surveys by job incumbents and their supervisors often provide useful indicators of these customers' perceptions of training effectiveness. Other customers whose feedback is important are the people with whom students work or whose work is affected by their performance. Comments from operating personnel during training reviews indicate their satisfaction with training and also provide customer feedback data that is included in this category.

This evaluation category includes customer reactions to training at the facility and various organization levels. Customers in this category include facility or site management and organization management. Management observations of training, feedback during management review boards, and management survey data provide information indicating management's confidence level in the training department's ability to train effectively. Other personnel who represent these levels of the organizational system can also often provide useful feedback on the usefulness of training.

Finally, this evaluation category represents the reactions of external customers to training activities and/or training results. External customers include industry and regulatory groups. Members of society including taxpayers, stakeholders, and the general public are also external customers. Examples of satisfaction data in this category include comments from regulators who have observed training activities and measures of the public's perceptions of nuclear safety performance and training quality.

3.11.3. Learner performance results (Level II)

The evaluation of learner performance focuses on job performance prior to training, how well training has developed and maintained employee job skills and knowledge, and what effect employee performance had on achieving organizational and external requirements after training has taken place.

This evaluation category includes observations and assessments of job performance that compare current performance levels against desired levels of performance and to identify true training and development needs, examinations and observations of demonstrated skills and knowledge gained during training while students are in attendance, and observations and feedback regarding learner performance after the students return to the job. Examination

performance indicators such as exam scores, pass rates, and the gains in scores between pre-tests and post-tests provide measures of how well and how much students learned as a result of the training. Learner performance indicators at the training system level provide immediate feedback on training effectiveness while students are still in training.

This category also includes measures of on-the-job application of the skills and knowledge that students learned during training. Job performance indicators that relate to specific training reflect intermediate impact or results that are measured or evaluated within the operational system after students return from training to the job environment.

Collecting post-training learner performance data can help 1) determine how to increase the use of learned skills and knowledge, and 2) make decisions about learning within the organization. For example, to measure retention and transfer, job supervisors observe individuals' performance of specific tasks recently taught in training. Their observations show on-the-job use of newly learned skills and knowledge. These results help assess the effectiveness or ineffectiveness of training and how best to reinforce or coach job incumbents to improve performance.

Another example of a learner performance indicator is the number of personnel errors due to lack of skill or knowledge. In-house event reports, quality control reports, and observations of human performance may reflect personnel error attributable to inadequate or no training. When training is required and implemented to improve job performance, trainers can monitor performance reports for personnel errors related to the specific training. For example, a process could be implemented to ensure required training for all operators on plant modifications could be implemented that requires the training department to sign a form certifying training has been satisfactorily completed prior to the system being turned over to operations. Such a process would significantly reduce operator errors related to changes or modifications.

Regularly collected job operational data such as equipment component failures and maintenance rework is another valuable source of data for monitoring training effectiveness (See Table 3). When evaluators link this data to specific training and the data reflects on-the-job improvement, they can demonstrate the contribution of that training to operational results. For example, when a reduction in the amount of time it takes a crew to perform a critical task after the crew has completed specific training is observed, an excellent opportunity exists to demonstrate training effectiveness. An example at one facility involved improved laboratory training that contributed to a 46% reduction in time to disassemble and reassemble equipment and a 50% reduction in personnel radiation exposure. When changes or improvements occur in the job environment as a result of training, the opportunity exists to show that training made a difference/contribution to improved on-the-job performance. Table 3 provides additional potential sources of job operational data.

Table 3. Sources of Job Operational Data

Departmental Reports	**1. Internal** **2. External (PSC, INPO, NRC, OSHA)** **3. Quality Control**
Change Actions	1. Procedural Changes a. Changes to the steps (elements) of a task that requires a change in the training b. A new procedure has been introduced on the job and affects the manner in which the training presently addresses other procedures c. A procedural change that requires employees to learn new skills and knowledge 2. Equipment Changes a. A minor change to the equipment since the training was implemented b. A major change to the equipment that requires new training 3. Updated lists of each employee's job responsibilities (note: rate the new ones and rate the possible impact on stress level) 4. Documented changes in other departments that interface with the job site in question
Performance Trends	1. Rework Information a. Reports of excess rework for a given task that training currently addresses b. Reports of rework due to faulty equipment, but originally the rework that was based on lack of training 2. Performance Indicator Charts 3. Attendance records correlated with other significant variables
Operating Experience	1. Preventable Occurrence Reports 2. Documented Customer Complaints 3. New problems arise as a result of the changes, and the training must address the problems and how to resolve them
Other Operational Data Information Sources	1. Narrative information that supervisors may furnish about employee comments concerning departmental operations such as work flow, equipment, and accidents 2. Narrative perceptions from customers about the department's operation 3. Narrative perceptions of job incumbents concerning the department's operation 4. Videotaped observations of departmental operations

3.11.4. Training process results (Level III)

The evaluation of the training process includes the measurable results of managing training processes within the training system. Measures of process management results provide indicators of how well the training department performs the processes required to develop and deliver training. For example, training materials are evaluated to ensure they meet design specifications, development criteria, and product standards. Some indicators in this

area are the number of development jobs outstanding, delinquent, and completed as compared to requested. These show how well the training organization is performing to meet its development or production goals. Another indicator in this category might be the number of plant changes or modifications installed on the control room simulator. Monitoring such an indicator provides information about how well the training organization is keeping the simulator up to date.

The evaluation of the training process also includes measures of the impact of training processes on plant specific department productivity or job performance. For example, training organizations monitor job incumbents' attendance at scheduled training classes. This indicator reflects the impact of training activities on the customer department's productivity. Job incumbents' review of training products to verify technical accuracy and line management's review of training plans to ensure training needs are being met are examples of evaluation-related activities that fall in this category. This category also includes indicators of the impact of job changes on the training system. For example, training organizations monitor the number of new or revised job tasks that must be analyzed and incorporated in training programmes. This indicator provides information about how well the training organization incorporates job operational system changes.

Training process evaluation includes measures of the internal impact of training system activities at the plant and corporate (company) levels. Evaluations in this category focus on how training process requirements affect business goals and objectives. The more complex the training programme, the more management control it will require to ensure it meets the schedule, cost, and performance requirements. One example of an indicator at the corporate level that relates to cost efficiency is the cost per student to complete a particular training programme. Quality control and quality assurance audits of training fall in this category. This category also includes indicators of the impact of plant and corporate activities or changes on the training system. For example at the plant level, the number of new or changed plant procedures that require modification to a training programme has an impact on the resources expended on training process activities. This evaluation category also includes the impact or results of training activities outside the organizational system at the industry and society levels.

At the industry level, evaluation activities and training indicators reflect industry or regulatory goals and process requirements. Evaluations such as external audits, operational readiness reviews, and training inspections fall in this category. Benchmarking internal performance results with external organizations (within the industry or outside) to select 'best' training practices (processes) for use internally is another evaluation activity in this category. Other indicators at the industry level include the number of training violations and follow-up items, the number of audit findings, and training department good practices or findings identified during plant evaluations. These indicators reflect how well the facility is meeting regulatory-related, training process goals and requirements.

3.11.5. Returned value (Level IV)

Evaluation at this level demonstrates that training has contributed value to the organization. This returned value includes direct and indirect cost savings and cost avoidance, improvements in efficiency and safety, etc. While it is often not possible to directly prove that training was the sole reason for the improvement or savings, it is nearly always possible to determine that training has made a contribution.

Prior to any training intervention, analysis should be conducted to ensure that the potential solutions to performance problems are cost effective and efficient in producing the desired change. These studies also set the benchmark data, the current level of performance versus the desired performance, and assigns values to the improvement required to achieve desired levels of performance. If the analysis identifies the most efficient and beneficial approaches and that training will provide direct value to the organization in a cost effective manner, then implementing the identified training is warranted.

During the development and implementation of training, data should be reviewed to identify alternative approaches that can avoid costs, reduce plant down time, improve efficiency and learning, and therefore improve the quality and value. After training, the new levels of performance are compared to those prior to training and the value of improvements is identified.

Facility and department goals and objectives should reflect business and mission requirements. Performance indicators in this category can reflect business results or impact linked to training. For example, at the facility level, when the number of qualified operators increases or is maintained as a result of improved qualification achievement rates, this indicates a training contribution to the facility goal of maintaining a specified number of qualified operators on the staff. An indicator at the corporate level that trainers can monitor might be the number of quality assurance findings, due to personnel lack of skill or knowledge that are issued on specific facility operations. When personnel performance has improved following training, trainers are able to demonstrate the positive impact that training had on operations. Evaluating the cost effectiveness of training is also included in this category.

At the external level, cost effectiveness can be estimated by costs avoided. Additional value can result from improved customer or stakeholder perception of a facility’s operations and be reflected in improved community relations and support.

3.11.6. Summary

The Training Performance Indicator Matrix provides a tool for understanding how managers, supervisors, and trainers can establish an evaluation system to determine and monitor the overall effectiveness of an organization's training performance. It can also help identify specific strengths or weaknesses of individual training programmes. These specific evaluation methods and indicators that trainers, managers, and regulators choose are a function of established goals and objectives. Trainers and managers must ensure training is instructionally sound, technically accurate, up to date, and meets the learning needs of individuals and performance requirements of the job, facility, and site. The better the evaluation and monitoring of training results, the more likely safe and reliable human performance will be achieved. The Training Performance Indicator Matrix is designed to assist trainers, training management, and line management in refining training practices to improve the evaluation and monitoring of training effectiveness.

4. SUMMARY OF THE SURVEY RESPONSES ON "EVALUATING THE EFFECTIVENESS OF NPP PERSONNEL/TRAINING"

4.1. INTRODUCING THE SURVEY

A survey intended for collecting information from the Member States on the evaluation of NPP personnel training effectiveness has been developed by the IAEA and a group of international experts. The survey, see Annex A, was administered to potential respondents representing the Member States' operating organizations, NPPs, utilities, nuclear facilities, training centres, and organizations involved in rendering training services for the nuclear power plants and nuclear facilities. Responses from twelve countries were received. Summary of these responses as well as accumulated good practices and lessons learned are presented in this section. A compact disc supplementing the report contains some additional data contributed by the Member States' organizations.

It should be mentioned that while selecting the examples and presenting a summary of the responses, a focus is made on the methods and instruments that correspond to an evaluation of training effectiveness but not simply on evaluation of training programmemes.

The survey contains ten questions, a request to provide the examples of tools/instruments assisting in an evaluation of training effectiveness, and the last question encouraging the respondents to express their expectations for this publication. The responses (answers) to the first ten questions are summarized in Section 4.2.

4.2. SUMMARIZING THE ANSWERS

4.2.1. Definition

The following definitions or explanations of "effectiveness of training" are the examples picked from the responses:

- Training effectiveness is an impact of the training given to work group staff on work conducted in the plant.
- Training effectiveness is achieved if people being trained are able to perform their duties errorless.
- Training effectiveness is an extent of achievement of defined training objectives within the planned training schedule and available budget. The training objectives are related to knowledge, skills and attitudes and are therefore connected to a better plant and human performance. *(This definition came from an organization providing training services)*
- Training effectiveness shows whether the personnel knowledge and skills are increasing over several years. *(This explanation from an organization providing training services)*
- Effective training — the training that is done in the best and most economic way. The same result could not be obtained at a lower cost, or a better result could not be obtained at the same cost.

4.2.2. Activities to evaluate training effectiveness

The following question was suggested in the survey: "What type of preparatory or actual evaluation activities does your utility/organization perform before, during and after training to determine whether training is effective?" Summary of relevant responses is provided below.

4.2.2.1. Activities performed before training

- Training needs analysis.
- Collecting and combining the training requests from the trainees and plant operating department manager.
- Identification or required knowledge, skills and attitudes.
- Analysis of potential impact of job performance on nuclear safety.
- Evaluation of significant events during plant operation and maintenance, including results of "human factor" analysis (annual list of necessary measures is issued by the plant superintendent).
- Every four years the job analysis for each NPP work group is verified to ensure it is current and accurate. The job analysis verification is performed by work group incumbents, supervisors, and training personnel responsible for each training programmeme. During the job analysis verification, the incumbent participants assess each task that they have been trained on, and provide feedback on their continuing training needs for those tasks selected for retraining.
- Training objectives to be covered in annual training programmeme are communicated by the plant managers and instructors to the training manager.
- Review whether the training objectives prescribed by the regulatory authorities are incorporated into the training programmemes.
- When training personnel design training material, work group SMEs are consulted with to verify that the tasks to be trained accurately reflect the scope of the job and to confirm the training needs. The work group may also help determine the setting in which the training should be given, whether it should be in the classroom, laboratory, or nuclear power plant.
- Entry-level written tests.
- Interviews of the trainees and their supervisors.
- Evaluation of trainee's initial level by his direct supervisor.
- Identification of specific training objectives.
- Making decisions on the most suitable training modes and settings.
- Individualization of training programmemes (in particular, using a computerized system accumulating data on the trainee career development, trainee performance and instructor comments).
- Ensuring that training objectives associated with the skills are measurable and their achievement is observable.
- Before a development of training materials is complete, the total training material package is sent out to the work group SME(s), supervisors and training personnel for review. The proper selection of reviewers promotes a critical, thorough, and objective evaluation of technical content and educational soundness. Frequently, new or revised courses are given a pilot (trial) training to a selected audience of SMEs and work group supervisors. This technique is used to obtain valuable feedback the first time through the course to ensure the content and delivery meet the expectations of the work group and the training group. As a final step in formative evaluation, plant supervisory personnel and subject matter experts approve training material prior to its being trained.

4.2.2.2. Activities performed during training

- Assessment of trainee knowledge, skills and attitudes by means of written and oral tests, and practical exercises/operating tests (using simulators, mock-ups, laboratories,

workshops, and in-plant on-job assessment sessions, walk-through in plant areas and in the control room). Job performance measures (JPMs) are actively used.

- Achievement of training objectives associated with the skills is checked. Not achieved objectives are identified and measures are taken.
- Competencies of the trainees are continuously evaluated against prescribed criteria during simulator training.
- Visual display systems are used to represent simulated plant parameters and measurable results of trainee performance.
- Evaluation of instructor performance.
- Evaluation by/feedback from the trainees.
- Observation by trainers and plant managers.
- As instructors prepare to deliver a training course, they are not only refreshing the material in their own minds, but also ensuring that it is current and accurate. They check the referenced nuclear power plant procedures and other references to verify the material is up to date.
- During the implementation phase evaluative information is gained through students' immediate verbal feedback. Supervisors who sit in the class and managers who observe portions of the training provide immediate evaluative feedback to the instructors to ensure the nuclear power plant philosophy and expectations are being met by the instruction.
- At any time during the course, generally near the end, students complete course critiques on the training material content and delivery. During the delivery, instructional supervisors periodically evaluate instructor performance and provide constructive criticism on instructional methods. Using the results of the end of course written exams, instructors are able to quickly deduce any points they may have missed in the instruction, points that were taught wrong, or any exam items that were not effective at evaluating the desired outcomes of the course.

4.2.2.3. Activities performed after training

- Annual verification of personnel competence by assessment of individual work results.
- Annual verification of licensed personnel competence by observation during simulator training.
- Written, oral and operating tests/examinations (e.g. simulator tests).
- On-job evaluation.
- Assessments of achieving the training objectives and inadequate trainee's performance during simulator sessions are communicated to shift supervisor in order he will be able to follow up during the work in the plant.
- Administering surveys (electronic and hard copy) and questionnaires.
- Conducting interviews (phone and face to face) with trainees, trainees' managers and customers of trainees.
- Final evaluation of trainee performance by means of a computerized parameter event data logging system using data from simulator exercises.
- Development of end-of-course evaluation reports by the instructors or/and training programmeme coordinators, and presentation of these reports to the training managers for improving the course content.
- Evaluation of total costs associated with the training.
- Each work group sponsors a curriculum committee with representatives from the training group and all levels of the work group. The work group manager chairs the committee. The curriculum committees routinely evaluate the effectiveness of training.

They provide examples of how training leads to improved worker performance and make recommendations to enhance the content and delivery of future training. The curriculum committees use worker performance data and trends to help select continuing training topics for their work group.

- The evaluation programmeme coordinator conducts post-training evaluation through interviews with former students and their supervisors. The focus of the interviews is to determine to what extent the training programmeme prepares or enhances the workers' ability to perform in the nuclear power plant.
- During the first quarter of each year the evaluation programmeme coordinator also writes an annual report summarizing all training evaluation activities from the previous year. The data inputs for the annual report include all sources of training effectiveness evaluation, both internally and externally provided. The report comprehensively assesses the status of the nuclear power plant's training programmemes, and focuses on training successes and areas for improvement. The summary report is addressed to senior nuclear department managers since they are ultimately responsible for evaluating the training programmemes' effectiveness at preparing nuclear power plant workers to perform their jobs.

4.2.3. Use of formal criteria

The question suggested in the survey was "Does your utility/organization have formal established criteria to evaluate the following areas?" Summary of the responses is provided below.

(1) The majority of utilities responded that they have formal criteria to evaluate personnel training process.
(2) Almost all utilities responded that they have formal criteria to evaluate training programmemes.
(3) Almost all utilities responded that they have formal criteria to evaluate training sessions.
(4) All utilities responded that they have formal criteria to evaluate trainees' performance.
(5) Approximately a half of utilities responded that they have formal criteria to evaluate Customer satisfaction.
(6) Approximately a half of utilities responded that they have formal criteria to evaluate on-job performance.

More detailed explanation of the text marked in bold above may be found in Annex A, Question 3.

However, responses to the request to provide examples which may demonstrate these formal criteria do not convincingly justify the existence of formal criteria, especially for the forth and fifth areas above.

Some examples of the criteria to evaluate the above mentioned areas may be found on CD attached to the report.

4.2.4. Indications used to measure the impact of training

The following question was suggested in the survey:

"What qualitative and quantitative indications does your utility/organization use to measure the impact of training on:

- Plant performance improvement
- Plant safety
- Human performance improvement
- Business conduct/plant productivity”

The following examples were provided for the four identified areas:

4.2.4.1. Impact of training on plant performance improvement

- Plant performance indicators
- Observation of personnel when they are working in plant areas
- Analysis of work results (outage periods, start up and shut down activities)
- Number of events caused by the personnel errors for the reported period

4.2.4.2. Impact of training on plant safety

- Plant or company event reports
- Number of events caused by the personnel errors of “over 0” level according to the INES scale for the reported period
- Accident rates
- Lost and away days

4.2.4.3. Impact of training on human performance improvement

- Number and type of human errors detected by “human factor” analysis
- Number of events caused by the lack of safety culture for the reported period
- Employee concerns voiced

4.2.4.4. Impact of training on quality of business conduct/plant productivity

- Analysis of plant performance (outage duration, delays in connection to grid)
- Production losses resulting from the personnel errors for the reported period

4.2.5. Improvements resulted from the redesign of training

The following question was suggested in the survey: “Have you ever modified the design of a training activity/course that resulted in a significant improvement based on the results of an evaluation?”

The majority of utilities modify the design of their training activities/courses based on the results of a training evaluation. Effectiveness of the redesign of training is determined often by the observations performed by the instructors and plant managers.

Examples of training activity/course modifications provided in the responses are presented in the table below:

4.2.6. Approving the training recommendations

The following question was suggested in the survey:

“After a training effectiveness evaluation is complete and recommendations are made:

- Who is involved in deciding what changes should be made?

- Who is the final authority for approving training recommendations?
- Do you have forms to document the review and approval of the recommendations?"

Examples of the responses are provided below:

4.2.6.1. Who is involved in deciding what changes should be made?

- Plant training review committees or training advisory boards
- Plant department/division heads and training (centre) managers
- Line managers
- Responsible plant personnel in conjunction with the training personnel
- Instructors of a training department
- Training departments or organizations providing training services
- Executive managers of operating organization

Table 4. Modifications to the Training Design

Training activity and the significant result	**Evaluation method**	**How did you determine the effectiveness of this training activity?**
Modifications were made to the theoretical course for Reactor Control Operators in the field of reactor kinetics in sub-critical state during the rod removal. The modifications led to significant improvement of trainees' performance.	Through the investigation of direct and root causes of events.	By the operating tests at the full-scope simulator.
Mock-up practice for high radiation work. Reduced man-rem and stay time.	Actual measurements. Also, the use of an electronic survey process was implemented to conduct Level 3 evaluations on 21 courses. This was used to establish a baseline data point to review other courses periodically in the future.	Work time.
An engineering continuing training course on "Principles of Nuclear Power Plant Safety" was redesigned to meet the needs of the line engineering organization.	The modification was initiated through a pilot training session to an audience comprised of line and training professionals. The audience determined necessary changes to the course design before it was delivered to the intended population.	Post-training evaluation interviews with students and supervisors who verified the value and effectiveness of the training.

4.2.6.2. Who is the final authority for approving training recommendations?

- Plant line managers
- Depends upon the job classification. For managers and professionals — plant operations manager. For workers — department/division manager
- Plant department manager
- Training department manager (at outside training centres providing training services)
- In some countries — nuclear regulatory authority for the licensed personnel, and operating organization for non-licensed personnel

4.2.6.3. Do you have forms to document the review and approval of the recommendations?

Only one-third of utilities are using currently special forms for this purpose. Some examples of these forms may be found on CD attached to publication.

4.2.7. Deriving the training needs from plant performance

The following question was suggested in the survey: “At your utility/organization are training needs formally determined from identified plant performance improvement areas or weaknesses?”

More than a half of utilities positively answered to this question. Relevant examples provided in the responses are presented in the table below.

4.2.8. Identifying the recommendations

Examples of training-related recommendations and/or other management initiatives that had been identified as a result of a systematic evaluation and determined to be extremely effective were requested from the respondents. Representative sample of the examples provided is included in the Tables 6 and 7.

4.2.9. Self-assessment regarding the training

The following question was suggested in the survey: “Does your utility/ organization conduct regular self-assessment regarding the training?”

Self-assessment regarding the training is performed by almost all utilities/organizations. The training programmemes are evaluated on regular basis. The participants of self-assessment are the line managers, training programmeme coordinators, training staff, and training managers. Examples of the self-assessment procedures are represented on the CD attached to this publication.

Table 5. Training Needs Identified from Plant Performance

Examples of performance improvement area	How did you verify training met the need?
Improvement needed in regard to the adjustment of throttle valves of the main circulation pumps.	Training provided on identified activity decreased the weaknesses during unit startups after repair outages.
Improvement of the unit startup activities after repair outages.	Training provided to the main control room personnel improved performance during startups.
Improvement of application of modified gaskets.	Training that has been provided to the maintenance personnel involved in the maintenance of equipment with joints improved the activity performance.
Improvement of human performance across the maintenance work force: electrical, mechanical, and instrument and controls. A two-day course on human performance toolbag training, on management expectations for work authorization packages, plant procedure use and adherence, and communications was designed, developed, and delivered to all maintenance workers by line supervisors and training personnel.	Post-training evaluation interviews with students and their supervisors
Improvement of the quality of engineering safety evaluations; a need for training was identified based on the management observation that the safety evaluations were being done poorly	Improved quality of safety evaluations as observed by management and regulators
Monitoring and improvement of the performance of licensed control room operators in the plant	The results of licensed operator annual Requalification exams are monitored closely by line and training management. The effectiveness of training is also monitored continuously throughout the year in simulator training exercises and performance exams

Table 6. Training-Related Recommendations

Identified problem or gap solved	Training action taken	How did you determine its value?
All plant personnel influenced by complete reorganization of NPP.	A series of 108 training sessions took place to inform all plant personnel on new organizational structure and modifications to the responsibilities.	Plant personnel accepted new organizational structure quite fast. No significant events occurred as a result of the reorganization of the whole plant.
Implementation of new software for clearance and tagging systems.	Practical training before the software is taken into service.	Error free application of the system from the very beginning of its implementation.
The problem of radiation dose reduction during maintenance of the reactor.	Training course on channel replacement technology.	No doubt that radiation doses would be higher without channel replacement course conducting.
The problem of safety culture deficiency and lack of knowledge on radiation safety revealed by evaluation of personnel performance.	Training courses implemented: - The main principles of radiation safety - Safety Culture - Work places preparation	Implementation of those courses resulted in regular radiation dose reduction for Kursk NPP maintenance personnel.
Deficiencies in reactor control associated with a lack of basic knowledge in neutron kinetics in sub-critical state.	Training course “Neutron flux kinetics and operator’s actions” was conducted.	Events similar to those that had occurred at the Zion NPP and Dungence NPP were not happening at the Kursk NPP.
Absence of practice in circulation recovery in the town heating circuit in case of NPP blackout.	Emergency drills were conducted.	Experts (observers) positively evaluated the actions of personnel.
Training props did not duplicate actual field conditions.	Props were modified to duplicate more closely the actual field working conditions.	Level 1 and 3 evaluations.

Table 7. Management initiatives identified from evaluation of the training

Identified problem or gap solved	Management initiative taken	Results achieved - positive or negative
Instructor experience could not be shared or effectively used by other peers.	Outlines of training scenarios, performance of trainees and instructor comments are accumulated in the computerized filing system.	Positive - each instructor can use the whole training record.
Difficulties in remembering and recalling the logic schemes of control and protection.	Development of a multimedia interactive product.	Positive – the client's satisfaction.
Some managers were not involved in the training process. They were delegating all training-related tasks to other professionals who were more familiar with the processes.	Most managers became more intimately involved in the training process through discussing the expectations for the training prior to the training conducting and the results of training after the students' attendance of the training.	Positive – managers became more familiar with the training objectives and how directly the training objectives are related to the specific organizational requirements.

4.2.10. Job aids to track training development actions

The following question was suggested in the survey: "Does your utility/organization have any procedure(s) and/or software to track training development actions?"

Approximately a half of the utilities/organizations responded that they have the procedures and they use software to track their training development actions. The examples of the procedures may be found on the CD attached to this report. A summary of the software use is provided below.

- Software for systematic analysis of personnel participation in prescribed training activities. Running in the plant network. Tracking of both the individuals and groups of individuals is provided. The software supports training managers to generate various kinds of reports.
- Integrated software packages to support all phases and activities of systematic approach to training, including tracking of training development actions.
- Computerized filing system that provides the maintaining and access to the trainee performance records and instructor comments.
- Two electronic databases that track the training development actions. One of the databases tracks the changes to and development of specific courses, the second database tracks open items that are associated with responses to training evaluation activities.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS DRAWN FROM THE TEXT OF THIS REPORT AND SURVEY RESPONSES

- Training for most NPP personnel is now accomplished using the systematic approach to training (SAT). If carried out properly the SAT process will effectively and thoroughly define the initial training and qualification needed by NPP personnel operating, maintaining, supporting, and managing the plant. As part of the process, training and performance objectives are identified. Once the training is implemented the achievement of those objectives can be measured by various evaluation methods some of which are described in this report.

- This report also provides an overview of the principles involved in the development, delivery and evaluation of effective training, including the management of training activities. The critical importance of the line manager's involvement is identified. The need to follow-up on programmes to ensure intended results are achieved is a principle accepted by all NPP managers. It is equally important to evaluate the effectiveness of training and modify programmes as needed.

- Training effectiveness evaluation can be conducted at more than one level:

  - The lower and easier to measure levels (Kirkpatrick 1–3) attempt to evaluate a performance of the training. They evaluate the effectiveness of the training process by sampling participant reaction, participant learning, and participant behavior change.
  - The higher and most difficult to measure level (Kirkpatrick 4) attempts to determine the impact of training on plant safety, reliability, and cost effectiveness. This is usually limited to anecdotal evidence of positive impacts when training is provided to solve specific performance problems or to prepare for special evolutions. Plant performance indicator trends depend on several variables. The contribution of training to a change in performance is difficult to quantify if other variable factors are also changing. It may be possible for NPP managers to estimate the relative contributions if soft data is tracked over time.

- There is evidence that training is sometimes identified as the sole remedy for plant performance problems. Problems such as repeat events or repeat component failures may have multiple root causes. If so, training will not be effective in correcting all deficiencies and training resources may be miss-allocated. Careful analysis of deficient training programmes by INPO resulted in identification of common problems, which were identified and grouped into seven categories cited as *warning flags*, presented in Section 2.3. When used appropriately, the training warning flags can provide an effective framework for self-assessments of training programmes. The precursors provided for each training warning flag may be used as subjective means in identifying early indicators of developing problems in training programmes. Considering the training warning flags when making changes to training programmes and processes may help maintain the effectiveness of the training provided.

- This publication reports that, in many cases, a group of individuals (stakeholders) working together to assess training effectiveness achieves the best results. Identified were:

    - Training programme review committees
    - Table-top needs assessment/analysis groups
    - Focus groups

    A nominal group technique (NGT) process is described.

5.2. RECOMMENDATIONS

- NPPs management personnel should rigorously conduct training effectiveness evaluations to ensure training and qualification programmes are providing and maintaining the needed competencies.
- NPPs management personnel should look for opportunities to assess the impact training is having on overall plant performance and safety to exploit opportunities for training that will “add value” or increase the “return on investment”.
- NPPs management personnel should not make resource allocation or budget decisions solely on the results of training effectiveness evaluations because of the difficulty in identifying quantifiable benefits.

APPENDIX A

KIRKPATRICK'S MODEL: FOUR LEVELS OF EVALUATION

Donald L. Kirkpatrick introduced a four-step approach to training evaluation in 1959 (Shelton & Alliger, 1993). He describes his approach in a chapter titled *'Evaluation'* in the three editions of the *Training and Development Handbook*; (1987, 1976, 1967). In these chapters, Kirkpatrick states, 'nearly every one would agree that a definition of evaluation would be *the determination of the effectiveness of a training programme'* (1987, p.302). His four steps have become commonly known in the training field as: Level One, Level Two, Level Three, and Level Four Evaluation. The table below reflects these four levels of evaluation and following the table is a brief description and suggested guidelines, for evaluating training at each level, discussed by Kirkpatrick in the 1987 edition of the Handbook.

Four Levels of Evaluation (Kirkpatrick Model)

Levels	What do I want to know?	When do I find it out?
1. Reaction	Did they like it? How well did participants like the programme or course?	Upon completion of the training session or course
2. Learning	Did they learn it? What principles, facts, and techniques were learned? What attitudes were changed?	Upon completion of the course
3. Application/Behavior	Did they use it? What changes in job behavior resulted from the programme?	Before and after training
4. Results	Did it produce tangible business results? What were the tangible results of the programme in terms of reduced cost, improved quality, improved quantity, etc.	Before and after training

Level 1: Reaction

Kirkpatrick defines this first level of evaluation as determining "how well trainees liked a particular training programme"; "measuring the feelings of trainees"; "measuring customer satisfaction". He outlines the following guidelines for evaluating reaction:

1. Determine what you want to find out.
2. Use a written comment sheet covering those items determined in step 1.

3. Design the form so that the reactions can be tabulated and quantified.
4. Obtain honest reactions by making the forms anonymous.
5. Encourage the trainees to write in additional comments not covered by the questions that were designed to be tabulated and quantified.

Kirkpatrick suggests along with evaluating the reactions of trainees, that the programme coordinators, training managers, and other qualified observers' reactions to the instructor's presentation(s) also be evaluated. An analysis of the two would give the best indication of the effectiveness of the programme at this first level of training evaluation.

Level two: Learning

Kirkpatrick defines learning, for the purpose of evaluation, as "attitudes that were changed, and knowledge and skills that were learned". He outlines the following guidelines for evaluating learning:

1. The learning of each trainee should be measured so that quantitative results can be determined.
2. A before-and-after approach should be used so that any learning can be related to the programme.
3. Where practical, a control group not receiving the training should be compared with the group that received the training.
4. Where practical, the evaluation results should be analyzed statistically so that learning can be proved in terms of correlation or level of confidence.

Besides using examinations (written, oral, and performance tests), Kirkpatrick suggests that if a programme is carefully designed, learning can be fairly and objectively evaluated while the training session is being conducted. For example, individual performance of a skill being taught, and discussions following a role-playing situation can be used as evaluation techniques.

Level three: Behavior (The Transfer of Training)

Realizing that "there may be a big difference between knowing principles and techniques and using them on the job," Kirkpatrick suggests that the following five requirements must be met for change in behavior to occur:

1. Desire to change
2. Know-how of what to do and how to do it
3. The right job climate
4. Help in applying what was learned during training
5. Rewards for changing behavior
6.

Kirkpatrick outlines the following guidelines for evaluating training programmes in terms of behavioral changes on the job:

1. A systematic appraisal should be made of on-the-job performance on a *before-and-after* basis.
2. The appraisal of performance should be made by one or more of the following groups (the more the better):
   - The person receiving the training
   - The person's supervisor or superiors
   - The person's subordinates (if any)
   - The person's peers or other people thoroughly familiar with his or her performance
3. A statistical analysis should be made to compare performance before and after and to relate changes to the training programme.
4. The post-training appraisal should be made three months or more after the training so that the trainees have an opportunity to put into practice what they have learned. Subsequent appraisals may add to the validity of the study.
5. A control group (not receiving the training) should be used.

Kirkpatrick notes that "measuring changes in behavior resulting from training programmes involves a very complicated procedure," nevertheless it is worthwhile if training programmes are going to increase in effectiveness and their benefits are to be made clear to top management. He also recognizes that few training managers have the background, skill, and time to engage in extensive evaluations, and suggests they call on specialists, researchers, and consultants for advice and help.

Level four: Results (The Impact of Training on the Business)

Based on the premise that "the objectives of most training programmes can be stated in terms of results such as reduced turnover, reduced costs, improved efficiency, reduction in grievances, increase in quality and quantity of production, or improved morale," Kirkpatrick concludes "it would be best to evaluate training programmes directly in terms of results desired." He recognizes there are so many complicating factors that it is extremely difficult, if not impossible, to evaluate certain kinds of programmes in terms of results and recommends that training managers evaluate in terms of reaction, learning, and behavior first and then consider tangible business results. He also cautions that due to the difficulty in the separation of variables — that is how much of the improvement is due to training as compared to other factors, it is very difficult to measure results that can be attributed directly to a specific training programme.

From Kirkpatrick's experience with Level Four evaluations, he concludes that it is probably better to use the personal interview rather than a questionnaire to measure results. Also, measures on a before-and-after basis can provide evidence (but not necessarily proof that the business results are directly attributed to the training even though other factors might have been influential.

APPENDIX B

TABLE TOP NEEDS ANALYSIS

1. *Assemble a focus group of no more than 7–10 people*: This group of people, should consist of at least 2–3 senior qualified individuals responsible for the work, 1 person new to the work, 1 job supervisor who oversees the work, 1 training specialist responsible for the training of these people, 1–2 support personnel such as engineering, technical, or someone responsible for developing procedures, and 1–2 skilled qualified facilitators. Before this group is assembled, the most important element to the success of the group is to obtain management approval for their time and a commitment that these individuals will be allowed to see the process through from beginning to end.

2. *Identify or validate job requirements/competencies*: If job requirements / competencies are already established, they will not have to be determined. If they are established, the first step in the process is to have the group review them to validate them and to examine them to determine which of the job requirements the work force may be experiencing difficulty with. In other words, the group will identify any performance deficiencies that exist with either the entire job or just the part of the job the group is tasked to look at. If the job requirements/competencies are not established (through some form of job or competency analysis) then they can be easily determined with this group of subject matter experts. The best way to accomplish this activity is to use a process called "nominal group technique" (NGT). This process is described in detail in Appendix B-1.

3. *Develop a list of performance deficiencies or needs*: Once the list of job requirements have either been identified and or validated, the facilitator then has the group look at the requirements and asks "Of all these job requirements listed, using the NGT, look at the list and make a list of those requirements focus group believes there is some level of difficulty performing or individuals can not do at all. The facilitator then facilitates the process of refining that list to the point that every group member agrees that the list represents some level of a performance deficiency. An important key to this step, step 2 , and steps 4 and 5 is that the group comes to a consensus as to what they develop. What this means is that all group members can live with the decision the group has made. They do not always have to agree they just have to say they can live with that decision.

4. *Develop a list of causes (barriers) for each performance deficiency or need*: When the list of performance deficiencies have been developed using the NGT process, the group then looks at each deficiency and lists the causes they believe create that deficiency. These causes are issues/items that prevent the workforce from doing the specific performance they are expected to do. This process takes some time because the NGT process has to be employed for every deficiency. When the list is finalized, it will yield a comprehensive list of deficiencies and reasons why those deficiencies exist.

5. *Develop a list of recommendations*: As the process matures to this step, the NGT process continues to go back to each of the deficiencies or needs one at a time to look at each cause to determine a list of recommendations. Once the recommendations have been developed, the group looks at each recommendation to determine if they are training related or non-training related. When this step is finalized, the group will have created a valuable publication that will provide the basis for an entire training

programme or just for a part of a training programme they may be tasked to develop training for. The publication will list job requirements, job deficiencies, causes for the deficiencies, or needs and recommended solutions. In some NPPs, a root cause analysis process will determine bases of a deficiency. This will make the job of facilitating the focus group through a nominal group technique (NGT) easier.

6. *Present findings and recommendations to training and line management*: To bring this process to closure, the findings and recommendations need to be communicated to both training management and line management responsible for the work discipline. This step works best if the entire focus group can get an audience with these management personnel and meet with them face-to-face to share with them the results of their efforts. This also allows clarification to the findings as well as building a strong working relationship between training and the workforce.

APPENDIX C

NOMINAL GROUP TECHNIQUE

The nominal group technique is a structured group process resulting in the maximum contribution of experienced individuals to a common goal. In order to avoid some common problems that occur when there is a gathering of highly competent people such as:

- Some people like to dominate any and all discussions,
- Ideas of other contributors are lost or dismissed,
- Some people never participate; and
- Non-productive environment exists for any creative thinking process.

The group must apply nominal group techniques to accomplish a common goal.

Briefly this technique allows every member of the focus group to provide valuable input into the process. For example, you provide a notebook and pencil to every person in the group and you have them silently list the items you are trying to identify. They do this individually and the facilitator's role is to make sure this is done by enforcing the ground rules of generating their list quietly, independently, and providing a structured time limit to accomplish the development of the list.

When each person in the focus group has developed their own list, the facilitator asks the group to share their list one item at a time going around the room until all items have been listed on a flip chart, chalk board, or dry erase board. The facilitator has to enforce the rules that all items are important and that during the process of listing the items, the group will not be allowed to discuss these items.

The facilitator also encourages the group to add to their list and to delete items from their list if someone else shares that item. When all items have been listed, the facilitator allows the group to combine ideas, eliminate duplications, and to refine the list as appropriate.

APPENDIX D

HARD DATA EXAMPLES

Output:	**Time:**
Units Produced Tons Manufactured Items Assembled/Disassembled Money Collected Items Sold Forms Processed Loans Approved Inventory Turnover Customers Visited Applications Processed Students Graduated/Qualified Tasks Completed Output per Hour Productivity Work Backlog Incentive Bonus Shipments Completed New Accounts Generated	Equipment Downtime Overtime On-Time Shipments Time to Project Completion Processing Time Supervisory Time "Break-in" Time for New Employees Training Time Meeting Schedules Repair Time Efficiency Work Stoppages Order Response Late Reporting Lost Time Days
Costs:	**Quality:**
Budget Variances Unit Costs Cost by Account Variable Costs Fixed Costs Overhead Costs Operating Costs Number/Type of Cost Reductions Project Cost Savings/Avoidance Accident Cost Occurrence Processing Cost Programme Cost Sales Expense	Scrap Waste Rejects Error Rates Rework Shortages Product Defects Deviation From Standards Product Failures Inventory Adjustments Time Card Corrections Percent of Tasks Completed Properly Number of Accidents

APPENDIX E

SOFT DATA EXAMPLES

Work Habits: Absenteeism Tardiness Visits to Health services First Aid Treatments Violations of Safety Rules Number of Communication Breakdowns Excessive Breaks Follow-Up	**New Skills:** Decisions Made Problems Solved Conflicts Avoided Grievances Resolved Counseling Problems Solved Listening Skills Interviewing Skills Reading Speed Discrimination Charges Resolved Frequency of Use of New Skills
Work Climate: Number of Grievances Number of Discrimination Charges Employee Complaints Job Satisfaction Unionization Avoidance Employee Turnover Reduced Litigation	**Development/Advancement:** Number of Promotions Number of Merit Pay Increases Number of Training Programmes Attended Requests for Transfer Performance Appraisal Ratings Increases in Job Effectiveness
Feelings/Attitudes: Favorable Reactions Attitude Changes Perceptions of Job Responsibilities Perceived Changes in Performance Employee Loyalty Increased Confidence	**Initiative:** Implementation of New Ideas Successful Completion of Projects Number of Suggestions Submitted Number of Suggestions Implemented Work Accomplishment Setting Goals and Objectives

APPENDIX F

DATA COLLECTION METHODS

This section addresses methods of data collection, sometimes referred to as evaluation methods. The methods directly relate to earlier material on instruments and evaluation design. A brief explanation may be necessary on the differences between instruments, evaluation design, and data collection methods. Data collection methods are concerned with the practical use of instruments and their applications to collect data. Data collection methods will usually be part of the evaluation design and use one or more instruments. These methods provide, from a practical standpoint, useful and effective approaches for collecting data necessary to evaluate training programmes.

In some situations the three terms "instruments", "evaluation design", and "data collection methods" are almost synonymous. For instance, pre-course and post-course testing represents a method of data collection. The instruments are the tests used in the evaluation, and the evaluation design is of the pre-course and post-course measurement variety. In another example the distinction is more apparent. Participant follow-up is a method of data collection. From the instrument design standpoint, the concern is only with the design aspects of the questionnaire, interview, or observation to use in the follow-up. In evaluation design, follow-up is one measurement or possibly a series of measurements in the overall design. The data collection method is concerned with the practical applications of the follow-up.

Pre-programme and post-programme examinations

A very popular data collection method involves administering examinations before and after a training programme. This method measures changes in skills, knowledge, and attitudes.

The guidelines for the design and use of pre-course and post-course examinations were briefly addressed in earlier sections and will not be amplified further. Advantages of this type of data collection method are:

- They are easy to administer.
- Improvement can easily be tabulated.

The inherent disadvantages of this type of data collection method are:

- Improvement measured during the programme does not assure that it will be put into practice on the job.
- The effects of testing may have an impact on the post-programme scores. The first examination might influence the score on the second.

Nevertheless, the pre-course and post-course measurements are used frequently and represent a significant method of data collection for use in evaluations

Participant feedback

Feedback from programme participants is the most frequently used, and least reliable, method of collecting data for evaluations. The popularity of this form of data collection is

astounding. Ratings from reaction questionnaires can be so critical that a person's job may be at stake, as in the case of instructor ratings in school systems. Feedback forms are used in many places outside the training arena. Any organization providing a service or product is usually interested in feedback from those utilizing the service or product.

While participant feedback is popular, it is also subject to misuse. Sometimes referred to as a "happiness rating," it has come under fire from many training professionals because it is considered worthless. The primary criticism concerns the subjectivity of the data. Possibly the criticism is unjustified. Some research shows a direct correlation between positive comments at the end of a programme and the actual improved performance on the job. This research was based on 90 government supervisors and managers who completed a basic management course. In all the variables examined, trainee reaction was the strongest determinant of on-the-job application of the new management principles. Those participants who enjoyed the programme most were the ones who achieved the most on the job. Those who did not like it apparently did not bother to do too much of anything with it. Armed with this data, training managers could logically assume that if participants enjoyed the course and said they planned to use the materials, they probably would. However, a word of caution is in order. This research might be measuring the effect of a self-fulfilling prophecy, that is, you will do what you say you will. Other research has produced mixed results on this issue.

While there is no good substitute for hard data in evaluating programmes, a carefully designed, properly used participant feedback questionnaire at the end of a training programme might supplement a more sophisticated evaluation method. There is a definite place for feedback questionnaires in training evaluation. A high quality evaluation may be difficult to achieve without feedback questionnaires.

Areas of feedback

The areas of feedback used on reaction forms depend, to a large extent, on the organization and the purpose of the evaluation. Some forms are very simple while others are very detailed and require a considerable amount of time to complete. The feedback questionnaire should be designed to supply the proper information. The following areas represent a comprehensive listing of the most common types of feedback solicited:

- Programme content
- Out-of-class assignments
- Instructor/speaker
- Facilities
- Planned improvements
- Instructional materials
- Method of presentation
- Programme relevance
- General evaluation

Objective questions covering each of these areas will provide very thorough feedback from the participants. This feedback can be extremely useful for making adjustments in a programme and/or assist in predicting performance after the programme. The area of instructor/facilitator evaluation deserves additional attention. In some organizations the primary evaluation centers on the instructor, and a separate form may be used for each instructor that covers a variety of areas. This highlights the importance of an effective course leader.

This is illustrated in the instructor evaluation process at Southwestern Bell. The evaluation focuses on five areas for evaluation of the instructor:

1. General performance criteria referenced to company standards.
2. Knowledge of the subject matter including familiarity with content and depth of understanding.
3. Presentation skills, which focus on clarity of the presentation, use of audiovisual material, pacing of material, maintaining eye contact and accessing learner understanding.
4. Communications, which include the use of understandable language, real-life examples and the promotion of discussion.
5. Receptivity, which includes responsiveness to trainees, responding effectively to questions and maintaining neutrality in responses to student comments.

Useful guidelines

The design information on questionnaires applies to the design and construction of reaction or feedback questionnaires. In addition to those design principles, there are a number of useful tips that can improve the effectiveness of this data collection method.

Consider an ongoing evaluation. For lengthy programmes, an end-of-the programme evaluation may leave the participants unable to remember what was covered at what time. To help improve the situation, an ongoing evaluation can be implemented. This evaluation form is distributed at the beginning of the programme and participants are instructed when and how to supply the information. After each topic is presented, participants are asked to evaluate the topic and speaker. The information is fresh on their minds and can be more useful to the programme evaluators.

Try quantifying course ratings. Some organizations attempt to solicit feedback in terms of numerical ratings. Although very subjective, these can be useful to programme evaluators.

Collect information related to cost savings. It is difficult to get realistic input on a feedback form related to cost reductions or savings, but it is worth a try. The response may be surprising. Just a simple question will sometimes cause participants to concentrate on cost savings. A possible statement might be:

As a result of this programme, please estimate the savings in dollars that will be realized (i.e., increased productivity, improved methods, reduced costs, etc.) over a period of one year. Please explain the basis of your estimate.

Express as a percent the confidence you place on your estimate.

(0 % = no confidence, 100 % = certainty)

Allow ample time for completing the form. A time crunch can cause problems when participants are asked to complete a feedback form at the end of a programme, particularly if they are in a hurry to leave. Consequently, the information will be cut short in an effort to finish and leave. A possible alternative is to allow ample time for evaluation as a scheduled session before the end of the programme. This could possibly be followed by a wrap up of the programme and/or the last section or lesson. Another alternative is to allow participants to mail the evaluation later. With this approach, a reminder may be necessary to secure all of the forms.

Put the information collected to use. Finally, sometimes participant feedback is solicited, tabulated, summarized, and then disregarded. The information is collected for one or more of the purposes of evaluation and should be used. Otherwise, the exercise is a waste of the participants' time. Too often instructors or programme evaluators use the material to feed their egos and let it quietly disappear in the files, forgetting the original purposes for its collection.

Advantages/disadvantages

There are some obvious advantages to feedback questionnaires. Two very important ones are:

- They obtain a quick reaction from the participants while information is still fresh on their minds. Quite often, at the end of a programme, participants have passed judgment on the usefulness of the programme material. This reaction can be helpful to make adjustments or to provide evidence of the programme's effectiveness.

- They are easy to administer, usually taking only a few minutes. And, if constructed properly, they can be easily analyzed, tabulated, and summarized.

The disadvantages to feedback questionnaires are:

- The data are subjective, based on the opinions and feelings of the participants at that time. Personal bias may exaggerate the ratings.

- Participants often are too polite in their ratings. At the end of a programme, they are often pleased and may be happy just to get it out of the way. Therefore, a positive rating may be given when they actually feel differently.

- A good rating at the end of a programme is no assurance that the participants will practice what has been taught in the programme.

In summary, there is a definite place for feedback questionnaires in training programme evaluation. They can provide a very convenient method of data collection. Ideally, it should be only a part of the total evaluation process.

Feedback from others

Another useful data collection method involves soliciting feedback from other individuals closely identified with the participants in the programme. Typically, these groups fall into five categories: (1) supervisors of the participants, (2) subordinates of the participants, (3) peers, (4) members of the training staff, and (5) specially trained observers.

Supervisors

The most common group for feedback is the supervisors of those attending training programmes. This feedback provides detailed information on performance improvement, which resulted from the training. Possibly the best person to evaluate performance is the participant's supervisor, particularly if he or she has been instructed to observe the participant. This "feedback from the boss" is usually obtained during a follow-up evaluation using an

instrument such as a questionnaire or an interview. The questions on the instrument should be designed to solicit specific information that will reveal as much tangible change as possible. This method can develop very reliable feedback data.

Subordinates

Probably the second most often used feedback group is the subordinates of the participants of a training programme. This information may not be as reliable as that obtained from the participant's supervisor but can nevertheless be valuable in the evaluation process. The information will be subjective and may be biased or opinionated, depending on the employee's attitude toward the participant. Generally, with this type of data collection method, employees are asked about changes or improvements in their supervisor's behavior since attending training. Patterned interviews are conducted with subordinates of supervisors before the supervisors are trained. Six months after the training, follow-up interviews are conducted to determine how effectively the supervisors handled nine specific employee situations. The results show if there were any situations where the resolution was more effective after the training programme.

Peers

Probably the least used feedback group is the peer group. This involves soliciting feedback from peers to see how participants have performed after training. This technique is rare, since it is highly subjective and may be unreliable because of the loose ties between the evaluator and the participant. The other two groups have a closer identification. The techniques of data gathering for this type of feedback are through questionnaires or interviews.

A word of caution is in order for collecting information from the previous three groups. Any information collected from another group may tend to put the participant on trial. Members of that group are watching unusually close to see if the participant performs in a particular manner. This close scrutiny, while it may be important to evaluation, may not be appropriate for the acceptance and endorsement of the overall training programme.

Training staff evaluation

Another group used for feedback purposes is the training staff. In these situations, staff members, properly trained in observation techniques, observe participants and provide feedback on their performance. Training staff evaluation can be very helpful and can represent a very professional and unbiased method of data collection.

Assessment center method

The final method of data collection involving feedback from others is a formal procedure called the assessment center. The feedback is provided by a group of specially trained observers (called assessors), not usually training staff members as in the previous section. For years the assessment center approach has been a very effective tool for employee selection. It now shows great promise as a tool for evaluating the effectiveness of training.

Assessment centers are not actually centers, i.e. a location or building. The term refers to a procedure for evaluating the performance of individuals. In a typical assessment center the individuals being assessed participate in a variety of exercises, which enable them to

demonstrate a particular skill, knowledge, or ability, usually called job dimensions. These dimensions are important to on-the-job success for individuals for which the training was developed.

The participants are evaluated or "assessed" by the assessors, and the evaluation is in the form of a rating for each dimension. This process takes anywhere from four hours to several days for the participants to complete all the exercises. The assessors then combine individual ratings and remove subjectivity to reach a final rating for each participant.

In training programme evaluation the assessment center process gives a rating or "an assessment" of the participants prior to training. After the training is conducted, the participants are assessed again to see if there are improvements in their performance in the job dimensions. The use of a control group in an evaluation design helps to produce evidence of the impact of training.

Although the popularity of this method seems to be growing, it still may not be feasible in some organizations. The use of an assessment center is quite involved and time consuming for the participants and the assessors. The assessors have to be carefully trained to be objective and reliable. However, for programmes, which represent large expenditures aimed at making improvements in the soft data area, the assessment center approach may be the most promising way to measure the impact of the programme. This is particularly true for an organization where the assessment center process is already in use for selection purposes.

Participant follow-up

Another common data collection method is the participant follow-up at a predetermined time after completion of training. The follow-up evaluation almost always follows an end-of-the-programme evaluation. In fact, in many situations the follow-up relates back to a previous evaluation. This follow-up normally involves the use of a feedback questionnaire, although other variations include interviews and observations. The primary purposes of the follow-up are:

- To help measure the lasting results of the programme.
- To isolate the areas where participants show the most improvement.
- To compare the responses at follow-up time with those provided at the end of the programme.

The follow-up evaluation usually focuses on learning retention, on-the-job application and organizational impact. In some evaluation models, follow-up evaluation is considered the most important phase of evaluation. It usually occurs three to twelve months after training is completed with the most common time frame being six months. For more comprehensive evaluation, the follow-up could occur at repeated intervals (i.e. at six months or one year intervals). This approach will depend on the organization's emphasis on long term results from the training.

Useful guidelines

There are some useful guidelines that will enhance the effectiveness of this follow-up evaluation.

Determine progress made since the training. This is an excellent time to determine what the participant has accomplished with the material presented in the training. Ideally, there will be additional data that reflects the success of the programme. Each item, which required an action at the end of the programme, should be checked at the follow-up to see what was accomplished.

Ask many of the same or similar questions. To provide the continuity for data comparison, the questions asked on the end-of-programme questionnaire should be repeated on the follow-up, if appropriate. For example, a question at the end of a programme on the relevancy of the training content to the job could be asked again on the follow-up. By this time, the participant has attempted to use the training. Different responses to the same question could reveal a problem in training content. If the participant was asked to estimate a dollar savings as a result of the training, then a follow-up question should ask what dollar savings did materialize as a result.

Solicit reasons for lack of results. Not all follow-ups will generate positive results. Some will indicate no improvement or will contain negative comments. A good follow-up will try to determine why the participant did not achieve results. There can be many obstacles to performance improvement such as lack of support from superiors, restricting policies and procedures, or lack of interest on the part of the participant. Identifying these obstacles can be almost as valuable as identifying the reasons for success, since the obstacles can possibly be avoided in future training programmes.

The follow-up should be carefully planned. A plan should be developed to solicit follow-up information. The plan should answer the questions of who, what, where, when, and how as they relate to the administration of the follow-up. For instance, at AT&T, a plan for follow-up is developed in almost the same detail required for training programme development. The time period for the follow-up is critical. It should be long enough so that the desired improvement can take place, yet short enough so that material is still relatively fresh.

Participants should expect a follow-up. There should be no surprises at follow-up time. The intention to administer a follow-up instrument should be clearly communicated during training, preferably at the end. Also, participants should know what information is expected from them in the follow-up.

Consider a follow-up assignment. In some cases, follow-up assignments can enhance the evaluation process. In a typical follow-up assignment, the participant is instructed to meet a goal or complete a particular task or project by the follow-up date. Completion of these assignments provides further evidence of the impact of the training. A variation of the assignment is a follow-up case, where participants have the opportunity to test themselves to be sure they have learned the material.

Follow-up information should be shared with the participant's supervisor. Ideally, the participant's immediate supervisor should be involved in the application of what was learned in the training. At a very minimum, the supervisor should know about what results have been achieved and receive the information on the follow-up evaluation.

Completing the follow-up should be required. The follow-up evaluation should not be optional. Participants are expecting it, and the training department must see that it is accomplished. This input is essential to determine the impact of the training. Good response from the follow-up evaluations is not difficult to come by. Some organizations, such as Shell Oil, boast of a 100% response on follow-up evaluation after the first reminder.

Advantages/disadvantages

The follow-up method of data collection has the following advantages:

- It is easy to administer and easy to tabulate.
- It provides a more accurate assessment of the impact of the programme when compared to the end-of-the-programme questionnaire.
- It helps to measure the lasting results of the programme.

The major disadvantages are:

- The information supplied by the participant may be subjective.
- It needs the cooperation of the supervisor.
- There may be intervening factors affecting the results.
- The participants may not have the opportunity to apply what they have learned.

In summary, participant follow-up is a commonly used technique for collecting evaluation data. Even with its shortcomings it is a very important part of evaluation.

Action plan

The Office of Personnel Management has developed a method called the Participant Action Plan Approach (PAPA). This approach can be used independently as the entire evaluation process, or it can be used in conjunction with other evaluation methods. The approach centers around five basic steps:

Step 1: Planning for PAPA
Step 2: In-course Activities
Step 3: Follow-up Activities
Step 4: Analysis & Conclusions
Step 5: In-course Report

In general, PAPA requires the participant to develop action plans listing behaviors to try upon the return to the job. The plans are based on the content of the training programme just experienced. After a set time, the participant is contacted to see what changes have actually been implemented.

Developing the action plan

The development of the action plan requires two tasks: (1) determining the areas for action, and (2) writing the action items. Both tasks should be completed during training. The areas for action should come from the material presented in the training and, at the same time, be related to on-the-job activities. A list of potential areas for action can be developed, a list

may be generated by the participants in a group discussion, or possibly, a participant may identify an area needing improvement for a particular situation.

The following questions should be asked when developing the areas for action:

- How much time will this action take?
- Are the skills for accomplishing this action item available?
- Who has the authority to implement the action plan?
- Will this action have an effect on other individuals?
- Are there any organizational constraints for accomplishing this action item?

The specific action items are usually more difficult to write than the identification of the action areas. The most important characteristic of an action item is that it is written so that everyone involved will know when it occurs. One way to help achieve this goal is to use specific action verbs. Some examples of action items are:

- Learn how to operate the new drill press machine in the department.
- Identify and secure a new customer account.
- Handle every piece of paper only once to improve my personal time management.
- Talk with my employers directly about a problem, which arises, rather than avoiding a confrontation.

If appropriate, each action item should have a date for completion and indicate other individuals or resources required for completion. Also, planned behavior changes should be observable. It should be obvious to the participant and others when it happens. Action plans, as used in this context, do not require the prior approval or input from the participant's supervisor, although it may be helpful. The action plans should be reviewed before the end of the training programme to check for accuracy, feasibility, and completeness. At that time, it should be made clear to the participant that the plan will be audited.

Advantages/disadvantages

The action plan approach is very flexible and has many inherent advantages:

- It is simple and easy to administer, and participants can understand the approach.
- It can be used with a wide variety of different HRD programmes,
- It can be used to collect a variety of information and can measure reaction, learning, and results.
- It can be used independently as the only method of evaluation or in conjunction with other evaluation methods.

Although there are many advantages, there are at least three disadvantages to this data collection method:

- The method relies on direct input from the participant. As such, the information can be biased and unreliable.
- There may be a problem with the type of data collected. It is usually subjective, in the soft-data category. If more concrete information is available through some other method, then it should be used.

- It can be time consuming for the participant and, if the participant's supervisor is not involved in the process, there may be a tendency for the participant not to complete the assignment.

Performance contract

The performance contract is another effective data collection method. Essentially, it is a slight variation of the action plan process described above. It is based on the principle of mutual goal setting, which has become a well-established process. It is a written agreement between a participant and the participant's supervisor. The participant agrees to improve performance in an area of mutual concern related to the subject material in the training programme. The agreement is in the form of a project to be completed or goal to be accomplished soon after the programme is over. The agreement spells out what is to be accomplished at what time and with what results. The commitment requires both parties to sign the agreement and commit themselves to making the improvements as outlined in the contract.

Steps in the process

Although the steps can vary according to the specific kind of contract and the organization, a common sequence of events is as follows:

- The participant and supervisor mutually agree on a subject for improvement.
- A specific, measurable goal(s) is set.
- The participant attends the training where the contract is discussed, and plans are developed to accomplish the goals.
- After the programme, the participant works on the contract against a specific deadline.
- The participant reports the results of the effort to his supervisor.
- The supervisor and participant document the results and forward a copy to the training department along with appropriate comments.

Selecting the subject

The individuals mutually select the subject or topic for improvement prior to the beginning of the training programme. The topic can cover one or more of the following areas:

Routine performance: includes specific improvements in routine performance measures such as production targets, efficiency, and error rates.

Problem solving: focuses on specific problems such as an unexpected increase in accidents, a decrease in efficiency, or a loss of morale.

Innovative or creative applications: includes initiating changes or improvements in work practices, methods, procedures, techniques, and processes.

Personal development: involves learning new information or acquiring a new skill to increase individual effectiveness.

Requirements for the contract

The topic selected should be stated in terms of one or more objectives. The objectives should state what is to be accomplished when the contract is complete. These objectives should be, written, understandable by all involved, challenging, achievable, largely under the control of the participant, measurable, and dated.

Reporting progress

If the contract extends more than one month from the end of the training programme, participants should possibly submit progress reports outlining what has been accomplished. Upon completion of the contract, a summary report should be submitted to the participant's supervisor. The report outlines the initial objectives and the standards by which the objectives were measured. It reviews the problems encountered and how they were solved, along with specific activities, costs, and benefits. A detailed statement of the results achieved is a significant part of the progress report. In addition, the participant's supervisor, after reviewing the report, makes appropriate comments outlining his satisfaction with the activity. Then the progress report is forwarded to the training department and becomes additional data to evaluate the programme.

Simulation

A final method of data collection is the use of job simulations. This method involves the construction and application of a procedure or task that simulates or models the activity for which the training programme is being conducted. The simulation is designed to represent, as closely as possible, the actual job situation. Simulation may be used as an integral part of the training programme as well as for evaluation. In evaluation, participants are provided an opportunity to try out their performance in the simulated activity and have it evaluated based on how well the task was accomplished. The assessment center method covered earlier is actually a simulation. Each exercise is designed to reproduce a work situation where participants exhibit behavior related to one or more job dimension. Simulations may be used during the programme, at the end of the programme, or as part of the follow-up evaluation.

Advantages of simulations

Job simulations offer several advantages for the training professionals. These are:

Reproducibility. Simulations permit a job or part of a job to be reproduced in a manner almost identical to the real setting. Through careful planning and design, the simulation can have all of the central characteristics of the real situation. Even complex jobs, such as that of the manager, can be simulated adequately. In addition, simulation can allow the trainers to shorten the time required to perform a task in an actual environment.

Cost effectiveness. Although possibly expensive to construct, simulations can be cost effective in the long run. For example, it is cost prohibitive to train airline pilots to fly an airplane utilizing a $50 million aircraft. Therefore, an aircraft simulator is used to simulate all of the flying conditions and enable the pilot to learn to fly before boarding the actual vehicle. In many other situations the cost involved in learning on the job also becomes prohibitive to the point where simulation becomes much more attractive.

Safety considerations. Another advantage of using simulations is safety. In the aircraft simulator example, safety is an important consideration for utilizing a flight simulator. It would be too dangerous for the pilot to learn how to fly an airplane without the use of a simulator. The nature of many other jobs requires participants to be trained in simulated conditions instead of real situations. For example, in training emergency medical technicians, the possible risk of life is too great to have someone learn how to administer emergency medical techniques on a victim as part of the training process. Firemen are trained on simulated conditions prior to being exposed to actual fires. For safety reasons, the applications for simulation are varied.

Simulation techniques

There are a variety of simulation techniques used to evaluate programme results. The most common techniques are:

Electrical/mechanical simulation. This technique uses a combination of electronics and mechanical devices to simulate the real life situations. They are used in conjunction with programmes to develop operational and diagnostic skills.

Task simulation. Another approach involves the performance of a simulated task as part of an evaluation. For example, in an aircraft company technicians are trained on the safe removal, handling, and installation of a radioactive source used in a nucleonic oil-quantity indicator gauge.

Business games. Business games have grown in popularity in recent years. They represent simulations of a part or all of a business enterprise. Participants change the variables of the business and observe the effect of those changes.

In-basket. Another simulation technique called an in-basket is particularly useful in supervisory and management training programmes. Portions of a supervisor's job are simulated through a series of items that normally appear in the in-basket. These items are typically memos, notes, letters, and reports which create realistic conditions facing the supervisor. The participant must decide what to do with each item while taking into consideration the principles taught in the training.

Case study. Possibly a less-effective, but still popular, technique of simulation is a case study. A case study represents a detailed description of a problem and usually contains a list of several questions posed to the participant. The participant is asked to analyze the case and determine the best course of action. The problem should reflect the conditions in the real world setting and the training content. The difficulty in a case study lies in the objective evaluation of the performance of participants. Frequently, there can be many possible courses of action, some equally as effective as others, making it extremely difficult to obtain an objective measurable performance rating for the analysis and interpretation of the case.

Role playing. In role playing, sometimes referred to as skill practice, participants practice a newly learned skill and are observed by other individuals. Participants are given their assigned role with specific instructions, which sometimes includes an ultimate course of action. The participant then practices the skill with other individuals to accomplish the desired objectives. This is intended to simulate the real world setting to the greatest extent possible. A difficulty

sometimes arises when other participants involved in the skill practices make the practice unrealistic by not reacting the way individuals would in an actual situation. The success of this method depends on the participants' willingness to participate in and adjust to the planned role.

In summary, simulations come in a wide variety and offer an opportunity for participants to practice what is being taught in training and have their performance observed in a simulated job condition. They can provide extremely accurate evaluations if the performance in the simulation is objective and can be clearly measured.

APPENDIX G

MEASURING RETURN ON INVESTMENTS (ROI)

Possibly the ultimate level of evaluation is to compare the financial benefits of training to the cost of that training. This comparison, which is most often referred to as the return on investment, is the elusive goal of many evaluators. This section discusses various methods of calculating this return, beginning with useful techniques to assign values to programme data, particularly in those areas where it is most difficult. Data must be transformed into dollar values before the financial benefit can be calculated. Methods of measuring the effectiveness of training will be addressed.

Assigning values to data

Earlier sections described the types of data collected for programme evaluation. Before this data can be used to compare benefits versus costs, it must be converted to a dollar value. Except for actual cost savings, the easiest programme measurement to convert to a dollar value is a change in output. An increase in output can appear in a variety of forms such as increased production, sales, or productivity. Savings in time and improvements in quality are a little more difficult to convert to a dollar value, while the greatest difficulty is encountered when attempting to convert soft data such as changes in attitudes, a reduction in complaints, or the implementation of new ideas.

Value of increased output

Changes in output are the goal of many training programmes. In most situations the value of increased output can be easily calculated, while in a few instances it may be difficult. For example, in a sales training programme the change in sales output can easily be measured. The average sales before the programme are compared to the average sales after the programme. The average profit per sale is usually easy to obtain. Therefore, the increased earnings as a result of increased sales is the increase in sales times the average profit per sale.

In another example consider a packaging machine operator in a pharmaceutical plant. The operator packages drugs in boxes ready for shipment. Operators participate in training to learn how to increase their output through better use of equipment and work procedures. In this example, the precise value of increased output is more difficult than the sales example. One approach is to calculate the unit labor cost of the packaging operation. Then the additional output of a unit ready for shipment saves the company the unit labor costs. Using this approach, the increase in output times the unit labor cost of packaging equals the cost savings. This figure may not be exact, since increases in output may affect the unit costs. However, this approach is usually accurate enough for measuring the return on a training programme.

These output factors are normally closely monitored by organizations, and changes can easily be measured. Assigning values then becomes a relatively easy task.

Value of cost savings

Assigning a value to cost savings is redundant. Training which produces a cost savings usually has a value equal to the cost savings. However, one item needs consideration when assigning these values: the time value of money. A savings realized at one point in time may be worth more than a savings at another time. A cost saving experienced by an employee or a group of employees over a long period might have a greater value than the actual savings, since costs normally increase during the same period. This can best be explained with an example:

A group of government employees operate a distribution center for publications. Supervisors have specific cost control responsibilities for their particular unit. They are held accountable for the direct variable cost and a portion of the fixed costs which are partially under their control. When costs seemed unusually high, the supervisors were trained in cost control techniques for both variable and fixed costs. Supervisors learned how to analyze costs and how to use the various reports to take action to control costs. Both fixed and variable costs were monitored for a six-month period before and after the programme to see if there were improvements. Part of these costs included raw materials, wages, and supplies, all of which increased during the one-year period. Therefore, to get a true picture of the value of the cost savings, the first six-month period costs were adjusted upward to what represented a cost target for comparison during the post-programme period. Then the actual cost comparison with the target costs gave the value of the cost savings as a result of the training, assuming no other factors influenced the cost savings.

Value of time savings

Many programmes are aimed at reducing the time for participants to perform a function or task. Time savings are important because employee time is money, in the form of wages, salaries, and benefits paid directly to the employee. There are several economic benefits derived from time savings.

Wages/salaries. The most obvious time savings results in reducing costs of labor involved in performing a task. The dollar savings are the hours saved times the labor cost per hour. The labor cost per hour can be an elusive figure. Generally, the average wage with a percent added for benefits will suffice for most calculations. However, time may be worth more than that and may in fact be overstated, the point is very important. The value of employee time is significant and is more than just wages and benefits. Whatever items are used in the calculations must be clearly explained. A conservative figure is probably best, since most managers feel more comfortable in dealing with the average wages plus benefits. However, if more detail is needed or a more accurate reflection of costs is necessary, the other factors should be included.

Better service. Another potential benefit of time savings is better service. This is particularly true when production time, implementation time, construction time, or processing time is reduced so that the product or service is delivered to the client or customer in a shorter period of time. As a result, there is better customer satisfaction, the value of which is difficult to quantify.

Penalty avoidance. In some situations reductions in time can avoid penalties. For example, in processing invoices in accounts payable, a reduction in processing time can avoid late

payment penalties and possibly earn a discount for the organization. In another example, a reduction in time to complete a construction project can earn the company a sizable bonus.

Opportunity for profit. A sometimes hidden, but potentially rewarding, benefit of time savings is the opportunity to make additional profit. For example, if a salesperson reduces the average time spent on a sales call, then there is time for additional sales calls. These additional calls can bring in additional sales, which bring in additional profits at no additional sales salary expense.

Training time. Frequently, training will be improved to reduce the previous training time. With new instructional technology and refinements as a result of programme evaluations, a new programme can possibly accomplish the same objectives in a shorter period of time. This savings in training time is another important part of a two-fold evaluation: (1) the reduction in the time to conduct the programme, and (2) the actual results achieved from the programme. For ongoing programmes, there are usually many opportunities for improvement that will result in less training time and which in turn result in a cost savings.

Value of improved quality

Quality improvement is an important and frequently used target for training programmes. Programmes are developed to overcome deficiencies in employees, which are evident, by low-quality output or an excessively high error rate. The cost of poor quality to an organization can be staggering. According to quality expert Philip Crosby, an organization can probably increase its profits by 5 to 10 % of sales if it concentrates on improving quality. The measurable impact of a programme for quality improvement must be calculated. Then, to calculate the return on a programme, the value of the quality improvement must be determined. This value may have several components:

Scrap/waste. The most obvious cost of poor quality is the scrap or waste generated by mistakes. Defective products, spoiled raw materials, and discarded paperwork are all the results of poor quality.

Rework. Many mistakes and errors result in costly rework to correct the mistake. The most costly rework occurs when a product is delivered to a customer and must be returned for correction, or when an expensive programme has been implemented with serious errors.

Customer/client dissatisfaction. The dissatisfaction of customers and clients represents a tremendous loss for the organization when errors and mistakes are made. In some cases serious mistakes can result in lost business. Customer dissatisfaction is difficult to quantify, and attempts to arrive at a dollar value may be impossible. However, more experts in service quality are insisting that customer and client dissatisfaction can be measured.

Product liability. In recent years premiums for product liability insurance have soared due to an increase in lawsuits brought against businesses. An organization which experiences more than average product defects will usually experience a higher product liability insurance premium. Therefore, better quality can result in less customer complaints; consequently, less lawsuits and lower premiums.

Inspection and quality control. In some organizations, the response to the demand for improved quality is to hire additional inspectors or beef-up the quality control staff. These inspectors often inspect products after they have been produced or inspect supplier products as they are received. Although some inspection may be necessary to determine the level of quality, it is not the solution to a poorly designed or manufactured product or an ineffective service delivery system.

Internal losses. There is still another type of loss tied to errors and mistakes that is not covered in the categories mentioned previously. They are internal losses caused by employee mistakes. For example, an overpayment to a supplier can possibly represent a loss that cannot be recovered. It does not result in rework or produce any waste, but it costs the company. Similar errors in processing paperwork can create substantial losses.

Employee morale. One cost of poor quality is employee morale. When mistakes are made, usually other employees have to suffer inconveniences, loss of the use of the product or services, extra time involved in correcting mistakes, or other forms of discomfort or dissatisfaction. Mistakes can lower the morale of the employees affected. However, this subject is difficult to quantify, and it may be best left in a subjective form when presented to management.

Value of soft data

While soft data are not as desirable as hard data; nevertheless, they are important. The difficulty arises in collecting the data reliably and in assigning values to the data. Almost any assignment of value is subjective and must be used with that in mind. There are a number of approaches to convert the soft data to a dollar value:

Estimating historical costs. Frequently, tangible items or historical costs will be intertwined with the soft data. Use as much of that data as possible. For example, the cost for employees being tardy can be calculated by making a number of assumptions about what happens when an employee is absent for a short period of time. Another example is the cost of grievances. Although an extremely variable item, there are historical costs which can form a basis for estimating the cost savings for a reduction in grievances. Tangible hard data, if available, should always be used when estimating the value of soft data items.

Expert opinion. Expert opinions are possibly available to estimate the value of the soft data. The experts may be within the organization, within the industry, or specialists in a particular field. Extensive analyses of similar data may be extrapolated to fit the data at hand.

Participant estimation. The participants in training may be in the best position to estimate the value of an improvement. Either at the end of a programme or in a follow-up, participants should be asked to estimate the value of the improvements. They should also be asked to furnish the basis for that estimate and the confidence placed on it. The estimations by participants may be more realistic, since they are usually directly involved in the improvement.

Management estimation. Another technique for assigning a value to soft data is to ask management concerned with the evaluation of the programme. This management group may be the superiors of the participants, top management (who are approving the expenditures), or

the members of a programme review committee whose function is to evaluate the programme. This approach solicits an estimate from a group of what it is worth to improve on a particular soft data item such as the implementation of new ideas, resolving conflicts, or increasing personal effectiveness. When management develops an estimate, it becomes their figure. Even if it is extremely conservative, it can be very helpful in the final analysis of the training programme.

These methods are very subjective but can help assign a value to soft data for use in calculating a return on a training investment. One word of caution is in order. Whenever a monetary value is assigned to subjective information, it needs to be fully explained to the audience receiving the information. And, by all means, when there is a range of possible values, use the most conservative one. It will improve the credibility.

Calculating the return

The return on investment is an important calculation, yet, it is a figure that must be used with caution and care. There are many ways that it can be interpreted, or misinterpreted. This section presents some general guidelines to help calculate a return and interpret its meaning.

Determining return on investment

The term "return on investment" (ROI) may appear to be improper terminology for the training field. The expression originates from the finance and accounting field and usually refers to the pretax contribution measured against controllable assets. It measures the anticipated profitability of an investment and is used as a standard measure of the performance of divisions or profit centers within a business.

The investment portion represents capital expenditures such as a training facility or equipment plus initial development or production costs. The original investment figure can be used, or the present book value can be expressed as the average investment over a period of time. If a training programme is a one-time offering, then the figure is all the original investment. However, if the initial costs are spread over a period of time, then the average book value is usually more appropriate. This value is essentially half the initial costs since, through depreciation, a certain fixed part of investment is written off each year over the life of the investments.

To illustrate this calculation, assume that a training programme had initial costs of $50,000. The programme will have a useful life of three years with negligible residual value at that time. During the three-year period, the programme produces a net savings of $30,000, or $10,000 per year ($30,000/3). The average investment is $25,000 ($50,000/2), since the average book value is essentially half the costs. The average return is

$$\text{Average ROI} = \frac{\text{Annual Savings (\$10,000)}}{\text{Average Investment (\$25,000)}} = 40\%$$

In many situations a group of employees are to be trained at one time, so the investment figure is the total cost of analysis, development, delivery, and evaluation lumped together for the bottom part of the equation. The benefits are then calculated assuming that all participants attend the programme or have attended the programme, depending on whether the return is a prediction or a reflection of what has happened.

Return on investment is sometimes used loosely to represent the return on assets (ROA) or the return on equity (ROE). Equity usually refers to the net worth of a company. The assets represent the total assets employed to generate earnings, including debt. The ROA and ROE are terms that are more meaningful when evaluating the entire company or division in the company. ROI is usually sufficient for evaluating expenditures relating to a training programme.

Finance and accounting personnel may actually take issue with calculations involving the return on investment for efforts such as training. Nevertheless, the expression is fairly common and conveys an adequate meaning of financial evaluation. Some professionals suggest a more appropriate name is return on training (ROT), or just return on human resource development. Others avoid the word "return" and just calculate the dollar savings as a result of the programme, which is basically the benefits minus costs. These figures may be more meaningful to managers to keep from getting the ROI calculation confused with similar calculations for capital expenditures.

Still another approach, especially in the area of government organizations is Cost Avoidance or Returned Value, since there is no return or profit to be realized from the investment. The true effectiveness to be measured here is whether training has avoided additional or unnecessary costs such as shutdowns, accidents or occurrences.

ROI may be calculated prior to training to estimate the potential cost effectiveness or after a programme has been conducted to measure the results achieved. The methods of calculation are the same. However, the estimated return before a programme is usually calculated for a proposal to implement the programme, that is to determine if the estimated cost is worth it.. The data for its calculation are more subjective and usually less reliable than the data after the programme is completed. Because of this factor, management may require a higher ROI for a training programme in the proposal stage.

When to use ROI

Attempting to calculate the return for a training programme may not be feasible or realistic in all cases. Even if the perceived benefits have been converted to dollar savings, the mere calculation of the return communicates to a perceptive manager more preciseness in the evaluation than may be there. Usually, the ROI calculation should be used when the programme benefits can be clearly documented and substantiated, even if they are subjective. If management believes in the method of calculating the benefits, then they will have confidence in the value for the return. The nature of the training can also have a bearing on whether or not it makes sense to calculate a return. Management may believe, without question, an ROI calculation for sales training programmes. They can easily see how an improvement can be documented and a value tied to it. On the other hand, an ROI for a programme, which teaches managers the principles of motivational management, is difficult to swallow-even for the most understanding manager. Therefore, the key considerations are how reliable are the data, and how believable are the conclusions based on subjective data.

Targets for comparison

When a return is calculated, it must be compared with a pre-determined standard to be meaningful. A 30% ROI is unsatisfactory when a 40% ROI is expected. There are two basic approaches to setting targets. First, a normally accepted return on any investment may be

appropriate for the training programme. Second, since the ROI calculation is more subjective than the ROI for capital expenditures, the company may expect a higher target. This figure should be established in review meetings with top management where they are asked to specify the acceptable ROI for the programme. It is not uncommon for an organization to expect an ROI for a training programme twice that of the ROI for capital expenditures.

Additional methods for evaluating investments

There are several methods other than ROI, which represent efficiency in the use of invested funds. The most common ones are:

Payback period. A payback period is a very common method of evaluating a capital expenditure. In this approach the annual cash proceeds (savings) produced by investment are equated to the original cash outlay required by the investment to arrive at some multiple of cash proceeds equal to the original investment. Measurement is usually in terms of years and months.

Discounted cash flow. Discounted cash flow is a method of evaluating investment opportunities that assigns certain values to the timing of the proceeds from the investment. The assumption, based on interest rates, is that a dollar earned today is more valuable than a dollar earned a year from now.

Internal rate of return. The internal rate of return (IRR) method determines the interest rate required to make the present value of the cash flow equal to zero. It represents the maximum rate of interest that could be paid if all project funds were borrowed and the organization had to break even on the projects. The IRR considers the time value of money and is not affected by the scale of the project. It can be used to rank alternatives, and specifying a minimum rate, can be used to make accept/reject decisions when a minimum rate of return is specified. A major weakness of the IRR method is that it assumes that all returns are reinvested at the same internal rate of return. This can make an investment alternative with a high rate of return look even better than it really is and a project with a low rate of return look even worse.

Cost-benefit ratio. Another method of evaluating the investment in training is the cost-benefit ratio. Similar to the ROI, this ratio consists of the total of the benefits derived from the programme expressed in dollars, divided by the total cost of the programme also expressed in dollars. A cost-benefit ratio greater than 1 indicates a positive return. A ratio of less than 1 indicates a loss. The benefits portion of the ratio is a tabulation of all the benefits derived from the programme converted to dollar values as described earlier in this section. Many training professionals prefer to use the cost-benefit ratio because it is not usually connected with standard accounting procedures. Although the benefits are converted to dollar values, steering away from the standard accounting measures is a more comfortable approach. See Appendix F, Cost/Benefit Analysis: A Simplified Example.

Utility analysis. Another important and interesting approach for developing the return on investment in training is the use of utility analysis. Utility is a function of the duration of a training programme's effect on employees, the number of people trained, the validity of the training programme, the value of the job for which training was provided, and the total cost of the programme. Utility analysis measures the economic contribution of a programme

according to how effective the programme was in identifying and modifying behavior, hence the future service contribution of employees.

***Consequences of not training*.** For some training programme efforts, the consequences of not training can be very serious. A company's inability to perform adequately might mean that it is unable to take on additional business or that it may be losing existing business because of an untrained work force. This method of calculating the return on training has received recent attention. A four-step method to calculate the consequences of not training involves:

- Establishing that there is an actual or potential loss.
- Obtaining an estimate of what the business is worth in actual or potential value and if possible, its value to the organization in terms of profit.
- Isolating the factors involved in lack of performance, which may create the loss of business or the inability to take on additional business. This includes lack of staff, lack of training, inability to staff quickly, inadequate facilities in which to expand, inadequate equipment, excessive turnover, etc. If there is more than one factor involved, determine the impact of each factor on the loss of income.
- Estimating the total cost of training and comparing costs with benefits.

This approach has some disadvantages. The potential loss of income can be highly subjective and difficult to measure. Also it may be difficult to isolate the factors involved and to determine their weight relative to lost income. This approach is only helpful in business organizations and usually where there is an expanding market.

APPENDIX H

TRAINING PERFORMANCE INDICATOR QUESTIONS

What is Measured	Prior to Training Intervention	During Training	After Training Has Taken Place	
			Internal	External
The Training Process Measuring the results of systems approach to training processes & the management of training	How responsive is the training system to customer requests and changes at various system levels? Do training products meet process requirements? Is the training department meeting production and delivery schedules? How effectively are instructors performing? How well does evaluation of effectiveness provide useful information for decision makers? What impact do customer identified training deficiencies have on training resources? How well is training in compliance with site policies and procedures? Is the training department meeting specified organizational training goals? How well does training meet industry commitments and requirements? What are Industry best training practices that are adaptable? Are we among the best? What are the current performance problems that require training?	How much training is provided/ completed? What is the level of quality of the training provided? How satisfied are instructors with the instructional design, materials, exams, and instructional aids? Are the facilities adequate to provide quality training? Are delivery policies, procedures, and processes effective in ensuring quality training?	How are training process requirements affecting work productivity? Have process improvements benefited the job environment? What impact do departmental changes (e.g., job scope, reorganization, turnover, staffing, etc.) have on training system resources? Have improvements in the training system benefited the organization or contributed toward achievement of organizational training goals? What impact do facility changes, system modifications, or new initiatives have on training resources? Have the products of training contributed to bringing about positive or negative change in the organization? Has improved operational data resulting from training had an effect on performance goals?	Does the training process consistently meet objectives? Does training comply with regulatory requirements? How well are industry commitments met? What impact does the training system have on the community? How does the training organization contribute to the quality of life in the community? How does the training system contribute to the education of society regarding nuclear safety? What contributions to environmental improvement are the result of the training system? What is the level of industry confidence in the training system ability to effectively train employees? How is the quality of training perceived in the industry?

What is Measured	Prior to Training Intervention	During Training	After Training Has Taken Place	
			Internal	External
Learner Performance Measuring the results of learners application of the knowledge, skills, attitudes	What skills and knowledge do employees have prior to training? What is the performance on pre-tests? What are the current performance problems that require training? How does the organizations performance compare with industry? What human performance errors are due to skill/knowledge deficiency attributable to improper or no training?	Are students achieving the learning objectives? What level of performance did students demonstrate on exams/tests at the end of training? What is the demonstrated overall learning gain from pre- to post-tests? How much remediation is required and provided? What improvements in affective behaviors are instructors observing as students go through training?	Are employees using the skills and knowledge learned during training? Which are used with greater/lessor frequency? Is the job environment supporting the use of new skills and knowledge? Are employees performing tasks as taught in training? Does job operational data indicate improved performance as a result of training? What improvements made in the job environment are a result of training? Has improved job performance contributed to improved organizational performance?	How does employee improved performance contribute to achievement of industry performance goals? How well do personnel perform with respect to industry standards? What is the level of performance as indicated by external observation or audit? How well has training provided for public health and safety in the community?

What is Measured	Prior to Training Intervention	During Training	After Training Has Taken Place	
			Internal	**External**
Customer Satisfaction Measuring the reactions and feedback of customers to training and training results	What training do job incumbents (their supervisors and customers) perceive they need? What is line management's confidence in training's ability to provide effective training? What are line management's perceptions about training's contribution to achieving performance goals? What is the overall satisfaction trend with respect to training? Is instructor performance meeting the needs of the customer?	What are the reactions of students to training at the end of the session? What training components do students perceive will help them to improve job performance? Did the students' confidence level in their job tasks increase at the end of training? What feedback do supervisors and managers provide when they observe training in progress? How effectively are instructors performing? What feedback is available from peer evaluations and performance appraisals of instructor performance?	What feedback do job incumbents provide regarding how well training prepared them for the job? What are incumbents' confidence level in their ability to perform better since completed training? How does that confidence level compare to what was expressed at the end of training? How satisfied are supervisors with the competency of trained employees? What are the reactions of incumbents and supervisors to the value of training after some time has passed. How satisfied is line management with the job performance as a result of training? What reactions are expressed when job performance is observed after training? What is the overall feedback of line management about training?	How satisfied are regulatory agencies that guidelines and requirements are being met? What feedback is available from industry evaluators and inspectors who review training programmes? How is the quality of training perceived in respect to training throughout the industry? What are the public's perceptions of personnel training and qualifications? What is their confidence level in the ability of the organization's employees to perform safely? What opinions do stakeholders have regarding the effectiveness of training? What reactions do special interest groups have regarding the quality of training?

What is Measured	Prior to Training Intervention	During Training	After Training Has Taken Place	
			Internal	External
Returned Value ROI Measuring the expected and actual returned value, return on investment & cost/benefit	How cost efficient is the training organization? How does the organization benefit from improvements made to the training process? What is the projected cost of the training to be implemented? What is the projected savings to be realized through improving performance by training? What is the value of correcting the performance problem? What is the cost/benefit ratio for the proposed training?	What are the actual costs of conducting the training? What is the perception of the value to be realized through conducting the training?	Has the training been responsible for a measurable return on organizational investment? Has training contributed to an increase in productivity or decrease in expenses or costs in work environment? Has there been an improvement in the quality of products or services since employees received training? Have there been fewer safety related accidents, non-compliance incidents, or preventable events due to improved job performance or improved skills and knowledge? What are line management's perceptions regarding the contribution training has made to achieving organizational goals and to the bottom line?	What is the perception of training's contribution to the safety of the community? What are the perceptions and improvement in the public opinion as a result of job performance improvements through training? What is the value of training as perceived throughout the community and industry?

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ANNEX A

IAEA SURVEY ON EVALUATING THE EFFECTIVENESS OF NPP PERSONNEL TRAINING

Introduction and instructions for the respondents

A. INTRODUCTION

This survey is designed to gather information about Evaluating of Training Effectiveness. Information acquired will be used in the development of the IAEA new publication “Effectiveness of NPP Personnel Training. Guidelines for Evaluation”. This task was recommended by the IAEA International Working Group on Training and Qualification of NPP Personnel (IWG-T&Q) and supported by a number of the IAEA meetings on NPP personnel training.

Among the major challenges of NPP and operating organization managers is the need to measure the effectiveness of their personnel training programmes. Unfortunately, the extent of the impact of training is not rarely unknown or vague at best. Measurement and evaluation processes and procedures are inadequate sometimes or need further development and refinement. Therefore, an accumulation of best practices in this subject area cannot be overestimated.

The purpose of the IAEA new publication is to provide an assistance for nuclear power plant and training organization managers in establishing effective training programmes.

The term *training effectiveness* intended to be used in this publication may have a variety of meanings, but particularly may mean that *it can be determined that training provided an added value to plant management in terms of quality, safety and production*.

As the nuclear power industry continues to be challenged by increasing safety requirements, a high level of competition and decreasing budgets, it becomes more important than ever to have some methodology of ensuring that training provides a value to the organization. Unfortunately the actual determination of training effectiveness is not an easy task because of the many variables associated with personnel performance. For example, for training to make a difference in job performance, line management should be involved prior to training delivery to identify what performance is desired, but not being achieved. Then, training is developed to meet desired performance, which is followed by practice and continued management reinforcement. Because of these other variables, it is extremely difficult to prove that training had a sole contribution to performance improvement, but rather one of many contributors needed for performance improvement. The difficulty to isolate training as a sole contributor has been documented in a number of research studies over the recent years.

Due to these limitations, a base assumption must be made in order to use any methodology for training effectiveness evaluation. That assumption is that there are some basic principles for developing training and if training programmemes are developed and maintained using these principles, then the training provided should be an effective tool to improve the line organization performance.

By monitoring various types of training effectiveness indications, weaknesses can be identified and improvements made. These improvements should support an overall improvement in plant performance. Strengths can also be identified to further strengthen the positive aspects of the organization.

It is planned that the IAEA new publication will contain a number of examples which will be provided by the Member States on methods and practices to identify and improve the effectiveness of training. This should result in:

- plant performance improvement,
- improved human performance,
- meeting goals and objectives of the business (quality, safety, productivity),
- improving training programmes.

Collection of the examples on methods and good practices in evaluating training effectiveness is possible only with your co-operation. The IAEA kindly requests to carefully consider the survey and its each item, complete a survey using the instructions provided below, and timely respond to the survey.

Information collected by means of this survey will be used in two ways. Common trends identified will be summarized in a main body of an IAEA new report on training effectiveness. Second, the surveys completed adequately will serve as the attachments to a publication, which in turn is planned to be published by the IAEA and also to be produced in magnetic version for the benefits of the Member States.

We clearly understand that some of the survey's questions may be challenging, therefore the responses to all of them are not mandatory. But anyway, your contribution to this effort is essential.

B. INSTRUCTIONS FOR THE RESPONDENTS

For the respondents' convenience, the instructions are provided in a checklist format to simplify the implementation and control of responding to a survey.

If you have any questions or problems related to this survey please contact A. Kossilov of the IAEA. Contact point is as follows:

Andrei Kossilov
Nuclear Power Engineering Section
Division of Nuclear Power
International Atomic Energy Agency (IAEA)
Wargamerstrasse 5, P.O. BOX 100, A-1400 Vienna, Austria
Telephone: + 43 1 2600 22802
Facsimile: + 43 1 2600 29598
E-mail: A.Kossilov@iaea.org

No.	Instruction	Reference Filename	Done "X"
1	Verify that in addition to these Itroduction&Instructions you have received files with the Survey Cover Page and Survey Questions.	TrEf Survey Int&Ins.doc TrEf Survey - CoverSh.doc TrEf Survey - Resp.doc	
2	Verify that a responding is organized to established survey milestone: deadline to receive the responses by the IAEA is 06 March 2000.		
3	All materials shall be submitted in English.		
4	All materials being submitted electronically should be processed (or saved as before submitting) in Windows'95 Word 7.0.		
5	Fill in the Survey's Cover Page, section "Responded by". Use fonts Times New Roman, size 12.	TrEf Survey - CoverSh.doc	
6	Fill in the Survey Questions form: (1) Respond to the Survey Questions. Use Times New Roman, size 9. (2) Complete an information in the Header (Country and Organization) and Footer (Date).	TrEf Survey - Resp.doc	
7	Produce and enclose possible attachments as requested in a survey (see the Survey's Cover Page). For newly developed attachments use Times New Roman, size 12. Attachments which are not available in magnetic media may be mailed to the IAEA as paper materials.	Filenames of attachments to be defined by a Respondent	
8	Each attachment (either electronic or paper version) shall have a cover page with an indication of: Country, Organization, No. of Attachment (No. corresponds to addressed Survey's item, see Survey's Cover Page and Survey Questions), and Title of the Material (see Cover Page).	TrEf Survey - CoverSh.doc TrEf Survey - Resp.doc	
9	Fill in the Survey's Cover Page, section "Materials provided in response". Use Times New Roman, size 9. If any attachment requested is not submitted (either electronically or in paper), check "No. of pages" and "Filename" boxes with " - ".	TrEf Survey - CoverSh.doc	
10	Submit all materials to the IAEA to Mr. A. Kossilov, see contact points above. Responses should be received by the IAEA no later than 06 March 2000.		
11	Computer files shall be sent to Mr. Kossilov's e-mail address indicated above. At least two files indicated in this row should be submitted electronically. The most of attachments, if any, are expected to be received also by e-mail.	TrEf Survey - CoverSh.doc TrEf Survey - Resp.doc Filenames of attachments to be defined by a Respondent	
12	Paper materials (i.e. some of the attachments) shall be mailed to Mr. Kossilov's address indicated above.		

The IAEA Survey on

Evaluating the Effectiveness of NPP Personnel Training

Cover Page

Responded by	Date: YYYY-MM-DD
Country:	Organization:
Name:	
Contact Points: Address: Telephone: Fax: E-mail:	

Materials provided in response:

Survey/ Attachment No.	Title of the material	No. of pages or " - "	Filename or " - "
N/A	Cover Page (it is this material)	1	TrEf Survey - CoverSh.doc
N/A	Survey Questions - Training Effectiveness	(currently - 6)	TrEf Survey - Resp.doc
3-1	Criteria to evaluate personnel training process		
3-2	Criteria to evaluate training programmeme		
3-3	Criteria to evaluate training sessions		
3-4	Criteria to evaluate trainees' performance		
3-5	Criteria to evaluate Customer satisfaction		
3-6	Criteria to evaluate on-the-job performance		
6	Forms to document the review and approval of the recommendations		
9	Self-assessment procedures to evaluate training programmemes		
10-1	Reports on training development actions		
10-2	Procedures for training configuration management		
11	Examples of tools/instruments/forms used to assist in evaluating training effectiveness (which are not included in previous attachments)		

1	Please provide your utility's/organization's definition of "Training Effectiveness" in the space provided below:

2	*What type of preparatory or actual evaluation activities does your utility/organization perform before, during, and after training to determine whether training is effective? In the table below, provide examples or a brief description of those activities.*
Before Training	1. 2.
During Training	1. 2.
After Training	1. 2.

3 Does your utility/organization have formal criteria established to evaluate the following areas? If yes, please attach the examples of the evaluation criteria.

☐ Yes	☐ No	3-1 Personnel Training process (i.e. does the process work ?)	☐ Yes	☐ No	3-4 Trainees' performance (i.e. did the trainees master the training objectives? - Knowledge/Skills)
☐ Yes	☐ No	3-2 Training programmeme (i.e. are the programmemes well established ?)	☐ Yes	☐ No	3-5 Customer satisfaction (i.e. what impact did training have on the organization ?)
☐ Yes	☐ No	3-3 Training sessions (i.e. did the trainees value training ? - attitudes)	☐ Yes	☐ No	3-6 On-The-Job Performance (i.e. do the trainees use on the job what they learned ?)

4 What qualitative and quantitative indications does your utility/organization use to measure or judge the impact of training on the following: (Please provide three examples, if any, of the indications you use). Identify which indication(s) you find most useful in each area with an "X" after a box with a number.

Impact of Training on Plant performance improvement		Impact of Training on Human performance improvement	
1.		1.	
2.		2.	
3.		3.	

Impact of Training on Plant safety		Impact of Training on Quality of business conduct / plant productivity	
1.		1.	
2.		2.	
3.		3.	

5 Have you ever modified the design of a training activity/course that resulted in a significant improvement based on the results of an evaluation? Please provide an example below:	
Training activity and the significant result	
Evaluation method	
How did you determine the effectiveness of this training activity	

6 After a training effectiveness evaluation is complete and recommendations are made:		
Who is involved in deciding what changes should be made?		
Who is the final authority for approving training recommendations?		
Do you have forms to document the review and approval of the recommendations?	☐ Yes If yes, please attach copies.	☐ No

7 At your utility/organization, are TRAINING NEEDS formally determined from identified plant performance improvement areas or weaknesses? If yes, please list three examples in the boxes below.	☐ Yes	☐ No

Example of performance improvement area	How did you verify training met the need?

8 In the table below, please describe TRAINING-related recommendations and/or other MANAGEMENT initiatives that were identified as a result of a systematic evaluation AND DETERMINED TO BE EXTREMELY EFFECTIVE. Please list three examples in each area.

	Identified Problem or Gap Solved	TRAINING Action Taken	How did you determine its value?
1			
2			
3			

	Identified Problem or Gap Solved	MANAGEMENT Initiative Taken	Results Achieved – positive or negative
1.			

2.			
3.			

9 Does your utility/organization conduct regular self-assessments of training programmes? If yes, please attach a copy of your self-assessment (evaluation) procedures which incorporate assessment (evaluation) criteria.		☐ Yes	☐ No
If yes, please describe what programmes are assessed and who conducts the assessments.			

10 Does your utility/organization have any procedure(s) and/or software to track training development actions? If so, please describe the type of software used in the space provided below. Attach examples of any (10-1) reports generated and (10-2) procedure(s) for training configuration management.	☐ Yes	☐ No

11 Please attach any other examples of tools/instruments; e.g., forms, evaluation sheets, used to assist in evaluating training effectiveness that were not previously included.

12. What kind of information would you like to see published in an IAEA document referring to determining training effectiveness?
1. 2. 3.

ANNEX B

TERMS IN THE FIELD OF NUCLEAR POWER PLANT PERSONNEL TRAINING[1]

The following are certain terms used in this report that may require explanation:

Ability – The mental or physical power or talent to undertake an activity, either innate or acquired through learning, practice and undergoing training. Ability encompasses attitudes, knowledge and skills. See *Attitudes*, *Knowledge* and *Skills*.

Accreditation – The formal process of approval against established standards by an independent body.

Action verb – A word that conveys action or behaviour and reflects the type of performance that occurs (e.g., to hold, open, describe, calculate, justify). Action verbs reflect behaviours that are both observable and measurable.

Active Learning – A learning situation in which the learner is required to participate and take an active role, in contrast to Passive Learning. See *Participation* and *Passive Learning*.

Adjunct Instructor – An assistant instructor, or an instructor attached to a facility, usually for a limited period of time. Also termed a seconded instructor.

Adult Learning – The learning process experienced by adults; this could take place in a school, college, university, community, industrial or business environment or by the adult alone through distance or open learning. See also *Andragogy*.

Affective – Relating to or resulting from attitudes, emotions, values or feelings; see *Affective Domain* and *Attitudes*.

Affective Domain – One of three areas used to classify *learning objectives*/*training objectives*) containing those relating to attitudes (feelings, perceptions and values). Also known as the Attitudes Area. The accepted taxonomy (ascending order or level of complexity) within the Affective Domain is:

- Attending: pays attention to received stimuli or events.
- Responding: reacts positively to stimuli or events by participation.
- Valuing: demonstrates belief in the worth or value of an event or activity.
- Organisation of Values: compares various values and prioritises them.
- Characterisation by Values: displays an attitude characteristic of a pervasive, consistent and predictable set of values.

See *Attitudes*, and also *Cognitive Domain*, and *Psychomotor Domain*.

Aim – In training, an alternative term for Terminal Objective. See *Terminal Objective*.

[1] Appreciation is expressed to all Member States and individuals who contributed to the development of this Annex, especially to R.J. Bruno (USA), C.R. Chapman (UK), A.Yu. Kazennov (Russia), T.J. Mazour (USA), A.

Analysis – (1) The fourth level in the Cognitive Domain or Knowledge Area that involves breaking down an idea into its constituent parts and examining their inter-relationships. (2) A method of subdividing a problem to be able to make decisions; examples are algorithms, network analysis, critical path analysis.

Analysis Phase – The initial phase in the Systematic Approach to Training (SAT) that serves as the foundation for training programmeme design, development, implementation and evaluation. The Analysis Phase assesses performance requirements or deficiencies, to be able to identify the competences, in terms of knowledge, skills and attitudes, needed for an individual or group to effectively and efficiently perform the job or jobs being analysed. See *Systematic Approach to Training*.

Analytical Simulator – a type of control room simulator designed to study plant behaviour in detail. See *Other-Than-Full-Scope Control Room Simulator*.

Analytical Skill – The ability to undertake, with competence, a formal analysis of a job or need. Although the word skill is used, inferring working only within the Psychomotor Domain, much of the work is in the Affective and Cognitive Domains. See *Ability*, *Affective Domain*, *Cognitive Domain* and *Psychomotor Domain*.

Andragogy – The teaching of adults as adults rather than as children (which is termed Pedagogy. Andragogic teaching assumes that the learners are mature and so the teaching is learner focused and the instructor or teacher acts more as a facilitator. See also *Pedagogy*.

Application – The third level in the Cognitive Domain that involves making use of appropriate theories and facts to solve a new problem. See *Cognitive Domain*.

Aptitude – The ability to learn when given the opportunity and suitable training, also the inherent (or learned) ability to do something. See *Ability*.

Articulation – The fourth level in the Psychomotor Domain. See *Psychomotor Domain*.

Assessment – A structured activity by which the knowledge and/or skills and/or attitudes of an individual are measured using one or more methods. The exact purpose of assessment (confirming competence, predicting future performance etc.) determines which assessment method is used. Assessment is often conducted at the end of a training session or course to determine the extent to which trainees have met the training objectives. See *Knowledge*, *Skills*, *Attitudes*, and *Assessment Method*. See also *Evaluation*.

Assessment Fidelity - The extent to which an assessment reflects the achievement of associated training objective(s). The closer the relationship the higher the fidelity of the assessment. Also termed Test Fidelity.

Kraut (Germany), and B. Molloy (UK). Particularly thanks are due to C.R. Chapman, A.Yu. Kazennov and T.J. Mazour who have compiled, developed and prepared the intermediate and final versions.

Assessment Method – A method of assessing an individual or group. A Multiple Choice Question, Essay type Question, Oral Question, Assignment, Project, Quiz, Walk-Through and Observation, are some typical assessment methods. See *Assessment*.

Assessment Reliability - The extent of the consistency with which an assessment produces the same results under different but comparable conditions, e.g. each time it is used. Assessment Reliability is also termed Test Reliability. See *Assessment*.

Assessment Type - The nature or type of Assessment, determined largely by the purpose of the Assessment. See *Assessment*.

Assessment Validity - The validity of an Assessment, but the validation criteria depend on the purpose of the assessment. Assessment Validity is also termed Test Validity. See *Assessment* and *Validity*.

Assessor – An individual assigned for conducting an assessment. See *Assessment*.

Attending – (1)The lowest level in the Affective Domain. See *Affective Domain*. (2) Being present for a training activity.

Attitudes – The observable characteristics of individuals resulting from their personal emotions, values and feelings that determine ways in which they interreact with others and their work, and so affect their interpersonal relationships and approach to their job and safety issues. Together with Knowledge and Skills, Attitudes provide the full requirements to competently undertake a given job or task. Attitudes are sometimes termed Affective Abilities. See *Affective Domain*, *Interpersonal Ability*, *Knowledge*, and *Skills.*

Attitudes Area – An alternative name for Affective Domain. See *Affective Domain*.

Audit – A methodical review of any situation or process by an individual or team experienced in, but not participating in, that situation or process based upon predetermined standards/requirements.

Audiovisual – A description of materials or systems that use both sound and vision. An audiovisual presentation uses, for example, audio tapes with slides, video tapes, or films as the medium.

Authorization – The granting of written permission, by an appropriate authority, to perform specified work, or a report granting such permission. See *Certification*, *Licence* and *Licensing.*

Basic Principles Simulator – A simulator that illustrates general concepts, demonstrating and displaying the fundamental physical processes of a plant. This type of simulator can provide an overview of plant behaviour or a basic understanding of the main operating modes. The simulation scope focuses on the main systems; auxiliary or support systems are often not

simulated, or are simulated in a very limited way. The main goals using of a Basic Principles Simulator are to help trainees understand fundamental physical processes, basic operation of complex systems, and the overall operations of a plant. See *Simulator.*

Basic Training – Training that provides knowledge, skills and attitudes for basic competence (e.g. for a mechanic or electrician) that is not job or plant specific. Also termed Fundamental Training.

Behaviour – The observable and measurable activity of an individual or group. In the Behavioural Approach to Learning, behaviour is the primary component of an objective. See *Behavioural Approach* and *Training Objective*.

Behavioural Approach – An approach to learning where the learner's expected behaviour after learning is pre-specified in terms of the expected performance, the conditions under which the performance is demonstrated and the standards or level of performance. See *Behaviour*.

Bloom's Hierarchy or Taxonomy – The classic example of a Learning Taxonomy. See *Learning Taxonomy*.

Brief – An explanation before an activity of the activity itself and the expected outcomes. See also *De-Brief*.

Case Study – A presentation to individuals or groups of a real or hypothetical situation, used as a substitute for real situations, used in order for the participants to gain experience by applying analytical, decision making and problem solving skills.

Categories of Personnel – Groupings of personnel for administrative or organisational purposes, often having similar job positions or functions, or with similar qualification or training needs.

Certification – The process by which an authoritative organization/body provides written endorsement of the satisfactory achievement of competence of an individual. Certification can follow the satisfactory completion of a performance based training programmeme or of a theoretical course of study.

Characterisation (by values) – The highest level in the Affective Domain. See *Affective Domain*.

Checklist – In training, a listing of tasks or task elements that is used to confirm that these activities need to be, or have been, performed. If the tasks have to be performed in a particular order, this appears on the checklist.

Classroom Training – A training setting in which lectures and discussions are lead by an instructor, normally with formal seating in a lecture room. Classroom Training is an example of Off-Job Training).

Coaching – Providing a trainee or trainees with guidance and feedback, primarily on learning methods, to encourage the successful completion of a task. Coaching normally helps trainees to adopt a new technique or to master an existing one. See also *Mentoring*.

Cognitive Domain – One of three areas used to classify learning objectives, containing those relating to knowledge based mental processes. Also known as the Knowledge Area. The accepted taxonomy (ascending order or level of complexity) within the Cognitive Domain is:

– Knowledge: Recognises and recalls information.
– Comprehension: Interprets, translates or summarises given information.
– Application: Uses information in a situation different from original learning context.
– Analysis: Separates wholes into parts until relationships are clear.
– Synthesis: Combines elements to form new entity from the original one.
– Evaluation: Involves acts of decision making based on criteria or rationale.

See *Knowledge*, and also *Affective Domain*, and *Psychomotor Domain*.

Competent - Adequately qualified for a job or task.

Competence (Competency) – (1) The ability to put skills, knowledge and attitudes into practice in order to perform activities or a job in an effective and efficient manner within an occupation or job position to identified standards.
(2) A combination of knowledge, skills and attitudes in a particular field, which, when acquired, allows a person to perform a job or task to identified standards. Competence (Competency) may be developed through a combination of education, experience and training.

Competences/Competencies – The plural forms of competence/competency.

Comprehension – The second level in the Cognitive Domain or Knowledge Area. See *Cognitive Domain*.

Computer-Based Training – Computer-delivered training involving interaction between a computer and a learner in which the computer provides data or questions and the learner responds.

Conceptual Document – A document in which concepts or ideas are expressed. A conceptual document is normally used as a working document for the period that its content, or the principles embodied in it, are being implemented or being developed into a final specification or procedure.

Condition (for training objective) – One of three parameters that should be stated or implied when compiling a training objective, the other two being Performance and Standard. Commonly identified conditions include presence or absence of particular tools, equipment or

work aids; adverse working environment; the working status of equipment; and plant operating mode (normal, emergency, etc.). See *Training Objective.*

Continuing Professional Development – Following the successful completion of an individual's initial training programmeme and appointment to a job position, a structured programmeme of additional education, experience and training; this normally continues throughout the working life of an individual to enhance that individual's competence and opportunity for career advancement. .

Continuing Training – A systematic training programmeme, provided after initial training, which is necessary to maintain and enhance competence for a particular job. Continuing training includes the consequences of equipment modifications and procedural changes, and lessons learned from internal operating experience and relevant external experiences. See *Initial Training* and also *Refresher Training*

Core Abilities – Fundamental abilities that trainees possess or learn regardless of their backgrounds. Core abilities are transferable (can be applied in many work situations and to many job positions). A term often incorrectly termed Core Skills. Many core abilities are in the affective domain, covering teamwork, business sense, flexibility, the ability to think creatively and solve problems, and to learn quickly and effectively. See *Ability* and *Affective Domain*.

Core Competences/Competencies – Fundamental competences/competencies that are needed in order to be able to undertake a specified range of jobs. See *Competence/Competency*.

Core Skills – Fundamental skills that trainees possess or learn regardless of their backgrounds. Core skills are transferable (can be applied in many work situations and to many job positions). A term often incorrectly applied to Core Abilities. See *Core Abilities.*

Cost Benefit Analysis - An analysis and evaluation of the total costs and benefits of a particular project (e.g. a training programmeme) giving particular attention to the social costs and benefits not normally considered in conventional costing.

Cost Effective Training Analysis – A comparative analysis of a potential training programmeme to determine whether the same expenditure could be used to provide more effective training, or whether the same training objectives could be achieved with less expenditure through alternative programmemes.

Course (Training Course) – A segment of training addressing a particular area or group of topics. A Training Course is made up of several training modules; several courses comprise a programmeme. See *Module*.

Course Map – A chart that depicts the designed sequence of modules within a course. Often termed a Course Plan.

Course Plan – A chart that depicts the designed sequence of modules within a course. Sometimes termed a Course Map.

Course Prerequisite – A requirement the learner must possess before being able to attend a course. A requirement to complete one course before attending another is an example of a Course Prerequisite.

Courseware – The Instructional Medium or Media for a course. See *Course* and *Instructional Medium*.

Criterion – A characteristic or measurement with which other characteristics or measurements are compared, usually being a standard against which something is measured. In training, the task or training objective standard is a measure of trainee performance. In test validation, it is the standard against which test instruments are correlated to indicate the accuracy with which they predict individual performance in a specific area. In assessment it is a measure used to determine the adequacy of a performance or behaviour. In evaluation it is the measure used to determine the adequacy of a product or process. A Criterion in the training context is sometimes termed a Standard. See *Adequacy*.

Critical Sequence – A prioritized order in which task elements must be performed to assure successful task performance.

Critical Step – A step within an activity or task that, if omitted or performed incorrectly, prevents the activity or task from being performed correctly.

Critical Task – A task that, if not performed to the specified standard, results in a serious adverse effect upon job performance or safety. Training must be provided for Critical Tasks. See *Task* and *Training*.

Cue – A prompt, signaling that a response is needed. An initiating cue is a signal to begin responding, performing a task or undertaking a task performance step. An internal cue is a signal to go from one element of a task to another. A terminating cue indicates that no further response is required.

Curriculum – A set of subject areas covered within a specified course of study.

Curriculum Development – A process of planning, validating, producing and evaluating new curricula; often applied to a training course or programmeme. The Systematic Approach to Training is an example of Curriculum Development. See *Systematic Approach to Training.*

De-Brief – A review after an activity of the activity itself and the outcomes, comparing the performance and actual outcome with the expectations. In training terms this enables the instructor and trainee to evaluate the activity and learning experience as well as the outcomes. In training this is also termed *Post-Activity* (Assessment, Exercise etc.) *Brief*. See also *Brief*.

Demonstration – The performance of a task or sequence of actions during a training or assessment session.

Design Phase – The second phase of a systematic approach to training in which the outcomes of the Analysis Phase are used to prepare specifications for training programmeme development and implementation: the design phase includes formulating a training plan, determining expected trainee entry-level competence, identifying training objectives and tests, and selecting training settings.

Development Phase – The third phase of a systematic approach to training, following the Design Phase, that involves developing training objectives and tests, establishing learning activities, selecting methods, modes and media, reviewing and selecting existing course materials, developing new training and assessment materials, developing and ensuring instructor competence, and the validation and revision of course materials.

Diagnostic Skill – The ability to analyse and evaluate a condition or situation and, if required, identify appropriate action. Although the word skill is used, inferring working only within the Psychomotor Domain, much of the work is in the Affective and Cognitive Domains. See *Ability, Analysis, Evaluate, Affective Domain*, *Cognitive Domain* and *Psychomotor Domain.*

Difficulty – A dimension used in rating tasks or prioritizing training objectives that reflects how difficult it is to learn or perform a task.

Difficulty-Importance-Frequency Model – One of several models available for use in selecting tasks for training. Using this model, tasks are identified as critical, based on the difficulty, importance, and frequency of job task performance.

Discussion – A guided conversation between trainees with direction provided by an instructor or group leader, often as a facilitator; discussion is typically used as a training method in a classroom situation with a small group of trainees.

Distance Learning – Learning undertaken under conditions where the learner and instructor are separated by distance and/or time. Distance Learning may involve the use of computer systems, the Internet, radio or television broadcasts, video presentations and correspondence courses, even library books.

Document – Written information that describes, defines, specifies, reports, certifies, requires, or provides data or results. A document is not considered a record until it meets the definition of a record. See *Record*.

Duty – The obligation, moral and/or legal, stated or implied, to perform a particular activity such as a job or task. Duty is often, incorrectly, used where Task-Element, Task or Job is the proper term. See *Job*, and *Task*.

Duty Area – A segment of work that typically represents a distinct major activity of that work comprising several tasks that may be related.

Education – The formal acquisition or successful completion of the requirements established by an accredited or approved educational establishment or institution. Such education is mostly in the area of knowledge, although skills and attitudes are also developed at some establishments and institutions.

Effectiveness (of training) – An indication of improved plant performance and/or human performance resulting from trainees participating in training modules and sessions. Not to be confused with Efficiency of Training. See *Efficiency of Training*; see also *Suitability of Training*.

Efficiency (of training) – (1) An indication of a trainee completing a training programmeme with the minimum of time and resources expended by the trainee and the instructor, and that these compare favourably with the predicted values. (2) An indication of the time and resources expended in using one training method compared with another to achieve the same objectives. Training efficiency is often measured in terms of cost of provision per trainee. Not to be confused with Effectiveness of Training. See *Effectiveness of Training*; see also *Suitability of Training*.

Element – In the training context, a sub-task (part of a task). An element is a discrete action or step undertaken by a trainee as part of a training session or executed by a job incumbent during the performance of a task.

Enabling (Training) Objective – A statement of intent, especially the expected outcome of a segment of training. An Enabling Objective must include the expected performance, and state or imply the associated conditions and standards. Meeting an Enabling Objective helps a trainee attain one or more terminal objectives or training aims. See *Condition*, *Standard, Training Objective* and *Terminal Objective*.

Entry Level Requirements – The identified levels or standards of a combination of education, training and experience required to enter a training course, module or programmeme.

Entry Level Test – An assessment containing items based on the prerequisites that the intended trainees must have mastered in order to begin a training course, module or programmeme.

Evaluation – (1) A series of activities used to measure the adequacy and effectiveness of a training session, course or programmeme (Evaluation is of “things” in contrast to an Assessment which is used as a measure of individuals). Evaluation can be Once-Off, Periodic or Continuous, depending on the frequency of the activity. See *Assessment*.
(2) The sixth and highest level in the Cognitive Domain. See *Cognitive Domain*.

Evaluation Criteria – The standards used when analysing, comparing and evaluating a performance, process or product.

Evaluation Phase – The final phase of a systematic approach to training, following the Implementation Phase, in which indicators such as operating experiences, employee performance and job requirements, are monitored and evaluated, and used to maintain and improve the effectiveness of a training programmeme.

Evaluation Hierarchy (four levels of evaluation model) - Donald Kirkpatrick identified the evaluation model most widely recognised today in corporate training organisations. The Kirkpatrick Model addresses the four fundamental behaviour changes that occur as a result of training:

- Level one indicates how participants feel about the training they received (reaction). This level is often measured with attitude questionnaires.
- Level two determines if people achieved the objectives (learning). This is often accomplished with pre-testing and post-testing.
- Level three answers the question, "Do people use the information on the job?" This level addresses transference of new skills to the jobs (behaviour change). This is often accomplished by observation and/or post-training surveys of supervisors.
- Level four measures the training effectiveness, "What result has the training achieved?" This broad category is concerned with the impact of the programmeme on the organization (results).

Evaluation Instrument – A test, or other means of measurement, used to obtain information to undertake an evaluation. Evaluation instruments include questionnaires, rating forms, inventories, and standard interviews.

Evaluation Objective – A clear statement of the purpose of a formal evaluation, normally containing the expected standards of the outcome, and any particular associated conditions.

Evaluation Report – A report generated as a result of a formal evaluation of a training session, course or programmeme. See *Evaluation*.

Examination – An assessment in the form of a formal series of questions or tests which trainees must complete, usually in a fixed time and normally under controlled conditions, to ensure there is no unauthorised collaboration. Examinations are often administered at the conclusion of a training course or programmeme. Less formal tests take place during or after training sessions and lessons.

Experience ***– (1) Work undertaken in a relevant topic and/or at a relevant facility during specific activities. Observation or presence only are not experience. (2) Practical work activities that, from reinforced practice, have resulted in the acquisition of identifiable knowledge, skills and attitudes.***

Facilitator – A training instructor or group leader whose role is to stimulate discussion among trainees, rather than directly imparting information. This may be achieved by listening, asking questions, providing ideas, suggesting alternatives, and identifying possible resources. See *Discussion*.

Feedback – 1) Information that is generated from any activity or element of an activity and considered when modifying that or a related activity for future use. In SAT, or any curriculum development model, information derived from evaluation of one phase of the training system is fedback to any phase, to correct programmeme deficiencies and adapt to changes in conditions and requirements.
2) Information, based on observation or research, given to trainees concerning the adequacy of their performance in a training event or work activity.

Formal Training – Training provided in a structured manner or in an organised situation by a recognised instructor, rather than in an Open Learning situation. Classroom training based upon a lesson plan is an example of Formal Training.

Frequency – In training, a dimension used in rating tasks during job analysis. Frequency indicates how often a task is performed by a competent job incumbent.

Full-Scope Simulator – A simulator incorporating detailed modelling of those systems of the referenced plant with which the operator interfaces in the actual control room environment; replica control room operating consoles are included. See *Simulation* and also *Plant-Referenced Simulator*.

Functional Simulator – A type of control room simulator. See *Other-Than-Full-Scope Control Room Simulator*.

Fundamentals Training – An alternative term for Basic Training. See *Basic Training*.

Gap – The difference between an established standard and actual results or performance.

General Employee Training (GET) – Essential training given to all employees of a particular organization or at a specific site. At a nuclear facility this training may include specific health, safety, emergency, policy and procedures training required to safely and effectively perform general (not job-specific) duties in controlled areas.

Graded Approach – The approach by which the level of analysis, documentation and actions necessary to comply with a requirement are commensurate with:

- the relative importance of safety, safeguards and security
- the magnitude of any hazard involved
- the life cycle stage of a facility
- the programmemed mission of a facility
- the particular characteristics of a facility
- any other relevant factors

This approach is used to ensure that resources are apportioned in a manner that results in the highest safety (or other targetted) benefit. The grading or proportioning is based upon considerations related to relative hazards and risks. The process of proportioning is termed the Graded Approach.

Graphical Simulator – a type of control room simulator. See *Other-Than-Full-Scope Control Room Simulator*.

Handbook – A document prepared specifically to provide guidance information in a concise form. Handbooks are used for the presentation of general information, data for procedural and technical use, and design information related to systems, structures and components. Also termed a Manual. A Job Aid may be part of a Handbook. See *Job Aid*.

Handout – Supporting text or pictorial information distributed by an instructor to a trainee.

Hands-on – An activity on equipment, real or simulated, rather than a theoretical study.

Higher Cognitive Abilities – See *Cognitive Domain*.

Human Error – An error in judgement or an incorrect action by an individual or a group

Human Resource Development – 1) Activities designed to build upon and improve existing abilities to make an individual more effective at a specified activity or activities. See *Ability*. 2) At a macro level, activities to improve the effective utilisation of the workforce as a whole, including activities such as resource planning, succession management and generic training strategies.

Imitation – The lowest level in the Psychomotor Domain. See *Psychomotor Domain*.

Implementation Phase – The fourth phase of a systematic approach to training, following the Development Phase, which includes conducting the training, and assessment of trainee performance.

Importance – In training, a dimension used in rating tasks or prioritising training objectives.

Individualised Instruction – Instruction that is tailored to meet the needs of an individual trainee rather than of a group of trainees. Self-study is one example of Individualised Instruction. See *Self-study*.

Informal Training – Training that is conducted in a competent but informal manner and for which no formal assessment is conducted or recorded. See also *Formal Training*.

Information Module – A module of training in which the aim is only the dissemination of information, compared with an Instructional Module or Unit. See *Instructional Module* and *Module*.

Initial Condition – The condition of a system, structure or component before an identified activity occurs.

Initial Training – A systematic training programmeme designed to ensure that individuals possess the necessary competence prior to being assigned independent job responsibilities. See also *Continuing Training*.

In-Plant Training – Training that takes place at a plant during construction, commissioning, operation or decommissioning, though not necessarily at the trainee's actual work area (which is On-Job Training). In-Plant Training is also termed On-Plant Training. In-Plant training is an example of On-Site Training. See *On-Job Training* and *On-Site Training*.

Instruction – The provision, delivery or implementation of information in the cognitive and/or affective and/or psychomotor domains.

Instructional Method – A particular method of providing instruction such as by discussion, role play, lecture, simulation or tutorial. Not to be confused with Instructional Strategy. See *Discussion*, *Role Play*, *Instructional Strategy*, *Lecture*, *Simulation* and *Tutorial*.

Instructional Medium – A tool used in instruction such as a book, handout, audio or video tape and CD. See *Handout.* A decision on an appropriate medium to be used for a specific training session is made at the Development Phase of a systematic approach to training. See *Development Phase*.

Instructional Mode – A mode of instruction. See *Mode*.

Instructional Module – A segment of instruction addressing one or more related terminal objectives; an instructional unit may contain several training sessions. Also termed an Instructional Unit.

Instructional Setting – The setting or environment in which instruction takes place. See *Setting*.

Instructional Strategy – The approach used to provide instruction such as the order of presentation of information and of testing, the level of interaction, feedback and remediation, and the choice of method. See *Instructional Method*.

Instructional Systems Design – An example of Curriculum Development, similar to the Systematic Approach to Training (SAT). See *Curriculum Development* and *SAT*.

Instructional Technology – Technology, including items and systems such as computers, compact discs, interactive media, modems, satellites and teleconferencing, that is used to support instruction and training.

Instructional Unit – An alternative name for an Instructional Module. See *Instructional Module*.

Instructor – A competent and authorised individual who delivers training, assess trainees and is involved in the evaluation of training sessions, modules, courses and programmemes and who may also participate in analysis, design and development activities. Also termed a Trainer.

Instructor Area – An area set apart for the use of instructors, not the trainees.

Instructor Qualification - A process of determining and verifying that an individual meets the required instructional and technical competencies, or the written confirmation of this. See *Instructor* and *Qualification*.

Instructor Station – The hardware and software that are needed to control and monitor a training activity.

Interpersonal Ability – The ability to communicate, relate and interact with other individuals. More commonly termed Interpersonal Skill or Skills even though the interaction is mostly in the Affective Domain. See *Affective Domain*.

Interpersonal Skills – See *Interpersonal Ability*.

In-Training Evaluation – A continual evaluation of training programmemes which is performed while training is in progress. See *Evaluation*.

Job – The duties and tasks identified for, and performed by, an individual. See *Duty* and *Task*.

Job Aid – A device that is designed to provide guidance on the performance of a specific job or part of a job. A procedure is an example of a Job Aid..

Job Analysis – A method used to obtain a detailed listing of the duties and tasks of a specific job. See *Job*, *Duty* and *Task.*

Job and Task Analysis (JTA) – A combination of Job Analysis and Task Analysis. See *Job Analysis* and *Task Analysis.*

Job Competency Analysis (JCA) – A type of analysis that concentrates on the education, experience and competence required to perform a job to required standards. See *Competence*, *Job* and *Job Analysis*.

Job Description – A description of the characteristics of a particular job. A Job Description often also includes the characteristics required by the job incumbent to competently perform that job together with the duties that are a part of the job. See *Job*.

Job Incumbent – A person assigned to, and undertaking, the tasks, duties and responsibilities required for a specific job. See *Task*, *Duty*, *Responsibility* and *Job*.

Job Performance Evaluation Checklist – An alternative term for On-Job Training Checklist. See *On-Job Training Checklist*.

Job Performance Measure – A test used to assess the level of performance of a job incumbent or trainee on a specific task, or set of tasks, against pre-determined standards. See *Test*, *Performance*, *Job Incumbent*, *Task*, and *Standard*.

Job Position – An activity or function that has a defined role with identified tasks, duties and responsibilities; i.e. an identified role in the organizational structure. A job position exists whether occupied or vacant.

Kirkpatrick Model – See *Evaluation Hierarchy*.

Knowledge – (1) The mental constructs used in acquiring and understanding facts, and the application and reassembling of facts to think creatively, solve problems and make judgements. Together with Attitudes and Skills, Knowledge provides the full requirements to undertake a given job or task. Knowledge is sometimes termed Cognitive Ability.
(2) The lowest level in the Cognitive Domain. See *Cognitive Domain*, *Attitudes*, and *Skills*.

Knowledge Area – An alternative name for Cognitive Domain. See *Cognitive Domain*.

Laboratory/Workshop Training – In training, a setting of an actual or simulated laboratory or workshop. Laboratory Training is an example of Hands-on Training. See *Hands-on Training*.

Learner – An individual who is undergoing learning. See *Learning*.

Learning – A relatively permanent and measurable change in behaviour, taking place as a result of deliberate or chance instruction, study or experience. See *Behaviour*, *Experience* and *Instruction*.
Learning Difficulty – A measurement of the time, effort, and assistance required by a learner to achieve a particular learning objective.

Learning Objective - A precise specification of what behaviour is to be learned in terms of the expected performance, the conditions under which the performance is demonstrated and the standards or level of performance. The two types of learning objectives are terminal objectives and enabling objectives. Learning Objectives are the same as Training Objectives except that Training Objectives focus on the training that is to be provided, while Learning Objectives focus on what an individual is to learn. See *Behaviour* and *Training Objective*.

Learning Resources – Items such as equipment and materials used by trainees in a specified learning process.

Learning Strategy – The approach used by a learner to achieve an objective, including using techniques for improving memory or study. Learning Strategy is not necessarily related to Instructional Strategy. See also *Instructional Strategy*.

Learning Style – The mode of learning used by an individual, influenced by the topics being taught and whether in the affective, cognitive and psychomotor domains, the learning difficulty and environment and the personality and circumstances of the learner. See *Affective Domain*, *Cognitive Domain*, *Psychomotor Domain* and *Learning Difficulty*.

Learning Taxonomy – A classification of cognitive, affective and psychomotor behaviours in three taxonomies (hierarchical orders or levels of ascending complexity). Devised by Benjamin S Bloom and his colleagues to interpret teaching, learning and assessment and applied in many training environments. Three Domains or areas are identified, Affective Domain (Attitudes Area), Cognitive Domain (Knowledge Area) and Psychomotor Domain (Skills Area). Also termed Bloom's Hierarchy or Taxonomy. See *Affective Domain* (Attitudes Area), *Cognitive Domain* (Knowledge Area) and *Psychomotor Domain* (Skills Area).

Lecture – A formal method of instruction by which trainees learn passively rather than by active participation, or a training session in which an instructor provides information orally to a group of learners. A lecture is one example of a training session. See *Session*.

Lesson – A discrete small unit of instruction on a particular topic or subject area having a series of related objectives (Enabling Objectives) that support one or more Terminal Objectives, normally led by an instructor. A lesson is one example of a Training Session. See *Objectives, Instructor* and *Session.*

Lesson Plan – An instructor's document that outlines instructor and trainee activities, training objectives, content, and resources necessary for the consistent delivery of instruction during a lesson. See *Instructor*, *Objectives*, and *Lesson*.

Licence (for an individual) – An authorisation in writing granted by a Regulatory Body to an individual to perform specified work. See *Regulatory Body*.

Licence (for an organization) – An authorisation in writing granted by a Regulatory Body to a facility on the basis of a safety assessment accompanied by specific requirements and conditions to be complied with by the applying, and subsequently holding, organisation. See *Regulatory Body*.

Licensed Operator – An individual who possesses a valid licence to operate a specified facility, granted by a Regulatory Body in accordance with the relevant national legal requirements. See *Licence* and *Regulatory Body*.

Licensing – The issuing of a licence by a Regulatory Body. See *Licence* and *Regulatory Body*.

Line Manager – Any manager or supervisor in an organisation's administrative structure between the most senior individual in the organisation and an employee

Local Operator Action – Action taken by an operator away from the (main) control room, either on the plant or at a local control room or console.

Lower Cognitive Abilities – See *Cognitive Domain*.

Maintenance Personnel – Personnel involved specifically in maintenance, repair or replacement activities at a site, on a plant or in a workshop in contrast to the actual operation of plant or equipment.

Management and Supervisory Training – Training in topics that are related specifically to the management and supervisory aspects of the job positions, duties and responsibilities of managers and supervisors. Many topics are in the Affective Domain and include soft skills, but some management training includes (but is not limited to) topics such as legislative matters, security, finance and budgetary control.

Manipulation – The second level in the Psychomotor Domain. See *Psychomotor Domain.*

Manual – (1) In training, an alternative term for a Handbook. See *Handbook.*
(2) An adjective used to describe a task performed by an individual without the use of a mechanical, electrical, electronic or computerised aid.

Mastery – Meeting all specified requirements for a particular, task or activity. Mastery is often associated with high standards of performance. .

Media – The plural of Medium. See *Instructional Medium.*

Mentoring - Providing new or inexperienced job incumbents with guidance and feedback, primarily concerning methods to implement their responsibilities. Mentoring is often provided by either experienced job incumbents or line managers of job incumbents, as a collateral duty, rather than a full-time responsibility. See also *Coaching*.

Mock-Ups – Physical replications of plant items or equipment used for hands-on training or pre-job briefings. See *Brief*, *Hands-on* and *Simulation*.

Mode – The way in which learning or training takes place. Examples are large group, small group and individual. A decision on an appropriate mode to be used for a specific training session is made at the Design Phase of a systematic approach to training. See *Design Phase* and also see *Training Setting*.

Module – A self-contained instructional unit that is designed to satisfy one or more training objectives. A module consists of one or more sessions. See *Session*.

Multi-Functional Simulator – A type of control room simulator. See *Other-Than-Full-Scope Control Room Simulator*.

Must – A verb used in training and associated documents to denote a compulsory requirement. Shall has an identical meaning. Many documents within a training context identify procedures and practices that, depending on the circumstances, may be followed, should be followed, or must (shall) be followed. To avoid any confusion in training documentation, the IAEA strongly recommends that these verbs are consistently used in training documents according to the meanings in this Glossary. See *May* and *Should*.

Naturalisation – The highest level in the Psychomotor Domain. See *Psychomotor Domain*.

Needs Analysis – In training, a method used to determine the competences needed to bring an individual or group to the required level. A Needs Assessment is the full process necessary to determine the training needed. Needs Analysis is also known as Front End Analysis.

Needs Assessment – An assessment of the results of a needs analysis and the priorities of those needs from which are determined the training programmeme or programmemes needed to bring an individual or group to the level of competence identified for a particular job position or positions or required by a particular job description. Also known as Training Needs Assessment and, incorrectly, as Needs Analysis. See *Needs Analysis.*

Negative Training - Training that causes a person who has completed a training course to make an error or an inappropriate response in completing a task. Examples of Negative Training include training on a control room simulator of a different configuration to the trainee's plant, or training that uses different procedures to those at the trainee's plant.

Non-Compliance – (1) A lack of demonstrable adherence to documented policies, programmemes, procedures or practices for office or plant activities.
(2) The omission of a relevant mandatory statement from documented policies, programmemes, procedures or practices for office or plant activities.

Nuclear Experience - Experience relating to nuclear processes normally acquired at a nuclear facility. See *Experience* and *Nuclear Facility*.

Nuclear Facility – Any facility such as a uranium mine, fuel fabrication plant, nuclear installation, nuclear power plant, nuclear repository, or any other facility using sources of ionising radiation including agricultural, commercial, educational, industrial, medical processing and research facilities.

Nuclear Regulatory Authority – The Regulatory Authority or Body that has responsibility for nuclear-related issues. See *Regulatory Authority*.

Objective Test – A test or assessment in which subjective bias is eliminated by providing the answers to questions as fixed choices. The answers, therefore, require no qualitative

interpretation and can be marked with reliability by non-subject specialists or electronically, e.g. by a computer. See *Assessment*.

Objectives – In training, a term that is applicable to, and incorporates, Enabling Objectives and Terminal Objectives. See *Enabling Objectives* and *Terminal Objectives*.

Occasional Instructor – An individual who is a qualified instructor and is involved in training on an occasional basis, but whose full-time job position is not that of an Instructor. See *Instructor*.

Off-Job Training – Training that takes place away from the trainee's work area. Off-Job Training could be in-plant or off-plant. See *In-Plant Training* and *Off-plant Training*.

Off-Plant Training – Training that takes place away from the plant where the trainee normally works. Off-Plant Training could be on-site or off-site. See *On-Site Training* and *Off-Site Training*.

Off-Site Training – Training that takes place away from the site where the trainee normally works. Off-Site Training could be at another facility or at a remote purpose-built training facility. See *Training Facility*.

On-Job Training – Training that takes place at or in the trainee's work area in the job environment. On-job training (OJT) is typically conducted by currently qualified job incumbents.

On-Job Training (OJT) Checklist – A document issued to an individual which lists training programmeme qualification requirements for a specific position and which is used to document on-job training and performance evaluation results on a task-by-task basis. Also termed a Qualification Card, and Job Performance Evaluation Checklist. OJT Checklists may also be used to document the evaluation of theory, equipment, systems, and procedural knowledge.

On-Plant Training – An alternative term for In-Plant Training. See *In-Plant Training*.

On-Site Training – Training that takes place at the site where the trainee normally works. On-Site Training could be in-plant or off-plant, on-job or off-job, or at an on-site, purpose-built training facility. See *In-Plant Training, Off-Plant Training, On-Job Training* and *Off-Site Training*.

Open-ended – A term applied to a question, test, exercise or project that has more than one acceptable outcome or response, rather than one correct solution or result. An essay-type question, for example, is open-ended.

Operating Experience – Experience concerning the operation or maintenance of equipment, plant or a system, including human factors and safety-related issues. See *Experience*.

Operating Organisation – An organisation authorized by a Regulatory Authority or Body to operate a nuclear power plant or other nuclear facility. See *Operation*.

Operating Personnel – Personnel involved in the operation or maintenance of equipment, plant or a system. See *Operation*.

Operation – A range of activities performed to achieve the designed purpose of equipment, plant or a system. At a nuclear power plant this includes maintenance, refuelling and in-service inspection and testing.

Optimum Class Size – The ideal number of trainees in a class that can be trained with maximum training effectiveness.

Organisation of Values – The fourth level in the Affective Domain. See *Affective Domain*.

Other-Than-Full-Scope Control Room Simulator - A simulator that does not provide the same human-machine interface as does the plant to which it is referenced. The model of the plant thermo-hydraulic and neutronics characteristics may be the same as that of a full-scope control room simulator, or may be less comprehensive. Generally, for a simulator of this type, the human-machine interface is provided through computer driven displays and either touch-screen or mouse-control of on-screen buttons. These displays and controls may be similar to those of the referenced plant, or may be simplified. Examples of the names given to such simulators have included: Analytical Simulator, Functional Simulator, Graphics Simulator, and Multi-functional Simulator.

Ownership (of training/training programmeme) – The situation in which an individual or group has participated in and contributed to one or more phases of a systematic approach to training and is thereby entitled to "own" and be committed to and take responsibility for all or some part or aspect of the associated training or training programmeme. Formal ownership would normally be documented.

Panel of Experts – A small group of individuals who provide expertise. For example, in job and task analysis, the panel typically comprises supervisors, job incumbents and training personnel who have mastery of the relevant knowledge, attitudes and skills associated with a particular job or family of jobs.

Participation – Taking an active role in the duties and responsibilities associated with a particular function, job position or training activity. Presence or observation alone do not constitute participation. In the learning situation, participation by the learner is termed Active Learning in contrast to Passive Learning. See *Active Learning* and *Passive Learning*.

Part-Task Simulator – A simulator that may incorporate detailed modelling of a referenced plant but of only some systems or portions of systems, thereby enabling a trainee to be trained specifically on only parts of a job or task. See *Simulation*.

Passive Learning – A learning situation in which the learner takes a passive role, such as by watching an activity or a training video in contrast to Active Learning. See *Active Learning*.

Pedagogy – The teaching of learners as children rather than as adults (which is termed Andragogy). Pedagogic teaching assumes that the learners have little or no experience of the topics being taught and so the teaching is instructor or teacher focussed. See also *Andragogy*.

Performance – The display or achievement of ability in undertaking a specific activity. In training, the conditions of performance and the standards required are normally specified. Performance is the main output used in the Behavioural Approach to learning or training, where the actual performance is compared with the expected, pre-specified performance under stated conditions and standards. See *Ability*, *Behavioural Approach*, *Conditions* and *Standards*.

Performance-Based Training – Training based on mastery criteria in which the relevant knowledge, attitudes and skills required for competent job performance have to be demonstrated by the trainee. SAT is one example of Performance Based Training. See *SAT*.

Performance Checklist – A listing showing a breakdown of a training objective into elements; the elements must be correctly performed to demonstrate that each trainee satisfactorily meets the performance standards described in the training objective.

Performance Criterion – Part of a training objective that describes or measures a trainee's observable behaviour (or the product of that behaviour) and is acceptable as proof that the objective has been achieved. Performance Criterion is also termed *Performance Standard*.

Performance Deficiency - A gap between actual performance and a specified performance standard. See *Performance.*

Performance Evaluation – The evaluation of performance of an individual or group. In the training context Performance Evaluation is often used to determine the success of trainees on a specific activity as a result of a training programmeme, and for weak areas to be identified. See *Evaluation* and *Performance*.

Performance Evaluation Tools – Performance tests, observations or evaluation of performance records that enable a Performance Evaluation to be undertaken. See *Performance Evaluation.*

Performance Measures – Specific standards based on requirements used to measure performance and, hence, trainee performance and/or training programmeme effectiveness.
Performance Objective – In training, an alternative term for Training Objective. See *Training Objective*.

Performance Requirements – The identification of the separate activities that are required for competent performance. See *Competence* and *Performance*.

Performance Standard – In training, an alternative term for Performance Criterion. See *Performance Criterion*.

Performance Test – An assessment of performance. This may involve a practical demonstration, by a trainee, of the ability required to perform a task that is assessed by a qualified instructor. See *Assessment* and *Performance*.

Periodic Evaluation – One style of training programmeme evaluation, denoting a random or specified frequency, as opposed to continuous evaluation. See *Evaluation*.

Phase – A stage in a sequence of periodic events. In the training context, Phase is applied specifically to the five stages of SAT, but is also applied to a major part of a training course that contains one or more modules. See *Systematic Approach to Training*.

Pilot Training Course – (1) A course that has been specially designed and developed following an analysis of training needs before it is implemented for the first time for a group of evaluators to evaluate its Suitability and Validity. (2) The process of conducting a pilot training course. See *Suitability* and *Validity*.

Plant Personnel – Individuals working at a particular plant, either permanently or temporarily. See also *Site Personnel*.

Plant-Referenced Simulator – A simulator that represents a specific nuclear power plant in its design, including the control room physical layout and control board hardware and the software/modeling. Generally, for a Plant-Referenced Simulator, standards are defined for the required fidelity between the plant and the simulator. See *Simulation*.

Position – An alternative term for Job Position. See *Job Position*.

Post-Activity Brief – An alternative term for De-Brief. See *De-Brief*.

Post-Training Evaluation – Evaluation of a training programmeme undertaken (typically) three to six months after the completion of a training programmeme. See *Evaluation* and *Training Programmeme*.

Practical Exercise – A technique used during a training session that permits trainees, through hands-on participation, to acquire and practice the knowledge, skills, and attitudes necessary to successfully perform one or more training objectives. See *Objectives*.

Practice – Repeated and systematic performance to gain and improve competence, in the affective, cognitive and psychomotor domains, through training. Practice helps a trainee to perform with greater competence. See *Competence* and *Affective, Cognitive* and *Psychomotor Domains*.

Precision – The third level in the Psychomotor Domain. See *Psychomotor Domain*.

Pre-Exercise Brief – A Brief in preparation for an exercise, e.g. on a simulator, or as a rehearsal for emergency procedures or enacting an emergency plan. See *Brief*.

Pre-Test – A test carried out before an activity. (Also known as pre-assessment) See *Test*.

Professionalism – The admired characteristics and high standards as displayed by an individual usually qualified in a particular discipline or learned profession.

Proficiency – The ability to perform a specific activity (e.g., a task) to demonstrate mastery of that activity. See *Ability* and *Mastery*.

Psychomotor – Of, or related to, physical action directly proceeding from mental activity.

Psychomotor Domain – One of three areas used to classify learning objectives, containing those relating to physical skills (movement and co-ordination). Also known as the Skills Area. The accepted taxonomy (ascending order or level of complexity) within the Psychomotor Domain is Imitation, Manipulation, Precision, Articulation and Naturalisation. See *Skills*, *Affective Domain*, and *Cognitive Domain*.

- Imitation: Observes a skill and tries to repeat it.
- Manipulation: Performs a skill according to instruction rather than observation.
- Precision: Reproduces a skill with accuracy, proportion and exactness. Usually performed independent of original source.
- Articulation: Combines one or more skills in sequence with harmony and consistency.
- Naturalisation: Completes one or more skills with ease and becomes automatic.

Qualified Person – An individual providing evidence of, or in lawful possession of, a Qualification. See *Qualification*.

Qualification – A formal statement that an individual possesses the education, training and experience required to meet specified job performance requirements. A formal statement of competence. The qualification may enable an individual to work independently, depending on local and national policies. See *Competence*.

Qualification Card – An alternative term for On-Job Training Checklist. See *On-Job Training Checklist.*

Qualification Programmeme – A structured series of assessed events, including education, experience and training, provided by management and training personnel for a trainee, with the aim to enable the trainee to obtain a qualification. See *Qualification*.

Quiz – An informal, often oral, assessment in which the correct answer is provided immediately after the learner has offered a response. A Quiz is conducted usually at the conclusion of a training session. See *Assessment*.

Reactor Simulator – A device that simulates the kinetics and operation of a nuclear reactor, used for training and for studying reactor dynamics. Reactor Simulators are of different complexities depending on their purpose. See *Simulation*.

Record – A completed document or other medium that provides objective evidence of an item, or process. See *Document*.

Refresher Training – Training that is used to reinforce previous training and/or sustain/regain previously acquired competence.

Regulation – A prescribed rule or authoritative order that must be complied with. The act of imposing a prescribed rule or authoritative order that must be complied with.

Regulatory Authority – The authority, body or organisation (usually national) that is empowered by legislation to conduct regulatory work, including establishing and publishing regulations, inspecting compliance and issuing relevant certificates, licences and authorisations for specified activities. Also termed a Regulatory Body.

Regulatory Body – An alternative name for a Regulatory Authority. See *Regulatory Authority*.

Remedial Training – Training designed, developed and implemented specifically to correct a trainee's demonstrated errors in, or inappropriate application of, knowledge, skills or attitudes. See *Training*.

Re-Qualification Training - Training necessary to maintain or re-gain qualification. See *Qualification* and *Training*.

Responding – The second level in the Affective Domain. See *Affective Domain*.

Response – An activity or behaviour resulting from a stimulus or stimuli. In training, it designates a wide variety of behaviours that may involve offering a single answer to a question, selecting one choice from several (multiple choice), solving a complex problem, responding to an alarm, manipulating buttons or keys, etc.

Responsibility – Action or decision for which an individual is held accountable. Responsibility is a component of a job position, with Duty and Task. See *Job Position*, *Duty* and *Task*.

Retraining – Training to equip an individual for an activity that the individual either has not undertaken previously or is not undertaking currently with the required competence. See *Training*.

Role Play – A technique used in training in which trainees and/or trainers act the parts and roles of any personnel or categories of personnel.

SAT – An acronym for Systematic Approach to Training. See *Systematic Approach to Training*.

Self-Paced Learning – A process in which a learner progresses through the instruction at a rate determined by the learner's current learning abilities. Computer-based and web-based training programmemes may be used by learners for Self-Paced Learning.

Self-Study – Learning by a student alone without the presence of an instructor but normally using structured training materials. Self-Study may be complemented by occasional or regular tutorial sessions in which an instructor answers queries, conducts an assessment or provides guidance for further self-study.

Self-Study Guide – (1) A document containing a series of lessons arranged in discrete steps with self-test questions that allow an instructor to monitor a trainee's progress. It is used to guide a trainee through a controlled path of study and specific job tasks with a minimum amount of supervision. (2) An instructional document that provides a trainee with study material in support of objectives. This document contains the objectives, subject matter content, reference to related reading or study material, review exercises with feedback, and directions to interact with training media including an instructor.

Session – The smallest unit of a Training Course with clearly defined Training Objectives. A Training Session may be a Lesson or Lecture, and may include a Role Play, Exercise or Self-Study period. See *Course*, *Training Objective*, *Lesson*, *Lecture*, *Role Play*, *Exercise* and *Self-Study*.

Setting – The environment or location in which learning, instruction or training takes place, including classroom, laboratory, workshop, simulator, and the actual work place. A decision on an appropriate setting to be used for a specific training session is made at the Design Phase of SAT. See *Design Phase* and also see *Mode*.

Simulation – The imitation of a real system, activity or situation; often used as a strategy in training to simulate the reality which is either too complex, or using the reality for training purposes may lead to operational problems or hazards. See also *Reactor Simulator* and *Training Strategy*.

Simulator Standard – A standard that defines the requirements for a simulator to meet the needs of a named organisation for a specified purpose. See *Simulation*.

Site Personnel – Individuals working at a particular site, either permanently or temporarily.

Skills – The physical and manipulative actions following the mental signal needed to perform an activity or task. A term often incorrectly applied to abilities. Together with Attitudes and Knowledge, Skills provide the full requirements to undertake a given job or task to specified standards. Skills are sometimes termed Psychomotor Abilities. See *Psychomotor Domain, Attitudes*, and *Knowledge*.

Skills Area – An alternative name for Psychomotor Domain. See *Psychomotor Domain.*

Soft Skills – The practical application of Attitudes in performing a task or undertaking a responsibility in a job position. Examples of Soft Skills are human interactions such as leadership, teamwork, communication, reinforcement, critiquing, assessing, coaching, observing, counselling, supervising, and managing.

Standard – (1) A document depicting specified parameters that must be complied with to meet identified criteria; the standard may be an internal Utility/Organisation document or one issued by a national or international authority, e.g. the International Standards Organisation (ISO). (2) In training, Standard is also used as an alternative term for Criterion. See *Criterion*.

Student – An individual who is involved in study, normally with the aim of acquiring or developing skills, knowledge, and attitudes. Older individuals are often termed Mature Students or Participants. In the training situation a student is commonly termed a Trainee. When the emphasis is on the learning process, rather than on training, a student is termed a Learner.

Subject Matter Expert – An individual who, by virtue of education, training, and/or experience, is a recognised expert on a particular subject, topic, or system, or who is acknowledged as being highly competent in performing a particular task. A Subject Matter Expert may be one of a Team of Experts. See *Team of Experts*.

Suitability (of training) – An indication of training suiting the needs of a trainee; do the training objectives meet the requirements of the trainee's job position? See also *Effectiveness of Training* and *Efficiency of Training*.

Syllabus – An ordered list of subjects to be included in a curriculum. See *Curriculum*.

Systematic Approach to Training – A training approach that provides a logical progression from the identification of the competences/competencies required to perform a job to the development and implementation of training to achieve these competences/competencies, and subsequent evaluation of this training. Often referred to by the acronym SAT.

Table-Top Analysis – A method of Job and or Task Analysis undertaken, without observing a job-holder at work, by a facilitator with a panel of experts or experienced job-holders. See *Job-Aid, Job Analysis* and *Panel of Experts*.

Target Population – An identified group of individuals for whom a defined activity is intended. In the training context the Target Population could be an identified proportion of the total employees, or a particular family of jobs, at a facility for whom a particular training programmeme or instructional product has been prepared.

Task – A measurable, well-defined unit of work, with an identifiable beginning and end. Several Tasks, which may be arranged within a Duty Area, are components of a job. See *Job* and *Duty Area*.

Task Analysis – The formal identification of the knowledge, skills and attitudes that are required to competently perform tasks associated with a particular job. See *Knowledge, Skill, Attitude, Task* and *Job* and see also *Job Analysis*.

Task Element – A step that must be undertaken as one of a sequence in order to complete a task. See *Task*.

Task Inventory – A compilation of tasks assembled during a job analysis. See *Task* and *Job Analysis*.

Task List – An alternative term for Task Inventory. See *Task Inventory*.

Teamwork – Co-ordinated work undertaken by two or more individuals, normally with complementary competences/competencies, cooperating as members of a team to achieve common objectives. See *Ability* and *Objectives*.

Terminal Objective – In the training context, a statement on the purpose or goal of a particular training session, course or programmeme. Also termed a Training Aim or Instructional Aim. A Terminal Objective is usually written in behavioural terms, stating the expected outcome in terms of performance, conditions and standards, but it may also be written in general terms, supported by Enabling Objectives which are always written in behavioural terms. Terminal objectives are intended for long-term retention and are reinforced through continuing training as needed. See *Session*, *Course*, *Training Programmeme*, *Behaviour*, *Performance*, *Conditions*, *Standards*, *Enabling Objective* and *Continuing Training*.

Test – A method of Assessment. See *Assessment*.

Test Reliability – The extent of the consistency with which a test produces the same results under different but comparable conditions, e.g. each time it is used. See *Test*.

Test Validity – The validity of a Test. The validation criteria are determined largely by the purpose of the test. See *Test* and *Validity*.

Topic – A subject, or series of closely related subjects, that merits, or is capable of, being discussed or commented on verbally or in writing. In the training context, the word “subject” is sometimes extended to include training objectives, so a Topic becomes a basic unit of training.

Trainee – An individual who has been assigned to undergo Training. See *Training*.

Trainer – An appropriately competent and authorised individual who facilitates the learning process for trainees by participating in a systematic approach to training. Also termed an Instructor. See *Training* and *Facilitator*.

Training – A combination of activities, including coaching and instruction, with the purpose to prepare an individual or a team to perform a specific task or job or series of jobs, usually through achieving a set of training objectives. Training, with education and experience, is used to develop an individual's competence. Training may be undertaken In-Plant, On-Job, On-Site, Off-Job, Off-Plant or Off-Site. See *In-Plant, On-Job, On-Site, Off-Job, Off-Plant* and *Off-Site*.

Training Advisory Board – A Panel of Experts composed of Senior Management Personnel from the Operating Organisation, other industries and from relevant Universities that considers, reviews, advises and endorses all major policies in a pertinent Training Project or Training Programmeme. Also termed a Training Advisory Committee.

Training Aid – An artefact to illustrate, clarify, exemplify or reinforce Training delivered by an instructor to a trainee or group of trainees. Examples of Training Aids are printed materials, overhead projector transparencies, films, models, items of actual equipment or plant, and simulators. A Training Aid is also termed a Training Tool. See *Training*.

Training Centre – A purpose-built or specifically modified and staffed facility, normally self-sufficient, where Training is provided. See *Training*.

Training Facility – A purpose-built or specifically modified facility, that may require external resource support, where Training is provided. See *Training*.

Training Group – A self-sufficient part of a Training Organisation. See *Training Organisation*.

Training Handbook – A handbook used by a trainee during training or after training, normally when on site. See *Handbook* and *Training*.

Training Manual – A document describing procedures for administering a training organisation and the activities undertaken within that organisation to develop and implement identified training programmemes. See *Training Organization* and *Training Programmeme*.

Training Materials – The items that are required to implement training and facilitate learning. Training materials include Training Aids, Lesson Plans, Assessment Documents, Handouts and Handbooks.

Training Method – An Instructional Method used in training. See *Instructional Method*.

Training Mode – A Mode in which the event or activity is designated for training purposes. See *Mode.*

Training Module – A Module of training. A Training Course contains one or more training modules. See *Module* and *Course.*

Training Need –The discrepancy, that can be met by training, between the competence required by an individual or group to be able to perform a specified job or jobs, and the actual competence of that individual or group. See *Competence* and *Training*.

Training Objective – A statement of the expected performance of a trainee, in terms of knowledge, skills and attitudes, on completion of a particular part of a training programmeme, to what standards and under what conditions. See *Learning Objective, Performance, Knowledge, Skills, Attitudes,* and *Training Programmeme*.

Training Organisation – An organisation responsible for all aspects of the analysis, design, development, implementation and evaluation of training.

Training Plan – A detailed plan, which is a product of the design phase of SAT, itemising the training objectives, entry level requirements of trainees, appropriate settings, assessment questions, schedule of training modules, identification of modules relevant to more than one group of trainees, and an estimate of the required resources

Training Policy – A formal, written statement issued by top management of an organization containing, as a minimum, the goals and scope of training. It may also address the organization and responsibilities for its implementation and the methods of monitoring and controlling its effectiveness. See *Training Procedures*.

Training Policy Document – A formal document issued by the operating organization containing its Training Policy. See *Training Policy*.

Training Procedures – Written instructions that describe the philosophy, principles and organisation of, and methodology and responsibilities involved in, preparing, administering, implementing and evaluating a training programmeme. Training procedures are based upon and consistent with Training Policy. *See Training Policy*

Training Programmeme – A planned and organized set of training activities, devised to achieve all training objectives for a particular job-position, incorporating initial and continuing training.

Training Project – A set of activities in the field of training with a specific objective to be met within prescribed resources of manpower, facilities, money and time.

Training Setting – The setting in which training takes place. See *Setting*.

Training System – A comprehensive framework within which requirements, resources and activities are identified to enable a particular training need to be met for specified personnel or categories of personnel.

Training System Language – The language in which a training system with its associated documentation and records are conceptualised, introduced, promoted, implemented and evaluated.

Training Tool – See *Training Aid*.

Triggering Event – An event that initiates another event or sequence of events. In the training context a Triggering Event, such as a plant modification, or a change to an operating procedure initiates the identification of new training needs.

Usability – The ease with which something can be used. An evaluation has usability if the evaluator can easily follow the instructions and administer it.

Validity – In training, the extent to which an item, such as a task statement or qualification, fulfills or represents the purpose for which it was intended. Validity is commonly used in Evaluation. See also *Assessment Validity*.

Valuing – The third level in the Affective Domain. See *Affective Domain*.

Verification – The confirmation of something by an auditable record. Verification may be applied to Competence, Training and Retraining of an individual relating to a specific job position.

Walk-through – A method of oral assessment in the trainee's work area where the assessor and trainee "walk through" or alongside the plant and the assessor asks the trainee questions relating to items of equipment or plant relevant to the trainee's training objectives.

Workshop Training – See *Laboratory / Workshop Training*.

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