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Experience in the use of systematic approach to training (SAT) for nuclear power plant personnel

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FOREWORD

The systematic approach to training (SAT) has been accepted by many nuclear utilities as the international best practice for the training and qualification of nuclear power plant personnel. The IAEA International Working Group on Nuclear Power Plant Personnel Training and Qualification has emphasized the importance of sharing the experience gained and lessons learned by Member States in the course of their application of SAT in order to establish and maintain the best possible training programme for nuclear power plant personnel. The International Working Group thus recommended the preparation and publication of an IAEA technical report on experiences in the use of SAT for nuclear power plant personnel.

This report complements two IAEA publications, the Guidebook on Nuclear Power Plant Personnel Training and its Evaluation (Technical Reports Series No. 380) and the IAEA World Survey of Nuclear Power Plant Personnel Training (IAEA-TECDOC-1063). It provides a detailed overview and analysis of the experience gained worldwide on the introduction and use of SAT, including the reasons why SAT was introduced and important lessons learned.

The technical document will be especially useful for nuclear power plant management and supervisors, all those responsible for the training of nuclear power plant personnel, and those in regulatory bodies whose duties relate to nuclear power plant personnel training and qualification.

The report was initiated through the contributions of members of the International Working Group at a Technical Committee meeting. The first full draft of the report was prepared at a consultancy by G. Bischoff, France, J. Gasper, United States of America, and P. Tompsett, United Kingdom. An Advisory Group provided detailed review, comments and input on this draft for the final version of the report, which was prepared at a subsequent consultancy by S. Idita of Romania and A. Vachon of Canada. The IAEA officer responsible for this technical document was F. Mautner Markhof of the Division of Nuclear Power.

Appreciation is expressed to all those who participated in the preparation of this technical document and to Member States for their support in providing experts from nuclear power plants, nuclear training centres, operating organizations and regulatory bodies to assist the IAEA in this work.

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1. INTRODUCTION

1.1. PURPOSE OF THE REPORT

One of the essential requirements for safe and reliable nuclear power plant operation and maintenance is the availability of competent personnel. The systematic approach to training (SAT) is recognized world-wide as the international best practice for attaining and maintaining the qualification and competence of nuclear power plant personnel. Many countries have applied and are now implemented or enhancing the use of SAT in their training systems, as demonstrated by the results of the IAEA World Survey on Nuclear Power Plant Personnel Training.

This technical document provides information on the experiences gained in the application of SAT based training programs for nuclear power plant personnel in a large number of Member States and, in so doing, also shows the high level of endorsement that SAT has received in the Member States and the advances made in its application. The transfer of information and experience, including lessons learned, on SAT application, as well as the selected examples of SAT outputs can assist nuclear power plants and training organizations in applying SAT and in dealing with challenges that may arise in the training of nuclear power plant personnel.

The IAEA Guidebook on Nuclear Power Plant Personnel Training and Its Evaluation (Technical Reports Series No. 380, 1996)[1] provides information on the reasons why the systematic approach to training (SAT) is now international best practice for the training and qualification of NPP Personnel, as well as for the evaluation of this training and also provides a detailed description of SAT methodology. This can be summarized as follows:

It is emphasized that all training, and especially SAT based training, is a means to an end and not an end in itself. The end or goal is the attaining and maintaining of the level of personnel competence required for the safe operation and maintenance of a nuclear power plant.

On the basis of experience gained worldwide in the application of SAT, SAT based training is now a broad integrated approach emphasizing not only technical knowledge and skills but also human factor related knowledge, skills and attitudes. In this way, all competency requirements for attaining and maintaining personnel competence and qualification can be met, thus promoting and strengthening quality culture and safety culture, which should be fostered throughout the initial and continuing training programmes.

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

SAT is a methodology which applies quality assurance (QA) to training and thus assures nuclear power plant personnel competence. The use of SAT offers significant advantages over more conventional, curricula driven training in terms of consistency, efficiency and management control. Consistency is achieved, among other means, through the fact that SAT based curricula, designed and developed according to SAT methodology, are not dependent on the knowledge and experience of specific instructors. SAT based training is also more easily adaptable to any new training needs and required changes resulting from feedback from the regular SAT evaluation process or from plant changes.

With a systematic approach to training, the competence requirements of an jobs in an NPP can be established and met in an objective manner. Furthermore, with SAT based training, it can be *demonstrated that all required competencies have been attained, through the process of performance*

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[1] The Executive Summary of the Guidebook is available in English, Spanish, Russian and French.

based assessment and evaluation. Without SAT, there is the risk that important elements of training will be omitted, which would adversely affect the safety and reliability of the plant. There is also the potential that training programmes will be too extensive for the needs of the job, with the consequent cost implications and loss of trainee motivation. Thus, SAT ensures that the right amount and kind of job specific training is provided.

The increased control and accountability features of the SAT process provide management and the regulator with the means of applying standard QA procedures and processes at any stage of the training process. The requirement for the training process to conform with the plant QA programme provides management and the regulator with far greater confidence in the qualifications and competence of personnel than that provided by a purely examination-driven assessment. SAT is a QA approach to training and therefore plays a significant role in the overall nuclear power plant QA programme.

SAT based training eliminates or minimize the competency gaps which affect nuclear power plant safety and efficient operation. A SAT based training system provides continuously the inputs for other processes to enhance NPP safety and reliability, such as the upgrading of plant procedures, systems and organizational structure, as well as human resources management.

An overview of the SAT process is given in Fig. 1.

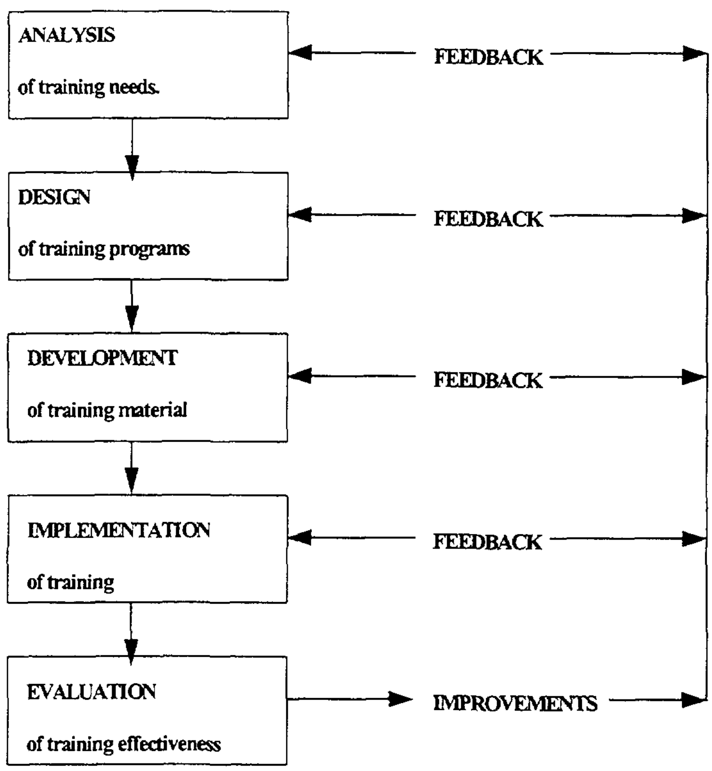

FIG 1. Overview of the SAT process.

SAT consists of five interrelated phases, which are:

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

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

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

IMPLEMENTATION — In this phase, training is conducted by using the training materials developed

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

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

In an ever changing environment, new technologies and new forms of organizations will trigger needs for nuclear power plant personnel to develop a wider range of competencies. SAT enables organizations involved in training to anticipate and adapt to future requirements concerning qualification and competence, thus enhancing the safety and reliability of nuclear power plant operation and maintenance

This report is addressed primarily to:

- Line and plant management responsible for assuring the competence of nuclear power plant personnel,
- Training organizations (internal and external to the nuclear power plant) providing the training needed by nuclear power plant personnel to become and remain competent,
- All nuclear power plant personnel participating in the application of any phase of SAT based training and qualification,
- Regulatory body personnel concerned with the nuclear power plant personnel training and qualification

1.2 SCOPE OF THE REPORT

SAT has been introduced in Member States to meet both common needs and also specific needs of each State This document addresses the reasons that have led various organizations to endorse and apply SAT for nuclear power plant personnel training

One of the important topics addressed is the experience gained in the application of SAT by many nuclear power plants and training organizations. This includes lessons learned and problems encountered when establishing and maintaining SAT based training programmes, as well as possible solutions Information on this covers all phases of SAT application, the role of management and the role of training organizations

Together with a model of the evolution of training to SAT based training, this report contains information from 21 Member States on their experience in the use of SAT for nuclear power plant personnel training, as well as selected examples on overall SAT application and on outputs of each of the SAT phases analysis, design, development, implementation and evaluation

2. REASONS FOR APPLYING SAT

The most common reasons for using SAT vary from country to country, and include the following:

- A recognized need to enhance training using international best practice,
- Recommendations from domestic or international training audits,
- Peer pressure,
- Nuclear regulatory body requirements or recommendations,
- QA requirements.

Additional advantages are that SAT·

- Promotes and strengthens safety culture and quality culture,
- Assures training consistency,
- Contributes to the acceptance of nuclear power,
- Provides confidence to plant management that the training addresses actual needs in an efficient manner,
- Enables involvement of plant managers and line managers in a simple manner to monitor and evaluate personnel training,
- Minimizes the risk that important elements of training will be omitted,
- Provides assurance, in the case of those events which have training-related root causes, that training will address these root causes,
- Helps an operating organization to provide assurance to the regulatory authority that the nuclear power plant training programmes provide the required competencies.

It has been demonstrated that SAT provides a strong tool for establishing new training programmes or upgrading existing ones in such a manner that:

- There is assurance that the job incumbents acquire and maintain all the necessary competencies,
- Training programmes are continually evaluated and improved,
- Necessary changes in the training can be made efficiently,
- Resultant training programmes have inherent QA features.

As SAT has inherent QA features, it provides a management tool for quality assurance of training.

3. A MODEL OF EVOLUTION TO SAT

3.1. GENERAL

Experience shows that each training programme has evolved from a certain stage which is specific to each country or nuclear power plant. This evolution takes place in many interrelated and interdependent areas or "dimensions" and proceeds in several related areas at the same time. Some of the main areas in which the evolution of training takes place are: the accumulated training experience, range of competencies addressed through training, and the range of training settings or techniques The experience gained in each and every area of the training process provides feedback into all other areas

Training programmes, as they evolve over time, will develop in general as shown in Figs 2 and 3 While training organizations should establish good, solid foundations before proceeding to the more complex training activities, programmes to develop competence do not have to proceed sequentially. Indeed, the development of communication and teamwork should be introduced into training programmes as early as possible and progressively developed through training courses devoted to acquiring technical knowledge and skills. The main point is that to facilitate the development of all required job-related competencies of nuclear power plant personnel, it is necessary to build up training capabilities and learn from experience in order to provide training which develops more advanced, usually human factor related, competencies through, among other things, the use of a wide range of appropriate training settings and techniques.[2]

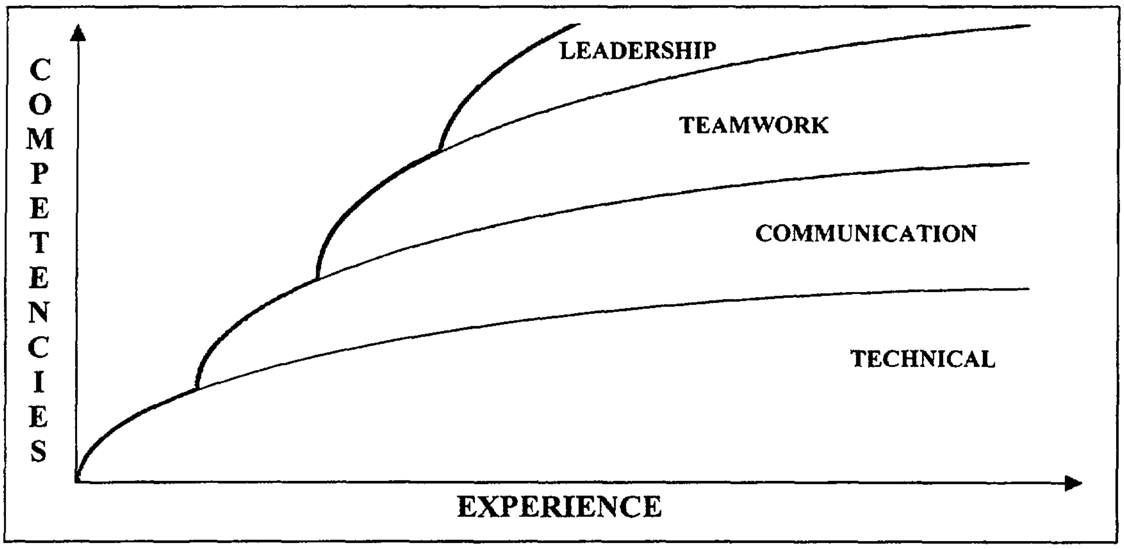

FIG.2. Competencies versus experience.

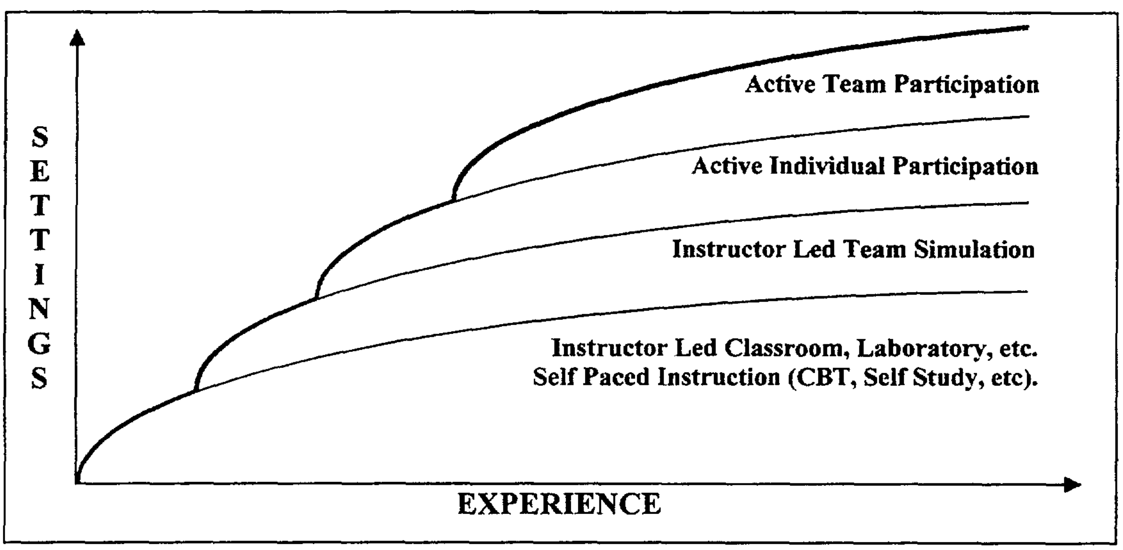

FIG. 3. Settings versus experience.

[2] For more details see section 5.8 of Nuclear Power Plant Personnel Training and its Evaluation, Technical Reports Series No. 380, IAEA, Vienna (1996).

The evolution of SAT will be influenced by many factors including:

- Country needs, conditions, requirements and traditions
- Organizational culture of an operating organization or nuclear power plant
- Education and training infrastructures/systems
- Regulatory requirements
- Training environment into which SAT was introduced
- Experience in the use of SAT in the given country/organization/nuclear power plant
- Support for training in the given country/organization/nuclear power plant
- Active involvement of line management in training activities
- Training facilities available
- Training expertise available
- Areas in which training is provided
- Training resources available (instructors, materials, funding, etc)
- Training delivery techniques used

3.2. COMPETENCIES

Training must enable the efficient and effective acquiring of all knowledge, skills and attitudes for those competencies required to perform the actual job in the work place. These range from the application of technical knowledge through human factor related competencies to monitored job performance with feedback (development). Experience has shown that, initially, training programmes aim to provide technical knowledge which is of a more academic nature rather than being job-related Following this phase, technical skills more related to the actual job are introduced into the training programme, and then human factor related competencies such as attitudes related to safety culture Finally, training is provided for individual development through monitored on-the-job performance with feedback from performance assessment. The most complete training programme will encompass all the training needed to attain full competence in the job, including required team-related competencies including competencies related to work and tasks performed within a team

3 3. TRAINING SETTINGS AND TRAINING TECHNIQUES

The evolution in this area begins generally with the method which provides training to large groups through lectures, which is the conventional learning/training approach. In such cases where there are a large number of trainees attending lectures on a large number of topics, there is little or unclear correlation between the subject matter being taught and the individual requirements for performing the job. This training approach can provide either too much or too little knowledge, and not generally at the time when this knowledge can be applied on the job, since classroom lectures must generally be followed by a specific additional sequence of more, job-specific training in laboratories etc As experience in providing training is gained, classroom instruction will become a smaller part of the overall training, which will include. self-study, instructor-led team simulation, and individual and team participation in the training process, specifically training design and development activities Thus, training evolves from the most general form or setting (classroom lectures) to an individual and team oriented form (see Fig. 2)

Through the experience gained in various countries, nuclear power plants and training organizations, it has been seen that as an organization gains in experience in providing training, it will utilize more individualized and advanced training settings. Ultimately, the design and development of the content and structure of individual/team training, including the choice of training settings and techniques, will take place with the active participation of the individual and/or team (see Fig 2).

In the same vein, experience gained shows that the competencies trained for are initially focused on technical competencies (knowledge and skills), but as experience in providing training increases, it becomes dear that it is equally if not more important to train for competencies in the areas of communication, teamwork and leadership, the latter being some of the critical human factor related competencies (see Fig. 3).

3.4. EXPERIENCE

The experience acquired in the process of training is gained continuously throughout the period of time in which training activities are developed and implemented. The ultimate goal is to have available for each job position a complete range of training modules covering every aspect of the knowledge, skills, attitudes and experience required for the job. This goal is a moving one, since new organizational structures, technologies and operational experience will require new competencies, which in turn generate new training needs for which new training techniques may be needed. Through this multidimensional evolution of all aspects of the training process, experience is gained which can and should lead to more effective, efficient training and fully competent persons able to fulfill the responsibilities of their jobs and assume a more important and active role in their own training.

3.5. EVOLUTION OF EACH OF THE SAT PHASES

This section illustrate for each of the five SAT phases — analysis, design, development, implementation and evaluation — the stages usually passed through as training evolved historically to SAT based training. There are many advantages for an organization, both in terms of time and human and financial resources, to be able to utilize relevant SAT results from other nuclear power plants and training organizations. Organizations now embarking on SAT application should seek to gain from the large body of available experience — adapting the results to their own conditions, needs and requirements — to start SAT application at an optimal stage and not necessarily from the early stages.

The evolution in each of the phases of SAT shows that the way in which SAT is applied will depend on:

- An organization's accumulated training experience,
- The range of competencies trained for,
- Training techniques and settings,
- Resources, support and leadership given to the training process on a consistent and long-term basis.

3.5.1. Analysis

The evolution of the analysis phase began from the point where an outside expert or educational organization decides what technical knowledge the trainee needs to know to do the job. It ends with an analysis (job task analysis (JTA) and/or job competencies analysis (JCA)), involving the job incumbents, which provides in detail all the competencies required by the trainee. Various milestones are:

- The beginning — an outside expert or educational organization defines the training needs and provides the training while knowing very little of the actual content or tasks of the actual job. If the scope of the training is wide enough, then at some time in the future some of the training will be required. However this type of training programme consumes unnecessarily time and money, and most of the knowledge will have been forgotten long before it is required on the job. This can also have a de-motivating effect on the trainees.

- A form of job-analysis is performed by a supervisor or job incumbent but is still limited to the technical knowledge areas, only takes into account the overall types of tasks to be performed and will probably provide broad objectives rather than detailed ones.

- A job task analysis or JTA is performed, in part, resulting in a more detailed analysis of the tasks to be undertaken in the job, but still limited to the technical knowledge area while including aspects of personal safety.

- Technical skills are included in the analysis. This includes examining how knowledge is applied at the workplace and the skills required for personal safety.

- JCA of the human-factors knowledge common to a set of jobs is included in the analysis, limited to theoretical knowledge of personal interactions, the impact on others, communication and how the activities performed impact on the safety of other personnel and the plant.

- JCA of the full range of the human factors skills required to perform the tasks of the job.

- An analysis of the attitudes that are required, defining the approach that should be taken when performing the job, including the assurance of safety when performing the job.

- The end — a complete definition of the knowledge required, how that knowledge is to be applied (skills) and the individual's approach (attitude) when applying the knowledge to perform adequately the tasks of the job. Additional competencies will be developed to allow the job incumbent to adapt to job-related changes and thus evolve with the job.

3.5.2. Design

The design phase of SAT evolves in a way that reflects the milestones of the analysis phase

- The beginning — a very loose, broad definition of the training objectives, based on what the trainee should know at the end of the complete course; written by individuals with little knowledge of the job tasks.

- Training objectives more clearly defined and produced for the training sessions within the training course, performed by supervisors or job incumbents (This continues during the evolution of the design phase.)

- Long training courses are divided into modules with clearly defined training objectives. This allows theoretical training to be integrated with periods where some tasks of the job are performed at the workplace.

- Skill based training objectives are included; training settings include simulation, workshop and directed on-the-job (skills) training. Assessment criteria are designed in conjunction with all training objectives

- Attitudinal training objectives are included; training settings include case-studies and role playing.

- Computer based and self-study training settings used to achieve knowledge based training objectives, small training modules designed so that particular subjects are covered in different levels of detail Evaluation processes are designed to assess training effectiveness and the transfer to the job of the knowledge, skills and attitudes acquired through training

- The end — individuals participate actively in defining their learning needs, for both individual and team work components; a wide range of training settings is available, designed to suit the method that will be used to develop the required competence.

3.5.3. Development

The development phase of SAT also evolves in a way that reflects the milestones through which the analysis and the design phases pass.

- The beginning — training material is copied from theoretical documents, in large quantities; presentations are not closely related to the training objectives, based perhaps on the knowledge and experience of the lecturer; no training material designed for the purpose is used.

- Training material prepared by individuals with some plant knowledge related more closely to the training objectives; still no training material designed for the purpose is used.

- Training material prepared with the active participation of supervisors or job incumbents, closely related to the training objectives; use of training material and plan designed for the purpose. More valid and reliable test items.

- Skills training material developed to support skill-related training objectives; for example, OJT guides including job performance measures developed.

- Computer based and self-study training material developed to support knowledge based training objectives, and small training modules produced to cover particular subjects at different levels of detail.

- Attitudinal training material developed to support attitudinal training objectives; training techniques include case-study and role playing.

- The end — training material developed to support the wide range of training settings and techniques available; the most appropriate media available for training material presentation and learning are used, with additional material available to support trainee learning by tutorial, guided training or coaching; integrated plant database available to support training material development.

3.5.4. Implementation

As in the previous phases, the Implementation phase of SAT also evolves to reflect the milestones passed in the analysis, design and development phases.

- The beginning — training implemented using lecture based presentations; lecturers do not possess plant knowledge but do possess presentational skills; no assessment of trainee learning performed and no feedback to the trainee takes place on the level of knowledge achieved; unstructured OJT.
- Lecturers possess plant knowledge but not necessarily instructional skills; present lecture based training material; some assessment of trainee learning of some of the learning objectives performed, but little feedback to trainee on the level of knowledge achieved.
- Training instructors possessing both plant knowledge and presentational skills used exclusively to present training material and to perform tutorials and assessment of trainee learning of all learning objectives; feedback and corrections to trainee knowledge included.

- Skilled instructors used to provide skills based training using simulated, mock-up or actual plant situations; an assessment of the level of skill attained is performed with feedback of results to the trainee.

- Instructors with facilitation skills lead attitudinal training events, ascertain the level achieved and relate that to the attitudes required when performing the tasks of the job.

- The end — training delivered to the individual using the techniques and settings most suitable to training being undertaken; training undertaken at a pace suitable to the individual; continuous assessment carried out and fed back to the trainee; tutorials and monitored on-the-job performance, with feedback provided by instructors, peers and supervisors and line management as appropriate.

3.5.5. Evaluation

The evaluation phase of SAT also evolves following the milestones passed by the other phases but linked primarily to design and implementation.

- The beginning — no evaluation performed.

- Parts of the training programme evaluated, concentrating on the opinions (so-called "happiness sheets") of the trainees, results primarily being used to improve the implementation phase.

- Complete training programme is evaluated, still concentrating on the opinions of the trainees, with the results used to improve all SAT phases; minor changes to the training programme result.

- Complete training programme evaluated, supplementing the opinions of the trainees with the results achieved in the trainee assessments; these are used to improve all SAT phases; significant changes to the training programme result.

- Complete training programme is evaluated incorporating feedback also from supervisors; modifications to the training programme occur in an effort to ensure the training is relevant for job performance.

- Evaluation of training programmes linked to the improvement of performance on the job.

- The end — continuous evaluation of training by trainees, trainers, supervisors and management; results linked to the improvement not only of job performance but of nuclear power plant technical and economic performance.

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4. EXPERIENCE GAINED FROM THE APPLICATION OF SAT

4.1. INTRODUCTION

This section provides a summary of the experience gained from the application of SAT by a large number of Member States. The other sections of this document should also be consulted to obtain a more complete picture of the experience acquired. This section documents lessons learned in the application of SAT in various Member States. It also provides information on problems observed in training programmes and the application of SAT and, for each of them, possible solutions. While representative of a broad range of experience gained, this listing is not exhaustive. The lessons learned and problems identified fall into the main categories of:

- Analysis
- Design and development
- Implementation
- Evaluation
- Role of management
- Role of training organizations.

Overall, the experience gained relates to the following:

- Utility management should effectively direct and adequately support plant training activities.
- Training staff (utility and contracted, if used) should possess the knowledge, experience, and skills required to fulfill their assigned duties.
- A systematic process should be used to: determine job performance requirements, define training objectives, specify training programme content, prepare supporting training materials, and maintain the training programme.
- Training programme content should provide the trainee with knowledge and skills needed to perform functions associated with the position for which training is being conducted. The content of initial training should prepare trainees to perform independently the duties and tasks for which they are being trained. The content of continuing training should be selected to maintain and improve incumbent job performance.
- Trainees acquire necessary job-related knowledge through structured training, including classroom training and individualized instruction. Trainee performance should be assessed in a reliable and valid manner.
- A systematic evaluation of training completeness and effectiveness should be conducted. The results should be used to modify the content and conduct of training programmes, as appropriate.

4.2. ANALYSIS

4.2.1. Lessons learned

- Job task analysis (JTA) and job competencies analysis (JCA) have proven useful to define training needs.
- A combination of JTA and JCA is the preferred method with the balance between the two being dependent on the nature of the job being analysed.
- The best way to start is with a pilot project addressing a few high priority job positions.
- Detailed JTA and JCA involve significant resources to perform.
- Significant time and resources can be saved by using, and adapting where needed, previously developed material.
- JTA and JCA result in a large amount of data which requires adequate database management. In general, JTA generates more data than JCA.
- JTA and JCA databases must be maintained to reflect changes to jobs and tasks.
- A JCA is less resource intensive than a detailed JTA, with respect to the effort required to

perform the analysis and to maintain the resulting data.

- JCA alone may not identify all training needs.
- JTA is not appropriate for all jobs, especially those involving complex human factor related competencies, such as managerial positions

4.2.2. Problems and possible solutions

Problems

- Training that does not meet all the training needs.
- Inefficient use of plant and training resources.

Possible solutions

- Provide adequate training to training staff, plant personnel, and other subject-matter experts involved in the analysis phase
- Revise generic task lists and task lists obtained from other plants to ensure they meet the specific needs of the plant
- Validate the results of the analysis before proceeding with the other phases.

Problem

Training objectives could not be developed from the results of an abbreviated table-top analysis

Possible solutions

- Before using an abbreviated analysis method, ensure the related plant procedures specify the detailed task elements
- Pursue the analysis sufficiently to identify the task elements needed to derive appropriate training objectives.

Problem

The training material cannot be efficiently revised to reflect changes in the plant

Possible solutions

- Establish a method for cross-referencing training materials to tasks and, if required, task elements
- Select and use a database management software which can handle the large amount of data produced during the analysis phase and which is able to effectively and efficiently to identify where necessary changes to the training documentation resulting from plant modifications and training evaluation feedback have to be made (traceability)

4 3 DESIGN AND DEVELOPMENT

4.3.1. Lessons learned

- Ensure appropriate establishment of entry level requirements when defining training objectives.
- Training objectives are sometimes derived directly from the tasks.
- Training programmes designed by different training organizations should be consistent and

avoid undue duplication.

- Resource requirements for the development of training material should not be underestimated.
- Significant time and resources can be saved by using, and adapting where needed, previously developed material.
- Care must be taken that the generic documents or documents obtained from other plants or organizations are adapted to the specific purpose for which they are intended.
- Training material should be piloted before use in training.
- When selecting training settings, equipment and aids, use cost-benefit analysis to choose among nearly equivalent alternatives that have been identified through SAT analysis and design as adequate to meet the training needs.
- Pass level for examinations should correspond to the training objectives.

4.3.2. Problems and possible solutions

Problem

For positions that require a progression through subordinate positions prior to entry into the position (e.g. the progression from field operator, to equipment operator, to control room operator, to control room supervisor) the expected knowledge, skills and experiences an individual will possess upon completion of training for a subordinate position (e.g. equipment operator) are not considered when developing or revising training objectives for the higher-level position (e.g. control room operator).

Possible solution

Begin the application of SAT with the entry position into the organization and progressively built through the successive positions.

Problem

Although the test items (e.g. written, oral, and/or performance measures) were based on the training objectives, they failed to assess effectively and fairly trainee knowledge or performance.

Possible solutions

- Each multiple choice question should be constructed with at least two valid distracters.
- Clearly state the pass/fail criteria in the training policy and on each examination paper.
- Specify the required content for essay answers on the answer key.
- Re-grade all examination if the answer key is revised.
- Clearly define the pass/fail criteria for an oral examination prior to the examination.
- Account for probabilities when using true or false questions.
- Validate test items before using them for testing trainees (e.g. confirm with subject-matter-expert that test item is clear).

Problem

Training objectives do not reflect adequately what the trainee is required to be able to do.

Possible solutions

- Train the staff responsible for writing training objectives on the essential elements of such statements, their classification and the related terminology.

- Revise the objectives to ensure they comprise an action to be demonstrated, the conditions under which the action will take place and the standard of performance expected.
- Ensure they are linked to the tasks the trainees will eventually have to perform.

4 4 IMPLEMENTATION

4.4.1. Lessons learned

- Training must be provided by staff who possess technical and instructional skills as well as appropriate knowledge and attitudes.
- OJT trainers and assessors should be suitably trained and qualified.
- Management should be involved periodically in the evaluation of the effectiveness of instructors
- Test items should be validated using peer review or assessment validation panels.

4.4.2. Problems and possible solutions

Problem

Assessment of trainees following on-the-job training is inconsistent.

Possible solutions

- Define pass fail criteria for the tasks to be performed prior to testing
- Train staff who assess the trainees
- Establish a valid evaluation method (e.g use of job performance measures).
- Designated for the assessment someone other than the individual involved in the conduct of on-the-job training for the particular trainee being assessed

Problem

Failure to maintain a configuration control programme for simulator hardware and software results in inaccurate representation of the operating characteristics of plant components and systems.

Possible solutions

- Set up a simulator configuration control system
- Ensure software maintenance staff obtain relevant information on plant changes.

4 5. EVALUATION

4.5.1. Lessons learned

- Training materials used must be up to date and consistent with plant configuration, if training is to meet needs.
- Feedback from trainee assessments must be used to modify future assessments
- Evaluation of training effectiveness must be based on defined objectives and criteria or equivalent requirements
- Adequate resources should be allocated to the revision and updating of training programmes and materials

- The use of feedback forms to be filled in by the trainees upon completion of a training activity is tending to decrease.
- The necessity and usefulness of good feedback is being recognized and evaluation inputs are being sought from several sources such as line managers, instructors and also trainees.

4.5.2. Problems and possible solutions

Problem

Trainee feedback forms do not capture trainee's ideas for improving training.

Possible solutions

- Design trainee feedback forms to elicit suggestions for improving training from trainees.
- Guide trainees when they complete feedback forms.

Problem

Post-training feedback is either not being obtained or not analysed systematically to capture lessons learned from previous training sessions.

Possible solutions

- Conduct post-training interviews with trainees and their supervisors.
- Have training curriculum committees conduct evaluations of post- training feedback.

Problem

The training material is out of date or does not reflect plant configuration.

Possible solutions

- Modify generic training material and training material developed for other plants to the specific conditions and characteristics of the trainees' plant.
- Establish clearly the responsibilities for revising training material.
- Require that plant personnel review and approve training material prior to implementation.
- Establish a process to ensure that all information necessary to update the training material is provided to the training department.
- Analyse changes and feedback (e.g regulatory changes, changes in job scope, results of evaluations and inspections, changes in industry guidance and associated training materials, changes in plant procedures, and changes in plant systems and equipment) to identify the need for modifications to the initial and continuing training programmes.

4.6 ROLE OF MANAGEMENT

4.6.1. Lessons learned

- Constant support and involvement of plant and line management in the application of SAT is essential.
- Understanding the SAT benefits is a prerequisite and therefore SAT seminars for managers should be planned from the beginning.

- Direct involvement in needs analysis and its validation ensures that training material meets the true needs. The same support is also necessary in all other SAT phases. For example, plant and training management should periodically assess the effectiveness of training provided by instructors.
- The balance between scope and allocated resources is the responsibility of plant management, as are selecting of the jobs and the assigning of priorities.
- It is recommended to apply SAT for all job positions. Since it is always necessary to take into account available time as well as human and financial resources, it is necessary to prioritize SAT application for jobs which are more safety-related
- Emphasis has been placed on operation job positions but it is now recognized that maintenance training should be given the same attention Maintenance activities are also safety-related though safety impacts may often be delayed.
- Needs analysis for maintenance job positions will often require more effort owing to a general lack of appropriate documents and procedures.
- Owing to the often wide range of maintenance job positions, an attempt has to be made to gather them into trade-related groups
- Plant management is responsible for ensuring the competence of the nuclear power plant personnel and their acquiring appropriate qualifications and authorizations. The "ownership" of personnel competency development and qualification must reside with line management

4.6.2. Problems and possible solutions

Problems

- Training policies and responsibilities have not been adequately defined in the operating organization or the nuclear power plant documents.
- The responsibility for conducting on-the-job training is not assigned clearly to line management
- Line supervisors do not understand their role in the training process.
- Training is organized independently within each department and significant differences in training standards have arisen.

Possible solution

Develop and implement training policies and procedures that clearly assign responsibilities for the application of the various phases of SAT and indicate specifically how each phase should be implemented.

Problem

Insufficient co-ordination of activities by management.

- The training organization takes the initiative to utilize SAT to upgrade the existing training programmes Plant management has not issued directives to plant staff to support this initiative, leading to a failure to upgrade the training programmes
- A project to improve training and a project to upgrade procedures are conducted simultaneously without consideration of how the projects may conflict if task elements and procedures steps are not consistent.

Possible solutions

- Utilize strategic planning and co-ordination processes to integrate the plant and training organizations goals, objectives and activities

- Set up a feedback process to monitor SAT application and adjust as needed.
- The training organization should give early notice to plant and line management when approval or resources on their part are needed.

Problem

- Inadequate funding and staffing to implement and maintain the training programmes.
- It is difficult to attract qualified personnel from the plant to become instructors.

Possible solutions

- Revise salary scale of instructors to provide an incentive for plant staff to become instructors. Salaries should be at least at the level of the corresponding plant positions.
- Develop a rotation programme between the plant and the training organization such that personnel from plant departments are assigned to the training organization as part of their normal duties.

Problem

Training records are not maintained to support management information needs, including required data on past activities. For example, records are maintained in different locations and by different departments and they are not all entered into the computerized training records system.

Possible solutions

- Centralize storage and maintenance of training and qualification records.
- Establish procedures on the responsibility for storage and maintenance of training and qualification records.
- Provide plant supervisors with up-to-date and easy-to-use documents (paper or electronic) that clearly identify each individual's qualifications and training status

Problem

Maintenance personnel training programmes are inadequate. Current maintenance personnel were trained using on-the-job training during construction and initial start-up of the plant. There is no structured programme in place to train replacements.

Possible solutions

- Apply SAT to develop training programmes that provide the knowledge, skills and attitudes needed by maintenance personnel.
- SAT analysis and design should be performed to identify the specific training facilities and equipment needed

Problem

A lack of communication between the plant and training organizations.

Possible solution

Set up a communication protocol between the two organizations and a process to resolve conflicts through higher level management

4.7. ROLE OF THE TRAINING ORGANIZATION

4.7.1. Lessons learned

- The development and qualification of training staff is important to ensure effective and efficient application of SAT, particularly the implementation phase of SAT.
- Salary scales for training staff should be at a level to attract and retain sufficient qualified staff Salaries should be at least at the level of the corresponding plant positions.
- Ensure that training staff are well acquainted with SAT and sufficiently motivated to perform all phases of SAT process.
- Instructors must be trained through a SAT based training programme
- When SAT application is at a more advanced stage, the number of full-time instructors tends to decrease, whereas the number of part-time instructors tends to increase.

4.7.2. Problems and possible solutions

Problem

Personnel who do not possess an understanding of the SAT process are given the responsibility to conduct analysis or develop training material

Possible solutions

- Provide training personnel with the necessary training on SAT before assigning them such tasks
- Ensure that personnel in charge of SAT application have the prerequisite knowledge and experience with SAT.

Problem

- Training provided by part-time instructors is not always adequate.
- Training provided by managers and supervisors without any lesson material results in poor quality training.
- Training materials used by vendors were inconsistent with the equipment used in the plant.

Possible solutions

- Provide instructional skills training to nuclear power plant personnel who serve as part-time instructors.
- Establish a "shadow" instructor programme to provide assistance to subject matter experts who deliver training on a part-time basis.
- Provide lesson plans for training to be delivered by managers and supervisors.
- Assign qualified training personnel to ensure training quality by appropriate assistance and monitoring.

Problem

Personnel who conduct on-the-job training and assessments are not sufficiently aware of utility policies, procedures, methods, or standards for conducting effective on-the-job training and task performance assessments.

Possible solution

Provide initial and continuing training for OJT trainers and assessors.

5. EXPERIENCES OF MEMBER STATES IN THE APPLICATION OF SAT

5.1. ARMENIA

5.1.1. Nuclear power plant personnel training and qualification

After a six-year shutdown, Unit 2 of the Armenian nuclear power plant, Medsamor, a WWER-440/V-270, was restarted in 1995. Centralized training within the Armenian nuclear power plant was organized in 1996. Before that, training was carried out by the nuclear power plant technical departments, and recently at the VUJE Training Centre in Slovakia and at Greifswald in Germany using the full-scope training simulator for the WWER-440. Before the restart, new staff of the nuclear power plant were sent abroad for full-scope simulator training. The control room of Unit 1 which is currently under shutdown conditions is being used as a supplementary training facility.

The training and qualification programmes for nuclear power plant personnel at present consist of the following: theoretical training, practical training on computer systems and full-scope simulators, practical work on the job, examination of knowledge and skills acquired, on-the-job training, participation in emergency and fire protection exercises, licensing.

The high seismicity and nearness to the capital which characterize the site of the nuclear power plant, as well as the long shutdown, make it imperative that personnel are trained and qualified according to best international practice. To make the most effective and efficient use of resources to upgrade training capabilities and personnel competence, it is necessary to learn from international experience and adapt this knowledge to the specific conditions and requirements of Armenia.

An IAEA Technical Co-operation Project has been started in Armenia on the Establishment of a Personnel Training System for Medsamor Nuclear Power Plant. This project will, among other things, assist the nuclear power plant in the establishment of SAT based training for nuclear power plant personnel, and familiarize instructors and senior and medium-level managers with SAT and their responsibilities for training. The job positions selected for starting SAT application are: reactor operator, turbine operator and head of the chemistry workshop. The IAEA will assist in the development of SAT procedures. The IAEA has been requested to assist the nuclear power plant in establishing its own training centre. This training centre will provide theoretical training and will have a partial simulator as well as mockups.

The management of the Armenian nuclear power plant are strongly committed to improving the nuclear power plant training system. The IAEA Project is expected to be an important step in strengthening safety and reliability of the Armenian nuclear power plant, through the application of SAT.

5.1.2. Role of the regulator

The training system of the Armenian nuclear power plant is based on approaches, practices and regulations which existed in the former Soviet Union. The only regulations in the area of personnel training and qualification are the former Soviet rules approved by the Government of Armenia. It is now necessary to create national regulations to define procedures for: selection of professional staff, training and retraining, monitoring of the training process, and nuclear power plant personnel licensing. Operations and senior personnel must also pass the examination of the Armenian Nuclear

Regulatory Authority to receive a license to work A new Decree on Atomic Power is in preparation After approval, it is expected that the Armenian Nuclear Regulatory Authority will approve the use of SAT for nuclear power plant personnel training and qualification

5 2 BULGARIA

5.2.1. Initiation

The pioneer measures in SAT introduction in the Kozloduy nuclear power plant (KzNPP) personnel training system can be traced back to 1990 when the first attempts were made by the training centre (TC) instructors to convince the management of the importance of SAT for safe and reliable plant operation

The progress in this direction was a reflection of IAEA recommendations during ASSET'90 and OSART'91 missions, as well as by a G-24 mission in 1994, identifying training deficiencies and "the noticeable absence of a systematic approach to training" After international missions, the TC construction was completed and a system was established for KzNPP personnel management and training, the TC being determined as an executive body of this system

In 1992, the development of job descriptions and formal training programmes was started for the main control room positions Simulator training for operations personnel was provided on the simulators of Novovoronezh nuclear power plant (for units 1 to 4) and Zaporozhje nuclear power plant (for units 5 and 6) The TC database was created, providing tracking of the plant personnel training and qualification At the same time, various training courses were developed and the delivery of training was started Training courses design and development complied with SAT methodology elements, although training needs were not determined basing on formal JTA A formal procedure for training effectiveness evaluation was also not established

5.2.2. Management and regulatory body involvement

During the period 1990–1995, various efforts were made for improving the complex interrelationship between the organizations involved in plant personnel training and in winning over the nuclear power plant management for "SAT Implementation" cause As a result, in 1995 the nuclear power plant management declaration on personnel training policy was issued and the personnel division was formed The necessity was recognized for upgrading the existing personnel training system and revising the basic training-related documents in order to have their complete conformity with SAT methodology The development of four simulators was initiated a full-scope, an analytical and a basic principles simulators for WWER-1000 and multifunctional one for WWER-440

There is still a lack of motivation of experienced plant personnel for work in the TC Regulatory body (RB) has accepted that SAT should be applied to nuclear power plant personnel training At present (March 1997) RB has not issued documents concerning methodology (requirements/recommendations)

5.2.3. Technology transfer

IAEA and G-24 missions identified as a highest priority item the SAT methodology transfer and its implementation for main control room (MCR) personnel, maintenance personnel and instructor training In this regard, several cooperation projects were started, aimed at SAT methodology transfer and adaptation of SAT based programmes for use in KzNPP personnel training

Upon the request, EDF provides training in maintenance quality assurance for KzNPP maintenance line managers, under the TWINNING programme. All the training materials are to be transferred and in the future, all the trainees are supposed to contribute considerably to other maintenance personnel training.

Of special importance is the ongoing co-operation project funded by Brookhaven National Laboratory (USA) within the framework of the International Nuclear Safety Programme. Under this project, KzNPP specialists and TC instructors were trained in SAT methodology and instructor skills Upon completion of training, they were involved in adaptation of the BNL — provided training programmes and materials for two MCR and two maintenance positions developed for the Khmelnitsky and Balakovo nuclear power plants. The project encompasses as well a presentation of SAT overview for the plants top management, which is intended to support the positive attitude to training-related activities Under the same project, a group of KzNPP TC simulator instructors has completed training programmes at the Zaporozhje nuclear power plant

5.2.4. Present SAT implementation status

SAT-upgrading of KzNPP personnel training system is in progress. The SAT methodology is based on:

- International documents (IAEA, WANO).
- Experience of SAT in the countries with which the KzNPP TC has joint projects France (the TWINNING programme, USA (DOE -BNL)
- Because of time and financial constraints the first stage — SAT analysis has been postponed

Experience gained through the introduction of SAT can be summarized as follows·

- After initiation of SAT, the MCR operators receive more reliable training. It is too early to try to evaluate SAT by analysis of plant performance.
- Insufficient number of SAT-trained instructors.
- The management generally supports the TC efforts. Still a change of attitude both of the management and the plant personnel is necessary for recognition of the TC status.
- “Classical” courses are revised, training programs provided within international projects are validated by joint groups of TC “SAT” instructors and plant specialists.
- For all new training programmes performance assessment exists
- Full-scale training programmes are yet to be established.

The TC has the responsibility maintaining of all training programmes and maintaining the database.

Work has been started to provide the training quality assurance involving revision of existing plant training regulating documents and development of new training procedures

Training in SAT methodology presently encompasses mainly TC instructors and plant specialists involved in maintenance training development and implementation. The target audience of this training is to be extended further to all levels of nuclear power plant managers and specialists with training responsibilities.

SAT is being used presently both in upgrading the existing training programmes and developing new ones

Adaptation of SAT based training programmes and materials developed for units of similar design proved to be an applicable, efficient and cost-effective approach to training upgrading and we are continuing our work in this direction.

Efforts are being made on training courses for the existing training programmes. Priority is given to development of training courses for senior operational positions, the TC and plant specialists being involved in this process. Already developed are 11 basic and 18 specialized training courses and 13 more courses are under preparation. In compliance with SAT requirements, each training course contains the following obligatory components: the assignment, materials for the instructor (technical description, slides, transparencies, videos, etc), trainee materials, pass-fail criteria and evaluation materials. Brief lesson plans have been also made which are being upgraded now

Two of the purchased simulators have been installed recently (basic principles and analytical ones for WWER-1000), the training has not yet been started. By the end of this year, two more simulators — the full scope for WWER-1000 and multifunctional one for WWER-440 are expected to be delivered. In this regard, the simulator instructor training and development of simulator training materials is now one of the highest TC and KzNPP priorities

5.3. CANADA

5.3.1. General description of the type of SAT methodology used

In the late 1970s, the Canadian utilities began adopting for their training selected elements of what is now known as the systematic approach to training. For example, training objectives were defined for the training courses already in place Similarly, in the early 80s, JTAs were performed by one utility for the control room operators (CRO) and shift supervisors (SS) positions. These JTAs were considered of limited practical value because of the disproportionate amount of resources required to perform them and because the utility considered the existing training programmes as being satisfactory. These efforts were mainly the initiative of the training departments and did not reflect endorsement of SAT by utility line management Nevertheless, acceptance of SAT by the utilities as the best method to revise existing training programmes and to develop new ones has grown over the years By the early 1990s, all Canadian utilities had endorsed SAT in their training policies.

Indeed, the revision of the science fundamentals and equipment principles training programme by an inter-utility working group referred to above was based on SAT. The analysis phase, however, did not include a formal, comprehensive JTA but relied on the results of JTAs done at other nuclear power plants, on data found in INPO guidelines and on information extracted from the existing utilities training programmes.

The revisions of the radiation protection training programmes completed at New-Brunswick Power and Hydro-Québec in the last few years and currently in progress at Ontario-Hydro have included JTAs. The revision under way at Ontario Hydro follows the different steps of the design and development phases of SAT methodically and includes a pilot run of the programme before its implementation on a regular basis

As mentioned above, SAT is now endorsed by nuclear power plant line management as the best method to revise existing training programmes and to develop new ones. However, even though the steps of SAT may be followed, it may not always be with sufficient rigor to ensure satisfactory results. What is currently being debated within the utilities is whether or not there is some latitude in implementing the various phases of SAT without compromising the results. This debate is usually about the analysis and design phases but also about the evaluation which, very often, receives less attention. Canadian experience shows that it is very easy to overlook or oversimplify steps in one or more phases of SAT The reluctance of management to make available adequate resources when implementing SAT, lack of staff experience in its implementation coupled with the lack of rigor referred to above are all reasons why the results are not always satisfactory.

5.3.2. Role of the regulator

In Canada the responsibility for providing the necessary assurance that the use of nuclear energy does not pose undue risk to health, safety, security and the environment is vested with the Atomic Energy Control Board (AECB). The Operator Certification Division (OCD), a division within the Directorate of Reactor Regulation of the AECB, has as its mission to obtain and document assurance that nuclear generating station operations personnel are initially well trained and competent to perform their duties and that, through continuing training and re-qualification activities, their competence is maintained. Presently the division has a staff complement of 25 which accounts for approximately 30% of the resources of the Directorate.

The AECB issues licenses to CROs and SSs. It obtains assurance that they are initially well trained and competent to perform their duties and remain competent via:

- A set of regulatory examinations comprising written and simulator based performance examinations before initial licensing,
- Assessments of the re-qualification tests conducted by the utilities, and
- The evaluation of the related training programmes.

Assurance of the competence of other nuclear power plant operations personnel is obtained via periodic evaluations of their training programmes.

While the use of SAT is not a regulatory requirement, the AECB promotes its use by the utilities. When the AECB started its programme of regular evaluations of utilities' training programmes, it focused on confirming compliance by the utilities with their own training policies, where they existed, or with a set of objectives and criteria that reflected SAT. Last year the AECB issued its own list of objectives and criteria and these are currently used for regulatory evaluations of nuclear power plant training programmes. These evaluations are normally conducted by AECB staff but contractual services were obtained in some cases. This practice will likely continue in the future in particular when the required expertise is not available within the AECB. The AECB does not certify training programmes but, where applicable, records deficiencies in the training programmes and requires corrective actions by the nuclear power plants.

5.3.3. Experience gained through the introduction and use of SAT

Even though the experience so far has confirmed the value of SAT, some of its features have been found to present considerable challenges. Among them:

5.3.3.1. The difficulty of defining "General" knowledge requirements.

Traditionally, training programmes in science fundamentals and system and equipment principles were not developed using SAT. Breadth and depth of knowledge in courses such as electricity, chemistry, thermodynamics were determined by expert judgment of course developers.

When such courses are now being revised applying SAT, there is a tendency by utility staff to eliminate elements of knowledge from the training if there is no obvious and direct link between them and at least one task. This sometimes can be inappropriate as it is difficult to determine all the knowledge of science fundamentals and equipment principles that a CRO should possess to take appropriate decisions and actions in a timely manner when facing abnormal or incident conditions This issue can be aggravated when a training programme review is influenced by a perception that past training was excessively long because it covered irrelevant topics or some topics to an excessive depth This can lead to unjustified cuts in the training curriculum, thus leaving job incumbents without all the knowledge they may require on the job

5 3 3 2 Difficulty of determining the specific knowledge of a nuclear power plant that must be known from memory when support documentation containing the relevant information is available

There is a tendency among the utilities to require very little to be known from memory, in particular when this information is readily available in station documentation as is the case for operating and emergency procedures It then follows that the only requirements could be in the case of the control room operator to be able to locate the relevant procedure and be able to implement its instructions To locate the relevant procedure can be relatively easy, if a direct link has been established between annunciations and observed parameter trends or values and a specific procedure Similarly, the knowledge required to implement the steps of a procedure can also be very limited and reduced in practice to know the location of the relevant devices and how to operate them

The difficulty arises in defining the knowledge requirements to ensure execution of the actions needed in a timely manner both under normal and abnormal circumstances, for example, to recognize when a procedure is no longer applicable or to bring the plant to a stable state when no procedure exists Because a timely response under these circumstances can have an impact on plant safety, it is very important to ensure that all the knowledge needed is identified This has proved to be a significant challenge to an inter-utility regulatory work group that has addressed the issue over the last few years

5 3 3 3 How much is enough?

The IAEA publication, Nuclear Power Plant Personnel Training and its Evaluation (Technical Reports Series No 380) and other international and national documents describe the activities that should be conducted for the training to be in accordance with SAT Objectives and criteria are also suggested to assist in performing evaluations to confirm the effectiveness and efficiency of training and to correct deficiencies as needed The challenge, both to the training departments and the regulators, is to determine which activities recommended by these documents must be necessarily completed when developing a training programme, which evaluation criteria must be met and which, if any, can be safely overlooked Utilities tend to argue that completion of all activities and compliance with all criteria are not necessary One utility training policy has documented the criteria of SAT that are mandatory and those that are optional The AECB position in this matter is that all the criteria must be addressed However, the AECB also recognizes that there may exist programmes which are valid and adequate but which do not necessarily meet all the evaluation criteria

The following points reflect additional lessons learned from the experience in the application of SAT in Canada as observed by regulatory personnel conducting training programme evaluations Several of these points confirm good practices recommended in IAEA documentation

- Get plant and line management endorsement and buy-in from plant and training staff involved If this is not taken care of early, the probability of success is very limited For example, in the analysis phase, job incumbents should participate, not only their supervisors

- Start with a relatively small project in order to be able to show progress and improvements made in a relatively short time e g part of a job instead of the whole job Set short term targets Try to select a training programme that is generally recognized as important It will be easier to show improvement and to retain buy-in into the project

- Provide training to those who will perform various steps of SAT. e.g. subject matter experts need training to be able to write adequate training objectives.

- Do not attempt to achieve perfection the first time around, particularly for the task analysis. Prevent paralysis by analysis. Use the evaluation concept of SAT to feedback at every stage and correct the previous steps as progress is being made in other phases. Commercial databases linking tasks and training material, including training objectives, are available and should be considered to assist in the analysis, design and development.

- Document reasonably to ensure that all aspects of a training programme can be justified at all times. Document the process followed, persons involved and their background, links between training objectives/content and the job and why some elements appear in the programme, particularly when differing opinions were expressed during the analysis, design and development phases.

- Except for the collection of feedback from trainees at the end of each course, the evaluation phase is often neglected. How requirements for change will be raised, recorded, tracked and how appropriate changes will be implemented in a timely manner need to be defined early on.

- OJT is too often neglected. It needs to be structured at least as much as, if not more than, other types of training particularly when considering the inconsistencies that can be introduced by the large number of persons involved in its delivery and in conducting field check outs. To ensure effectiveness and improve efficiency, complementary OJT delivery should be synchronized with classroom and other skills training delivery.

- Lessons plans are important as they ensure that training is reproducible. There should be no shortcuts on lesson plans.

- The application of SAT must take into account the differences that exist between technical skills and knowledge training and other training covering aspects that do not lend themselves easily to objective and quantitative evaluations. This has been found valid for the training of managers and supervisors and of the technical staff.

- Good instructors are key to the implementation phase, but highly skilled persons are not necessarily the best persons to be instructors.

5.3.4. How are SAT based training programmes maintained?

There is no staff charged solely with the maintenance of SAT based programmes. The responsibility of maintaining any training programme, including SAT based programmes, rests normally with the training departments which are responsible to evaluate the effectiveness of training and initiate appropriate corrective actions. Databases have been used to facilitate the analysis and design phases when applying SAT. More databases are also being set up to record the various elements (e.g. tasks, training objectives, test items) of SAT based programmes and the links between them, and thus facilitate revisions of these programmes.

5.4. CHINA

China has two operating nuclear power plants: 2 × 900 MW units at the Guangdong Nuclear Power Station at Daya Bay, and 1 × 300 MW unit at Quinshan. Two nuclear power plants are under construction: Qinshan units 2 and 3; and six more units are planned: 2 × 900 MW at Lingao, 2 × 700 MW at Qinshan, and 2 × 1000 MW at Liaoning.

5.4.1. Use of SAT

SAT based training is used in all aspects of training and proceeds through the following phases·

- Identification of training needs
- Analysis of training needs
- Definition of training programmes
- Development of the training content
- Implementation of training
- Evaluation of training results.

The SAT application follows the IAEA guidelines. The best way to train operations and maintenance personnel is through participation in commissioning and pre-operational testing

Entry-level requirements in all job positions are at a good level Initial and continuing training is fully provided for all job positions except for shift supervisors.

Specific positions for which training is available are: operations, maintenance (mechanical, electrical, I&C), technical support (engineering, radiation protection, chemistry), management.

Compulsory training in order to obtain authorization and licenses for each job position comprises:

- Personnel qualification training to perform all tasks of a given job
- Career enhancement training to improve individual capabilities and to prepare for possible future promotion.

Increased emphasis will be given to maintenance training. In particular to establishing special training facilities for maintenance personnel and improving training through the extensive and intensive application of SAT.

5.4.2. Role of the regulator

The National Nuclear Safety Administration (NNSA) is the regulatory authority. Its function is the review and supervision of the safety of civil nuclear facilities according to the nuclear statute, laws and regulations of the country. It is responsible for inspecting licensing activities and especially for reviewing and issuing licenses for reactor operators and senior reactor operators.

The China National Nuclear Corporation (CNNC) has responsibility for all industry and research activities in the nuclear field in China.

The nuclear power plant is responsible for training the candidates for nuclear power plant operators according to the standard and for implementation of licensing examinations of nuclear power plant operators.

There is an Operators Qualification Examination Committee (OQEC) for the nuclear power plant, which is responsible for assurance of the training programmes and arranging the examination to ensure the qualification and competence of nuclear power plant personnel.

5.4.3. Training centres

The training centres are located at Daya Bay and at Qinshan.

The training centres are responsible for:

- Co-ordinating all training for nuclear power plant personnel
- Leading the development of training programmes
- Procuring and maintaining all training tools, equipment and materials including simulators and mockups
- Maintaining records on the training and qualification of all nuclear power plant personnel.

Each training centre has the following main facilities:

- Basic principle simulator
- Full-scope simulator
- Mockups for maintenance training
- Language laboratory
- Video facilities
- Classrooms, computers, etc.

The development and monitoring of training involves the client or end user, which is the trainee and nuclear power plant, and the contractor, which is the nuclear training centre manager. Every year, the training centre holds a meeting with the different nuclear power plant branches to determine training needs for the upcoming year. Based on this, an annual training plan is drawn up containing:

- Approximate workload for classroom and simulator training for each branch
- New training modules and courses to be developed
- Training resources to be allocated to training.

Nuclear power plant branches are responsible for defining, scheduling, performing and assessing job-specific training and on-the-job training.

Monthly meetings with nuclear power plant branches take place to discuss training programme content, potential problems and the main results of training.

The plant training committee meets regularly to follow the implementation of the training programmes, analyse the main results and make decisions on proposals to improve the training and authorization processes.

5.4.4. Qualification process

The Qualification Review and Evaluation Committee (QREC) of the CNNC:

- Reviews and approves the qualification and structure of the nuclear power plants examination committees
- Determines the examination contents
- Sets the examination questions and standard answers
- Reviews and approves the qualification of the license candidates and submits the license to the National Nuclear Safety Administration
- Deals with matters concerning renewal and cancellation of RO and SRO licenses.

The nuclear power plants are responsible for personnel training and competence. The responsibilities of the nuclear power plant examinations committee include:

- Setting the oral and simulator examination questions and standard answers
- Conducting written, oral and simulator examinations
- Developing of examination management procedures
- Submitting license application to the QREC

Each nuclear power plant employee must get special authorization from the plant manager. The authorization document is issued for a given period, and renewal follows the same process for any given function, the required competencies will cover·

- Technical and professional knowledge and skills
- Quality-assurance-related skills
- Knowledge of installations
- Knowledge, skills and attitudes related to safety and safety culture.

Before submitting an authorization proposal for approval, the branch heads must verify compliance with the following requirements:

- Employee must have successfully completed all compulsory training courses related to the authorization.
- Employee must have demonstrated his ability to hold the intended position.
- Medical requirements must be met.

5.4.5. IAEA SAT seminar

A national seminar on the systematic approach to training and qualification of nuclear power plant personnel was held at Daya Bay in November 1995. This seminar provided information on experiences in other countries using SAT for nuclear power plant personnel training. It also covered the role and responsibilities of management for nuclear power plant personnel training and competence and the use of SAT for ensuring QA of training programmes and for enhancing the safety and reliability of plant operation and maintenance

5.5. CZECH REPUBLIC

5.5.1. General description of the type of SAT methodology used in the Czech Republic

Nuclear Training Centre Brno (NTC) is responsible for the introduction of SAT methodology into the nuclear power plant personnel training system in the Czech Republic.

The training of the nuclear power plant personnel assigned for nuclear safety related activities has been always well organized in the Czech Republic in accordance with QA programmes. According to the G-24 mission of 1994, the Czech Republic has in general an adequate nuclear power plant personnel training system. JTA/JCA is used for selected personnel with direct impact on nuclear safety only. The definition of training objectives for other personnel takes place through the decision of experts based on their experience. The nuclear power plant personnel assigned for nuclear safety related activities are divided into five categories

- Management personnel
- Selected personnel with direct impact on nuclear safety

- Technical personnel
- Servicing shift and operating personnel
- Maintenance personnel

Each category is divided into further professional groups·

- Primary circuit
- Secondary circuit
- Electrical systems
- Chemistry
- Instrumentation and control systems
- Radiological protection.

Each job position is defined by a combination of category and name of a professional group. For each job position group of experts prepared the list of qualification requirements and according this list a training plan was designed by the NTC.

In these training plans there were defined training modules, lessons in each module and scope of theoretical, laboratory, on-job-training and training on the basic principles and full-scope simulators.

The training for selected personnel with direct impact on nuclear safety was approved by State Office For Nuclear Safety (SONS)

In the development phase, by instructors of NTC and experts from the nuclear power plant prepared the necessary training materials for different type of settings.

At NTC Brno, and at the nuclear power plants Dukovany and Temelin there are enough qualified instructors to conduct all forms of training. Only the training on full-scope simulator for the Dukovany main control room operator is performed on WWER-440/213 simulator at VUJE Trnava (Slovakia) and training for such personnel for Temelin will start on newly constructed WWER-1000/320 simulator six month before the first fuel loading.

Initial training for the Dukovany and Temelin NPP personnel is performed mainly at NTC Brno and trainees obtain after final examination a "certificate". For some job positions further training to obtain a „License" is required, based mainly on-job-training Continuing training is organized and provided by the training centres (TC) of each nuclear power plant. The content of continuing training is focused on:

- Upgrading of required knowledge and skills
- Modifications and changes of nuclear power plants and procedures
- Lessons learned from incidents and events

An important part of each setting form and lesson is assessment of trainees performance and experience feedback from trainees, instructors and nuclear power plant supervisors.

5.5.2. Role of regulator

The regulatory body (SONS) is divided into three departments·

- Department of Components and Systems

- Department of Nuclear Safety Assessment
- Department of Nuclear Materials.

Within the competency of the department of components and systems belong:

- Nuclear facilities personnel training supervision
- Control room operators licensing
- State examination commission for licensed personnel
- Nuclear power plant training centre licensing
- Approval of training plans for licensed personnel with direct impact on nuclear safety.

Implementation of SAT methodology is a recommendation of the State Office For Nuclear Safety.

5.5.3. Experience gained through the introduction and use of SAT

Advantages of SAT based training:

- Possibility to improve the level of qualification of nuclear power plant personnel by using better and more individually tailored training system
- Implementation of human factors competencies into nuclear power plant personnel training.

Problems encountered in implementation SAT

- JTA or JCA performed strictly according SAT methodology require huge financial and human resources

5.5.4. How SAT based training programmes are maintained

NTC Bran is responsible for maintaining SAT based training programmes.

The personnel of NTC Brno, TC nuclear power plant Dukovany and TC nuclear power plant Temelin are mainly involved in the implementation of SAT.

5.6. FINLAND

5.6.1. General description of type of SAT methodology used

Imatran Voima OY (IVO) operates two PWR-units in Loviisa and Teollisuuden Voima OY (TVO) operates two BWR-units in Olkiluoto in Eurajoki. Both have their training centres including training simulators on site. In both cases an essential part of the personnel got much of their training by participating in the design, erection and commissioning of the units. In their retraining and training of new personnel the principles of SAT as described in the IAEA Guidebook (Technical Reports Series No 380) are being utilized as combination of job task analysis and job competency analysis. An important tool in implementing these methods has been a training manual that in TVO has been used since 1990.

5.6.2. Role of regulator

The Finnish Centre for Radiation and Nuclear Safety (STUK) issues detailed regulations concerning the safety and physical protection of nuclear power plants and safeguards

The YVL Guides are rules any individual or any other organization concerned shall comply with unless some other acceptable procedure or solution is presented to STUK by which the safety level laid down in an YVL Guide is achieved.

The total number of valid YVL Guides exceeds 60 and two of these give requirements for training, namely:

(1) YVL Guide 1.6 ”Nuclear power plant operator licensing” describes the necessary procedures for licensing and operator training.

(2) YVL Guide 1.7 “Functions important to safety, and training and qualification of personnel”.

5.6.3. Experience gained through the introduction and use of SAT

The guides define in a clear way the functions required for the safe operation of an organization and for which position-specific qualification requirements shall be established. Each function's description is the basis for the qualification requirement. YVL Guide 1.7 presents the basic education, work experience and medical fitness for the job required during recruitment, the requirements relating to the initial training arranged by the license holder to qualify a person for his job and certain job-specific approvals granted separately. General requirements for the training function and for the re- and continuing training arranged by the license holder are also set out in this Guide. The Finnish example in Annex C.6. sets out the basic education and work experience for persons in functions important to safety. Since the assignment of duties varies from plant to plant, the requirements shall be confirmed in the plant's administrative routines or in the organization manual to ensure compliance with requirements which are in conformity with those presented in the example.

The YVL Guides in their present form are a result of more than 20 years systematic evolution. As a result the utilities also have developed their procedures. In TVO all the principles and procedures applied in training are written in the company's training manual utilized since 1990. The training manual has been sent to STUK who supervise that the principles and procedures comply with it.

Position related competence requirements have been defined for all such functions that are involved in the operation and their supporting functions. Training programmes have been drawn up for those positions that have certain requirements set by the licensing authorities. Finally, individual training plans are made for all employees entering the company or a new position within TVO. Similar procedures are applied in the other utility with nuclear units IVO.

In Finland both nuclear power plants have their full scope plant specific training simulators located on site, IVO`s from the very beginning and TVO's since the beginning of 1990. Before that TVOs operators received their simulator training at the B1-simulator of KSU in Studsvik, Sweden. Having one's own simulator on site makes direct dialogue between the training centre and plant units very easy, thus enabling direct feedback in both directions quickly. An advisable feature is to have a yearly rotating simulator instructor from control room crews to act on one hand as an ordinary instructor, and on the other hand to design training plans for most topical training needs for operation.

5.7. FRANCE

The size of the French nuclear power programme has forced EDF to set up within a period of a few years training system enable all nuclear power plant personnel to perform their job within the international safety and quality requirements. From the launching of the first plants, training has been recognized as a safety related activity. As such, the standard quality assurance programme has been applied to training of nuclear power plant personnel from the beginning

5.7.1. Initial aims of the EDF training system

First, the training system had the role of providing a mass schooling accessible for all nuclear power plant personnel. The strategic choice to man the first nuclear power plants with personnel coming from the fossil generation side of the company made the training system a huge technical school. At the same time as training was providing nuclear power plant personnel with basic education elements, it also provided them with a social cohesion, a specific nuclear culture.

The second aim of the training system had to provide nuclear power plant personnel with knowledge and skills to allow them to acquire the competencies necessary to hold the job. It was a tremendous effort, involving a huge amount and diversity of scientific, technological and procedural knowledge requirements for all operation and maintenance positions.

The third aim or function was to reassure a number of groups: the company, the personnel, the government and the public. The huge dimension of the training system was then a guarantee for high qualification and therefore for a good level of nuclear safety.

The last function is related to the bound any existing between training and job appointment. training was used for recognition of a given qualification which then legitimated the change in job through promotion. As the programme accelerated, vertical job movement called for more training which thus became the control device of the internal job market.

5.7.2. Training organization

Despite all technological and managerial changes or mutations, the training organization stayed the same for a little more than 15 years This can be read at two levels.

5 7.2.1. The formal organization

The first level is that of a mass schooling system. training was the essential part of a systematic approach to personnel management. There was a strong will to cover in all domains all the different fields of knowledge. Safety does not allow any gap in the personnel qualification. Thus training was for all. The Nuclear Generation Division had become a teaching organization where each job position is held in direct relation with the knowledge and skills that the incumbent has demonstrated at a given time and which could be documented through the training system. The validation of knowledge legitimated the job appointment which gave the rank in the division hierarchy scale as well as in the local society.

The necessary knowledge- scientific, technological and procedural — most of it external to the company, was instilled through self-contained training modules listed in a training catalog 18% of the division payroll was devoted to training during for all these years.

At this time SAT had not yet been formalized and recognized world-wide as the best practice in nuclear power plant personnel training Nevertheless, it is believed that EDF was using SAT, or a similar quality assurance system, without calling it SAT Indeed, the approach was encrusted into the Nuclear Quality Manual and comprised the following phases: problem identification, needs analysis, design and development, implementation, evaluation and feedback.

5.7.2.2. The non-organized training

The success of the French nuclear power programme cannot be exclusively attributed to formal training, although its huge development in terms of quantity and quality has been one of the main criteria.

In informal and non-structured ways, competence of nuclear power plant personnel has been constructed in direct relation to the day-to-day work. Owing to strong team spirit, self-training and eagerness to comprehend the machine from job activities, first during construction and then start-up, knowledge acquisition occurred through direct contact with equipment. It was not only knowledge but knowledge and skills enabling personnel to perform, actions; it was actual competence.

The development of this informal training was possible because all conditions were favorable, in particular the work climate in all nuclear power plant work teams. The future offered equal opportunities to all and inter-individual competition practically did not exist. Furthermore, in the control room, dialogue and collective reflection before action were usual attitudes. It is worth noting that nuclear power plant personnel spent as much time in training themselves or training colleagues as in producing electricity!

The informal system was reinforcing the formal one and vice-versa. It was a dual system in synergy in which everyone shared knowledge as well as limitations, gaps and questions.

The success of the acquisition of high qualification and team competencies is to be found in the synergy between the quality of the systematic training modules and the good conditions in work teams.

5.7.2.3. Organization effectiveness

With a historical perspective, it is striking to note the good match between the training systems then in place and the four aims/functions that it was set to achieve. It is the main reason of its duration, whereas training practices evolved greatly in all other fields of activities. The system was pertinent and effective from both the points of view of the company and of the individuals.

5.7.3. Changes

The key-words of the changes in the environment could be:

- From a pioneer area to industrial reality
- An increase in the international pressure on nuclear safety
- An increase in procedural work
- An emphasis on management and more reporting
- An economic crisis triggering uncertainty about the enterprise future
- A general career development plateau
- An aging of installations and personnel.

5.7.4. The local system of development of competencies

Several favorable conditions have disappeared along with several internal drives. External and internal pressures on safety have increased asking not for more knowledge or skills but competencies.

Professionalism is the master word. formal training had to change. Self-contained training modules could be maintained but had to be used in a more dynamic manner:

- More individualization to take into account the diversity of personnel.
- Still more field quality.
- A better integration between training and personnel management. Training has now to be thought of not only as a necessary step to promotion but firstly, as a necessary step to adapt and acquire pertinent background for new competencies of new trades and of new jobs.
- A better integration between training and work, to progress toward a "learning organization".

A number of nuclear power plant employees have not only acquired knowledge and skills but have also produced new ones, often without their complete awareness. These people will then participate in training not for more knowledge but for assistance to identify, formalize and circulate their own experience.

5.7.5. SAT in EDF

SAT has been integrated into the existing training system which has itself evolved according to the new needs mentioned above The main difference between the EDF system and the initial SAT was the methodology used to define any job needs.

For historical reasons, the EDF training system has evolved towards a needs analysis through what it is now called a job competencies analysis (JCA). This methodology by itself has also evolved as experience accumulated.

All nuclear power plant jobs have been progressively analysed using JCA and to each of them a "référentiel métier" or job reference frame, was associated. Activities, competencies, performance level required and associated knowledge, skills and attitude are listed in interrelation. This analysis phase is performed through table top investigation during meetings between job experts, experienced job incumbents, trainers and human resources corporate experts. Such an analysis requires typically less than 50 person-days for a job family. From the associated knowledge, skills and attitudes learning objectives can then be derived.

5.7.6. Role of regulator

The French safety authorities are attached to two ministries, the Ministry of Industry and Ministry of Environment An external body provides for technical support and expert opinion.

The Safety Authority body delivers plant operations authorizations. It is in charge of drawing all general safety objectives. It verifies conformance with all legal requirements as well as effective implementation of all arrangements agreed upon.

EDF Nuclear Generation Division is responsible for overall nuclear power plant safety. It makes proposals on how to meet the safety objectives. It must thus take all arrangements to assure safety of all nuclear power plants in all functioning modes. It must also prove and document that those arrangements are within safety requirements.

The Safety Technical Support body assesses EDF proposed arrangements and documentation It also prepares the technical file for decision.

Concerning training of nuclear power plant personnel specifically, EDF is responsible for the whole process from personnel recruitment to individual nuclear safety authorization delivery. Training is only a part of this process.

The safety authorities verify the pertinence of all training programmes and the fulfilling of qualifications requirements of all trainers.

5.7.7. Experience gained through the introduction and use of SAT

As mentioned earlier the introduction of SAT had rather been a rewording of an existing system rather than a revolution in the way training was conducted. JCA has been developed and more formalized to meet international standards. Other countries have now preferred the JCA approach to the more conventional JTA approach, and thus confirmed EDF in its initial choice.

Training as such is slowly transforming into a more individual-targeted system of competence development. The aim is twofold: helping the person to develop the competencies needed to hold the job of today as well as of tomorrow and, at the same time, providing the facilities and conditions for work teams to develop collective competencies. It is believed that the use of SAT with the JCA approach is the best way to achieve this endeavor.

5.7.8. How SAT based training programmes are maintained

5.7.8.1. Principles

The top management of the Nuclear Generation Division finalized the above analysis into four principles:

- A global view and forecast of training needs centralized by corporate departments, each of them responsible for a domain: safety, management, radiation protection and security, maintenance, operation, engineering, etc.
- A transitory phase to go from a initial mass training to a system of development of individual competencies
- Manager responsibility for using training as a tool to develop their personnel competencies
- An efficient control of all the training chain with a national steering committee and a recognized partner as our lead contractor.

5.7.8.2. Corporate responsibilities

The different corporate departments are grouped into the Corporate Resources Division (MCP). Ownership responsibility is shared between the 20 nuclear power plants and MCP. It concerns:

- Identification of job family evolution in terms of new competencies to be acquired and perspective about the impact of technology on specific jobs
- Training needs in terms of competencies
- Conformance between training end-results and what was expected.

The strong will to involve all managers in the training process and the high priority given to the maintaining of knowledge and the development of competencies imply that the ownership responsibility is shared between the local and corporate levels.

- MCP is in charge of the initial training, the implementation of national orientations and training actions needing large resources:
  - initial acquisition of basic knowledge
  - job family and trades evolution
  - accident conditions training (simulator policies)
  - national feedback experiences incorporation
  - SAT methodology dissemination
  - development of national expertise.

- Within each department a small unit has the responsibility to manage job networks in order to disseminate valuable experiences and to relate training to the actual everyday work.

- Within MCP, the Management Support Department (DAM) is in charge of the overall co-ordination of training (methodology coherence, consolidated budget, international training relations, general relations with the internal contractor, in particular for trainer appointments, etc.).

5 7 8.3 Site responsibilities

Sites are in charge of the adaptation of training to individuals and implementation of the quality control process:

- Definition of competencies to be acquired and choice of corresponding means
- Control for sat methodology conformance
- Local feedback experiences incorporation.

Each site has the full responsibility for its local training programmes and may call upon the national contractor or external firms.

5.7 8 4. Organization

Coherence is achieved through the site local training plan constructed within a 3-year strategic national framework set by top management.

Permanent work groups (GMF), one per corporate department, are implemented with the assignment to act as a validation and control body

A national co-ordination group (IFN) is in charge of all strategic orientations concerned with training for the Nuclear Generation Division. It is the official link between the owner and the internal contractor and is the decision level.

5 8. GERMANY

5.8.1. General description of the type of SAT methodology used

German utilities have always used the typical "German professional training approach" as practiced in the whole handcraft and industrial system for their nuclear power plant staff training. This approach is based on several hundred years of experience and its principle — definition of training needs from experienced senior job incumbents — was adapted to the needs of a modern industrial society and to scientific results, e.g. in pedagogical principles.

The whole approach is organized by specific institutions (e.g. the chambers of commerce) or industrial associations under strong government regulations and control. The German approach is a typical example of a JCA based SAT.

Following this industrial tradition, German utilities founded in 1957 an education centre "Kraftwerksschule" (KWS) to train their staff for the duties within the electricity and steam production industry. Under supervision of the industry association "VGB" the Kraftwerksschule has supported since 1959 the training of power plant staff, including nuclear power plant personnel.

Several expert committees support the training programme design and development and they have created various guidelines for the training of nuclear power plant personnel. These guidelines cover basic education needs, training objectives and so on. Also a general utility recommendation for maintaining the competence of plant management staff was elaborated. The first nuclear power plant simulators were installed at Kraftwerksschule. Owing to the increasing significance of simulator training for the utilities, a dedicated simulator training centre (KSG/GfS) was established in 1987.

So, since that time, Kraftwerksschule KWS is responsible mainly for theoretical and practical skills, and the simulator training centre KSG/GfS for simulator training.

5.8.2. Role of regulator

The German Ministry of the Environment, Nature Conservation and Nuclear Safety is responsible for all nuclear safety related guidelines. Because personnel qualification of nuclear power plant staff is essential for nuclear safety, the ministry has issued six guidelines to ensure the appropriate knowledge of nuclear power plant staff.

Within these guidelines, only basic education, areas of theoretical and practical knowledge, skills and attitudes, and minimum experience are described. The definition of training needs, learning objectives (design phase actions) are performed by the utility organizations taking into account the authority requirements.

The implementation and management of training programmes in a particular power station is inspected by the local authorities. They monitor the stations compliance with a defined programme and participate in the final examination of control room staff before issuing a operator license.

5.8.3. Experience gained through the introduction and use of SAT

The JCA based SAT approach has existed now for more than 30 years in the nuclear power plants. No major deficiencies where detected during that period and all stations have operated well. However, there was a permanent updating during the whole period based on experience feedback, and commissioning of new systems (e.g. accident management provisions) as proposed by SAT.

For example the KWS "basic nuclear training course guideline" has undergone a total revision (training goals, learning objectives) and the course sequence was totally rearranged. This means, that during the whole period there was never a significant break in the training process, but a continuing improvement.

Although there was no reason to change the existing training system, in the early 1980s (after TMI accident) the German Ministry for Nuclear Safety conducted a huge study on "optimization of training for control room staff". This study "SR 243" was performed from 1981–1984 by Batelle, Lahmeyer International and the utility organization VGB.

The methodology used was a complete JTA for control room staff. 190 tasks regrouping 1300 "part tasks" were analysed and related training objectives were defined. Also, experts in

Arbeitswissenschaft were involved in the study. After three and a half years of work and at a cost of about 3 000 000 DM the main outcome was a confirmation that existing training objectives were appropriate and complete. There was even a slight tendency to have too many training objectives defined with the more "practical" JCA approach than with the JTA

Therefore, the conclusion for the utilities was to rely on the JCA as the main basis for the SAT evaluation process.

A major change in the training area took place in the early 1990s. German utilities then decided to increase the number of simulators and to acquire plant specific simulators There were two main reasons for this decision: firstly, the increased personnel rotation due to retirements within many units which requires more simulator training in total, and secondly, the implementation of more systematic evaluation of control room staff performance during simulator sessions. The installation of additional simulators will be completed by the end of 1997.

Another tendency which should also be mentioned here is the increase of training related to soft skills such as team work, communication, decision making, stress resistance. Special courses were developed by human factor specialists and other organizations such as the airline industry are now used by the nuclear power plants to train their staff in soft skills. Also, within the normal simulator training there is more sensitivity to soft skills and personal behavior

5.8.4. Maintenance of training programmes

As mentioned earlier, the existing organizations ensure quite well that common training programmes are updated continuously taking into account operating experience feedback and research results For plant specific programmes the officially assigned "training manager" must confirm that the updating of internal plant training programmes is done by the responsible plant management even if it is a principle that senior plant managers are directly responsible for the training programme of their staff.

5.8.5. Ideas and recommendations based on experience

Reactor technology and jobs and tasks in a nuclear power plant do not differ so widely from other industries as some people believe. A large amount of training goals and objectives were created in various organizations around the world for most of the tasks in a nuclear power plant. So it is a good solution to make use of these materials Even if this is not cost free, significant cost reductions are achievable for the evaluation phase of SAT and the financial resources can be used for the implementation of the training programme itself

German utilities can provide training programmes for control room staff, health physics staff and plant management as well as for the common training needs of non-control room staff.

For the maintenance staff, national training programmes exists in much detail. However, those training programmes are not specific for nuclear power plants because they are also valid for identical or comparable tasks in other industries

5 9 HUNGARY

At Paks nuclear power plant an IAEA-supported Hungarian model project (HMP), has been running since 1994 with the task and responsibility to introduce SAT into the training of nuclear power plant personnel Specific tasks of the HMP are to develop and apply SAT methodology to SAT based training programmes for a number of operational and maintenance job positions, successfully applicable in the Hungarian environment The methodology and procedures used by the project and the background required for applying SAT must ensure implementation of SAT based training programmes for further job positions as required by the plant.

5.9.1. Description of the "Paks-SAT" methodology

The selection and development of the method to be applied in Paks required a long preparation time and several attempts. The analysis phase of the developed methodology is most similar to the combined JTA-JCA method as detailed in IAEA Technical Reports Series No. 380. The steps of the process are demonstrated in the flow-chart (Annex A.1.).

5.9.2. Role of the regulator

In relation with the plant the role of the regulator is played by the Nuclear Safety Inspectorate of the Hungarian Atomic Energy Commission. The Regulator's responsibility is the control over the training and qualification requirements as prescribed in the respective laws and the execution of the training process as described in procedures and orders

It is the regulator that issues or renews licenses in specific job-positions (272 licensed personnel on 31 December 1995.)

SAT is not yet a regulatory requirement, considering that the process of introduction of SAT based training has not been finished by the HMP At the end of 1997 it is planned that the regulator shall approve the HMP elaborated SAT based training programmes in selected job-positions

5.9.3. Specific job-positions wherein SAT based training is implemented

In the framework of the HMP, SAT based training programmes are being developed for the positions as presented in Table I.

TABLE I. SAT BASED TRAINING PROGRAMMES

Job Position	**Area**
Reactor operator	
Primary circuit field operator	
Turbine operator	Operation
Turbine field operator	
Electric senior operator	
I&C technician	
Reactor maintainer	
Primary circuit valve senior maintainer	
Safety valve maintainer	
RCP maintainer	
Reactor technologist engineer	Maintenance
Reactor preparation engineer	
Welding technologist	
Reactor fitter-CRD mechanic	
Primary circuit ultrasonic in-service inspector	
QC officer — system supervisor	Other

5.9.4. Experience gained through the introduction and use of SAT

Expected advantages at Paks nuclear power plant from SAT application:

- The overall and detailed definition of competency needs in the identified job-positions
- Authorized knowledge test questions enabling effective performance test
- New training programmes providing a better coverage of real training needs
- The overall review, updating, supplementing of available training materials, development of new training materials
- Centralized, state-of-art process and tools for training material development and maintenance
- Methodological establishment of maintenance personnel training utilizing the new Paks maintenance training centre (MTC) capabilities and providing SAT based training for both plant and contractor personnel
- A positive side-effect for acceleration of the exchange of poor quality plant documentation
- Increase of commitment to the company and enhancement of safety culture

Problems encountered during implementation of SAT

- Initial resistance against implementation
- Availability of human resources
- Long preparation period, time-consuming analysis phase
- Data management
- Lack of uniform international approach on SAT technology

5.9.5. Management commitment

The senior management of the plant committed itself to the implementation of SAT officially when the HMP started The development of SAT based training programmes took place under supervision of and with support from the line management

The training centre head, in charge of the HMP as well, is fully committed to the matter of SAT application

The use of conventional-type training programmes

At Paks nuclear power plant, the training of plant personnel, except for the very early years of plant construction, was conducted in the on-site training centre The training practice and the training programmes developed during the nearly 15 years of plant operation proved to be a good basis for elaboration of SAT based training programmes

Maintenance of SAT based training programmes

The SAT based training programmes are currently being developed Until the HMP is operational, the related responsibility, as well as the development of procedures and tools that support maintainability lies with the project

A database stores the SAT analysis phase data, and software capable of handling the overall process is ready as a result of the project development

5 10. INDIA

5.10.1. General description of the SAT methodology used

The term systematic approach to training (SAT) was introduced in India in Indian NPPs only in 1990, after IAEA-TECDOC-525 was published. An attempt was made to implement the concept as a pilot project in mechanical maintenance training and qualification. Detailed task listings for major pumps were attempted but had to be abandoned due to extremely high resource demands with concurrent priorities of on-going training activities However, all-out efforts towards improving human performance in NPPs were also launched around this time in India, thanks to international work made available on good practices and human factors. A strong foundation of technical training built over operating experience of twenty-five years rendered easy identification of performance deficiencies in general and of human element in particular Continuous feedback by various evaluators by then had already built a logical structure for qualification of all NPP personnel It was, therefore, feasible to undertake in nineties, SAT based training systems in parts using now more friendly the "Job-competencies" criteria as outlined in the IAEA Technical Reports Series No. 380 There is a strong management commitment to slowly, but, progressively implement this methodology in all disciplines of training The text below summarizes the process of our organization learning and concludes with a typical illustration of SAT application to nuclear power plant maintenance qualification

5 10 1 1 Training aims and experiences in the 1970s & 1980s

In the seventies, with just two to three units operating, the aim was to master and manage the high technology in nuclear power plant and provide adequate skilled manpower out of fresh trainees The training addressed NPP orientation, safeties and basic commissioning skills. The regulatory mandates then, were in general terms applicable only to the licensing of shift charge engineer and the control room operator and to a limited extent, the fuel handling panel operator. A policy decision was taken at this stage to provide intensive foundation training to all operations & maintenance (O&M) personnel lasting 1 year to 2 years, allocate to commissioning stages and eventually place them in O&M positions An on-going system of induction of trainees with matching resources of nuclear training centre and commissioning based on-job training practices could got then established

With the introduction of more nuclear power plants in India in the eighties the scope of regulatory and corporate evaluation of training increased. The role played by direct operations was endorsed, but that of maintenance, QA and trainers staff were also highlighted. The contributions made by members at all levels from tradesmen to management towards safety were underlined, As a result, it was necessary to expand the scope of entire system as given below.

- Senior management officials with non-licensed background needed to have broader competencies, i.e either a license for operation or at least a special additional qualification that focuses on safety culture, design and operation safety and root cause analysis.

- Commissioning trained system experts needed more training to get licensed to operation engineers position due to their divided attention to commissioning tasks and self training for licensing

- On-job trainers lacked experience in specifying the learning goals and standards for each task They also lacked perspectives of human factors in learning

- Shift charge engineers had not been exposed to operational experience in on-power refueling as rightly observed by regulators

- Licensed staff used as examiners for written examinations did not have specific guidelines in formulating of tests and there were non uniformity across nuclear power plants

- Trainers did not find adequate challenge, being busy with administrative co-ordination and academic teachings Their contribution in on-job training was limited because of its highly routine, unstructured nature

5 10 1 2 Correctives actions — 1980s

The following improvements were brought about in the training system of eighties

- A revised five level organization, with specific competencies requirements at each level for all positions in operations, maintenance, technical services and training centre, was put in effect This structured all qualifications and also provided equal opportunity and career to all, including support personnel

- A separate system of training and operation qualification for management personnel was implemented This strengthened management skills

- A special procedure was designed and implemented for training shift charge engineers towards on-power refueling this created a more cohesive on-shift organization

- A one year compulsory formal nuclear training on plant systems and on-job orientation on shift operation was put in effect for all engineers This paved way for licensing up to management levels

- Simulators, both full scope as well as PC based, were taken up as in house effort Trainers got new challenges in contributing as trainers, simulator developers as well as intermittently in duties of qualified nuclear power plant O&M engineers Trainer motivation towards developing training resources increased

- More nuclear training centres (NTC) were set up Each NTC was equipped among others things mock-ups/loops for hands-on training, e g assembly and seal replacement of reactor coolant pumps, ice plugging reactor feeder pipes, stroking and testing control valves, setting motorized valve actuator switches, and calibration and testing of instruments and so on

- Training quality as well as trainer effectiveness accordingly improved because of improved training settings

- A centralized licensing examination system for all stations were created The bank was designed on SAT principles, i e defining job competencies for each licensed position, designing knowledge and skill test items and implementing through matching training and testing activities from headquarters and fully endorsed by regulators Similarly, job competencies were structured for all non licensed and maintenance positions also in the form of a Corporate document on qualifications

5 10 1 3 Training needs — 1990s

The early 1990s saw emergence of concepts of organization development with key words "root causes", "human factors", "systematic approach to training" guiding all actions It is here, where the corporate management set the minimum nuclear power plant performance goal as "not more than one outage per month"

This goal has now been more than achieved in Indian nuclear power plants. Yet in early 1990s, the performance was to be enhanced and accordingly training system was put for review for improving human performance. Even though our training system imparted adequately, the appropriate technical concepts and skills, there was a need to assess human performance. This could be possible only if we could sensitize station personnel towards systematic self assessment to find out real causes and perform problem solving to avoid recurrence of inappropriate actions. This was done in steps below.

- Train in the first step, a group of 20 root cause analysis facilitators through a US consultant.

- Developed specific diagnostic training packages focusing on human deficiencies and conducted a series of workshops on problem solving in nuclear power plants. In parallel, a massive needs survey was organized.

- Each training workshop, as a bonus, provided voluminous diagnostic data on "attitude deficiencies" e.g.
  - "lack of verification culture"
  - "lack of team work and supervision"
  - "failure to follow procedure"
  - "inadequate communication".

- A consensus was arrived on such cases that while level of technical skills was adequate, special training programmes were needed on
  - self assessment
  - team training
  - quality assurance.

- Maintenance training, on-job training to be precise, was taken up for detailed examination. Examples below typified findings of human knowledge, skills and attitudes deficiencies.
  - inattention of maintainers causing inappropriate actions of sudden ground faults, lifting leads, left-open drain valves, left closed guard valves, etc., was all found due to lack of knowledge of importance of the job on hand
  - poor workmanship due to haste on pump seals replacement or flange gaskets was due to lack of verification checks
  - untrained maintainers did overgrazing due to lack of supervision causing burn-out of motors.

Only in cases of new technologies adopted in new nuclear power plants did certain personnel show inadequate technical skills acquired through training.

5.10.1.4. Training system improvements — 1990s

The following outlines the initiatives and decisions taken to bring in needed improvements.

- All training packages would incorporate tailored team training, root cause analysis and quality orientation.

- Continuing training would include periodic reviews of all significant events by licensed staff and bring out specific data on human deficiencies. These provide continuously organizational diagnostic data too.

- Maintenance personnel in recently commissioned nuclear power plants/new units would undergo only SAT based qualification programme. A beginning for one of the nuclear power plants is already made and the system has been described here later Mock-up training equipment is being built in new units

- PC based trainers for complex I&C systems such as, micro-processor based controllers would be made available during commissioning of new units This has been developed in house.

- As on-power refueling system simulator would be built in-house to train and license refueling as well as main plant personnel.

- Full scope simulator training including LOCA training being now mandatory, would be made available in-house and well before criticality of new units The lesson plans for them would include not only technical skills building, but also human factors such as team work, communication and supervision cases

- An integrated corporate organization for HRD and training was built which paved way for implementation and control of staffing, training and career planning from one standpoint

- Top management reviews and issues directives in monthly meetings for developing, implementing and evaluating SAT based training activities, which provided continuous impetus to trainers and line managers on SAT

5.10.2. Role of regulators

The training and qualification systems are developed in Indian nuclear power plants with continuous communication and concurrence of the regulators. Regulators audit periodically all licensing practices, oversee staffing and training activities and conduct expert reviews of training and qualification. In particular, regulators participate in licensing assessment interviews and have key role in such decision making. Regulators also approve or advise on administrative procedures followed for licensing A set of codes and guides on the subject are also being published shortly. SAT, however, is not yet a regulatory requirement.

5.10.3. Experience gained through introduction and use of SAT

During our efforts to introduce SAT, we learnt several lessons Some of these are:

- There are mental barriers to provide data on root causes on human deficiencies. We solved this by using massive training workshops as producers of fast and reliable sources of data for "needs analysis". Training setting provides a conducive, objective climate for free and frank examination not otherwise easy to do

- Root cause analysis (RCA) provided a powerful tool and culture to separate human deficiencies from other equipment or procedural defects, as also solutions that are best served by training improvements. Unless thinking is root cause, training improvements might only add more training burden Without this tool of RCA, training needs analysis would not be effective

- Training department personnel are to be developed and motivated as owners of SAT based programme. They will get specialized on SAT and as SAT based training design is expressed in the language of plant managers, they give ready acceptance and value-addition to trainers efforts in this direction

- However, massive training to SAT facilitators and selected line managers are necessary for speedy implementation and acceptance. Lot of resistance or indifference, initially, came only due to ignorance about SAT.

- Government of India has a scheme for developing trainers on design of training: on SAT principles. We found this programme as very effective for training SAT facilitators, who could extend the methodology even to administration, finance and materials management personnel, besides in core areas.

- SAT based training materials are very demanding in terms of time, efforts and skills and require considerable planning. Unless materials are available, no trainer can discharge trainer duties on SAT lines and SAT implementation would suffer.

- Training setting for certain on-job training on operation & maintenance were very effective in manufacturers works or R&D test loops or during construction. However, this limited breadth of trainees/candidate knowledge and skills and shift charge engineers did not get enough training time to master other areas. This increased licensing time.
- Licensed operation engineers were found best trainers as subject matter experts (for SAT methodology) on process systems. However, for I&C and electrical systems, maintenance qualified engineers are best resource persons.

- Continuing training must be designed using finding of all root cause analyses and for this retraining course members are best trained as resource persons to analyse, develop and implement training.

- A central agency to continuously analyse all incidents for human factor analysis is a must for developing and upgrading training packages on SAT lines. This is the best evaluation of training, using root cause analysis.

5.10.4. How SAT based training programmes are maintained

The trainers, along with corporate head quarters, have been assigned major role to support line managers in implementing SAT based programmes. The logistics such as data bases of competencies are being jointly developed by trainers and line managers. Trainers have been trained to facilitate maintenance of SAT based programmes and will carry out this duty as we make more progress in this direction.

5.11. KAZAKHSTAN

In Kazakhstan there is no special training organization to provide training to nuclear power plant personnel. There is no training centre in Kazakhstan. The Kazakhstan Atomic Energy Agency supervises all activities of MAEC, the BN-350 unit (fast neutron sodium-cooled reactor) situated at Mangyshlak nuclear power plant. The Atomic Energy Agency checks existing programmes, as well as the frequency and quality of training. It receives regular reports from MAEC which describe all aspects of personnel training, including problems encountered.

The chief engineer at MAEC is responsible for the training and retraining of nuclear power plant personnel.

SAT is used for the training of field operators, chemistry and radiation protection technicians. The training for other jobs involves learning safety rules, instructions and specifications. Training programmes are oriented to people with a high level of education.

The training of the operating personnel includes the following stages:

- Basic education
- Checking suitability for a job (aptitude tests, medical examination)
- Self-study (learning of technical documentation and details concerning the specific plant)
- Examination on each type of equipment
- Final examination (process technology, emergency measures, etc.)
- On-the-job training
- Independent work.

As the BN-350 reactor will not be in operation beyond 2003, a simulator for this reactor type will not be built. A new PWR is planned, for which a technical and financial assessment is now being made. A simulator will be built for this nuclear power plant.

5.12. REPUBLIC OF KOREA

5.12.1. Training programmes

5 12 1 1. Korea Electric Power Corporation (KEPCO)'s training and qualification of nuclear power plant personnel

The plant manager ensures that the plant operations are conducted in conformance with regulatory requirements and internal policies Particularly, the plant manager has the primary responsibility for general personnel affairs such as staffing and training as well as maintaining employee qualification according to the qualification and training requirements of nuclear power plant personnel.

All kinds of training activities such as the responsibility of training, training methods and procedures as well as the training evaluation are described in the Qualification and Training Requirements of Nuclear Power Plant Personnel (Technical Procedure No.-48). This contains the major contents of the qualification and training requirements, which are basically divided into three technical levels (level I, level II, level III) according to plant job classification.

5 12 1 2 KEPCO's training programme

The KEPCO's in-house training programme consists of an initial training programme for new employees and continuous training programmes for nuclear power plant personnel. Every new KEPCO employee undergoes an initial training for 39 weeks, which is divided into 6 phases including two 8-week on-the-job training phases at the plant site. After finishing the initial training programme, all employees who are assigned to a specific department of the plant have continuous training, including on-the-job training, for 2–4 weeks according to their technical and managerial level, which is described in the internal qualification and training requirements for nuclear power plant personnel.

1.5 12.1.3. Korea Power Plant Service Company (KPS)

KPS is a subsidiary company of KEPCO and is in charge of the maintenance service of power plants. KPS's maintenance works, together with other subcontractor's work, are properly supervised under the KEPCO's maintenance guidelines and procedures. The KPS's in-house training programmes are also divided into two parts The first is the initial training programme, which consists of classroom training for 2–6 weeks and on-the-job training for 6–32 weeks according to the job classification. The other part is a continuous training programme which consists of both off-the-job training and on-the-job training. After a job assignment to a plant site, all employees complete training programmes to meet internal qualification requirements. There are 41 types of qualification for nuclear power plant maintenance personnel. Qualification is divided into two or three technical levels.

2.5.12.1.4. Role of regulator

There are the SAT-related statements concerning nuclear power plant personnel training and qualification in the Atomic Energy Act, and its Enforcement Decree and Enforcement Regulation as a regulatory recommendation to the utility states that the "utility should have training programmes for nuclear power plant personnel and these training programmes should be maintained and implemented systematically". This statement is based on the qualification and training requirements of a final safety analysis reports of nuclear power plants.

5.12.2. Introduction and use of SAT

5.12.2.1. General description of type of SAT methodology used

The KNTC adopted the following principles : establishment of training system, development of an optimum training programme, improvement of the training environment, reinforcement of the plant support system. The KNTC/KEPCO has implemented its procedures for the development of a training programme which are similar to the SAT methodology recommended by INPO from the late 1980s. In order to improve and develop its training programmes continuously, the KNTC has maintained the training work procedures as follows;

- Procedures for a training plan associated with a long-term nuclear training plan and an annual training plan
- Procedure for training programme development associated with job analysis and training need analysis, programme design and development, training implementation, review and evaluation of training results, adjustment of short/mid-term plan, and systematic feedback
- Procedure for the improvement of instructor capability, associated instructor training and qualification, and the selection of part-time instructors
- Procedure for text and training material development
- Procedure for training result evaluation.

The above mentioned procedures have a similar logic to the SAT methodology recommended by the IAEA. The following of the INPO's SAT-related guidelines were modified and simplified in accordance with KNTC conditions when the KNTC developed these procedures at the end of 1980s.

- Training system development model overview (ACAD 84-032)
- The training principles of training system development manual (ACAD 88-002)

  Addendum I : Test item development

  Addendum II : Examination, design, development, and implementation

  Addendum III : Evaluation instrument examples

  Addendum IV : Learning objectives

  Accredition of training in nuclear power industry (INPO 85-002)

- Qualification and training of nuclear maintenance personnel (INPO 85-038)
- Other INPO's guidelines for SAT-related methodology

The training activities, such as the responsibility for the training, training methods and guidelines, are described in the KEPCO's Procedure for Qualification and Training Requirements of Nuclear Power Plant Personnel (Technical Procedures No -48) The Technical Procedure No -48 contains its objectives and scope, reference documents, definitions and responsibilities, and guidelines for nuclear power plant personnel training and qualification

5 12 2 2 Specific position for which SAT based training is provided

The KNTC's SAT-related procedures were modified in accordance with requirement of the KNTC and applied to their training programmes for all positions of nuclear power plants such as plant shift supervisor, control room supervisor, control room operator, field operator, technicians for mechanical and electrical maintenance, I&C, QA/QC, radiation protection, chemistry and instructors

5 12 2 3 Experience gained through the introduction and use of SAT

The training needs identify the trainee's job, the related tasks and competencies for which training is required, and the contents of the training programme The KNTC makes a training needs survey with plants managers and plant departments managers, instructors and meets to evaluate the survey with associated members before the training course implementation In accordance with INPO recommendations, the KEPCO has updated its procedures and guidelines for nuclear power plant personnel training and qualification since the end of 1980s

Training work procedures which were developed and updated under the basis of SAT methodology consist of three kinds of procedures those for training plans, training development, and simulator operation and maintenance

5.12.3. Reference documents

ANSI/ANS-3 1-1987, Selection, qualification and training of personnel for nuclear power plants
10 CFR 50 120, 1993, Training and qualification of nuclear power plant personnel
USNRC Regulatory Guide 1 8 1987, Qualification and training of personnel for nuclear power plants
ANSI/ANS-3 5-1985, Nuclear power plant simulator for use in operator training
INPO 85-002, The accreditation of training in the nuclear power industry
INPO 85-038, Qualification and training of nuclear maintenance personnel
KEPCO TP-48, Qualification and training requirements of nuclear power plant personnel
KPS's Technical procedure of qualification and training requirements of nuclear power plant maintenance personnel
INPO, ACAD 84-032, Training system development model overview
INPO, ACAD 88-002, The training principles of training system development manual

5 13 LITHUANIA

5.13.1. Status of the Ignalina nuclear power plant training and qualification system

The plant consists of two Russian-built RBMK-1500 units, water cooled, graphite moderated, channel type reactors The reactors are the largest power reactors in the world with a nominal power capacity of 1500 MW(e) each The units were commissioned in 1983 and 1987 For safety reasons they both run at a reduced capacity of 1250 MW(e). The Ignalina nuclear power plant is the only nuclear power plant in Lithuania It is situated about 150 km northeast of Vilnius close to the Latvian and Belorusian borders There are 7-shift cycles.

Ignalina nuclear power plant today has about 5000 employees. Most of the plant management, control room operators, maintenance engineers and other specialists are former Soviet Union citizens with Russian mother tongue

Of the 5000 employees, about 3400 perform safety-related duties Annual turnover is less then 2 % The breakdown of staff is approximately as follows:

- Main control room (MCR) operators — 95
- Shift engineering support staff — 144
- *Shift local operators — 680*
- Middle level management and supervisors (department heads, their deputies) — 45
- Maintenance supervisors, engineering and technical support staff — 286
- Repair and maintenance workers — 1700
- Training staff — 18

Plant evaluation of the incidents showed that for 91 events and incidents, six were related to personnel performance deficiencies, including two events related to reactor department personnel, and four to MCR operators Generally speaking, the need for continuing training is much greater than for initial training

5.13.2. Training organization and training programmes

There is a training centre at Ignalina nuclear power plant. Since 1996, the training centre has been licensed by a special Committee on Social Affairs where the Nuclear Regulatory Body (VATESI) is represented as well. VATESI conducts the audits of training centre In addition, the training centre has to have a license issued by the industrial safety regulatory body (this is a license to train personnel to perform duties and tasks associated with plant equipment that is not under regulations of National Nuclear Regulatory Body)

Currently, there are 14 full-time employees working at the training centre. In 1996, new staffing was approved for the training centre, which has increased its staff to 49 people, including 18 instructors

New operating and engineering support staff are educated mostly in Kaunas/Lithuania Technical University and in Obninsk/Russia Institute for Nuclear Energy.

The training centre conducts both initial and continuing training, and some training is provided by external organizations It delivers practically all training for the operating and engineering support personnel, and approximately 90% of the training for maintenance personnel Current training programmes tend to be of the traditional/conventional type, and not SAT based, although many performance based and systematic features can be found.

Duration of annual continuing training for operating personnel is two weeks.

There are some specific training courses dealing with plant systems, new technologies, and preparation for independent work

Globally, about three thousand employees take part in training courses in a 5-year cycle to receive a permission/license to perform specific plant jobs and duties. Training to acquire a second profession is provided as well but mostly for workers. Supervisors and management staff are now receiving supervisory training (2-year cycle conducted by Swedish specialists). Many Ignalina nuclear power plant specialists are trained in foreign countries, on average 30–40 annually.

5.13.3. Ongoing training-related projects

The following main projects are ongoing

- Development of analytical and full-scope simulators.
- Maintenance personnel training development — within a bilateral initiative with the USA (delivery and implementation of new maintenance technologies, training, upgrading of maintenance training infrastructure, i.e. computers, office equipment, CBT software for maintenance personnel).
- Supervisory and management training (mostly managerial skills and a part of soft skills), supported by Sweden.
- Refresher training in Obninsk City/Russian Federation, mostly MCR operators and I&C personnel
- Metal inspection specialists' training (in Moscow and St Petersburg in the Russian Federation)
- Measurement inspectors' training (in Russian Federation).
- Training of the specialists responsible for testing and putting systems and equipment into operation (in Kiev, Ukraine).
- Training of instructors on topics dealing with job performance with very strict industrial safety observations (in Russian Federation).
- Continuing training of electrical department and I&C department personnel (in St. Petersburg, Russian Federation).
- IAEA technical co-operation project on "Systematic Approach to Training (SAT) for NPP Personnel".

5.13.4. Regulatory approach and licensing

Before 1993 the former Soviet Union documents and regulations on training were in use. In 1993 the Lithuanian national documents were issued, namely the Law on Nuclear Safety, the Training Regulations, and the Temporary Regulations for Licensing. Later the Requirements for personnel training and qualification were developed and issued as well.

Formally, the National Nuclear Regulatory Body (VATESI) does not require SAT use in training. But VATESI regulates plant quality assurance programme development, where SAT is recommended for personnel training.

5.14 MEXICO

At present at the Laguna Verde nuclear power plant the training and qualification priorities are:

- Maintaining personnel qualification

- Application of the SAT
- Introducing nuclear power plant personnel to the safety culture philosophy.

5.14.1. Maintaining personnel qualification

To maintain the qualification of the Laguna Verde personnel, the training centre has a qualification programme for the following groups: licensed operators, non-licensed operators, mechanical maintenance, electrical maintenance, i&c, health physics, quality control, chemistry, and engineering support.

Simulators and mockups are used in the programmes to maintain personnel qualification. There is a unit one full-scope simulator in use since 1991 for the initial training and retraining of licensed operators. The simulator has also been used for training managers on emergency situations, and for validation of procedures before their implementation in the plant. Once a year the entire crew participates in the emergency simulator scenarios. Some part-task simulators are used for I&C technicians.

Important features of the operations and maintenance training involve the emphasis on human factor related competencies such as: human relations, communication, team work, management and supervisory skills, root cause analysis techniques and maintenance good practices.

It is important to note the positive impact in training effectiveness when the management of a department increased its ownership of their training programmes.

5.14.2. Application of the SAT

At Laguna Verde the application of SAT methodology for training is underway.

For the analysis step, the method selected is a combination of the job and task analysis (JTA) and the job competencies analysis (JCA). The departure point is the revision of the job orders executed in the plant. There are approximately 86 000 job order for analysis; the standards were set by training and the revision is made by a contractor. On the first step started in September 1996 and completed in early 1997, 40 000 job orders were selected.

The outputs expected from the analysis of the work orders are:

- The tasks which are more frequently executed
- The competencies required to perform these tasks.

The documented work orders will allow identification of the person who performed the task and consequently the competencies the personnel already have and do not need training on, as well as identification of the competencies that require training. On this basis, the SAT process will be used to produce training objectives.

The person who, according to the work executed, has certain specific competencies, will be interviewed by his/her supervisor to confirm the knowledge required for that competency; if that person has this knowledge, he/she will be certified on that specific competence. In addition, as of mid-1996, for important and/or critical activities, an on-field verification is made and documented, those responsible for the verification being an instructor and the worker's supervisor.

In the case where the person does not have the knowledge or skill needed, then a training objective is developed, to be able to certify the person in that task.

In parallel, the maintenance training programmes as of 1996 were designed using SAT. The whole process is expected to be completed in three years The source of the definition of training objectives was a self-assessment made by the maintenance and training departments on the performance of the maintenance department personnel since 1993.

Some of the outputs of this self-assessment were.

- The equipment failures which are frequently experienced.
- The type of work orders more frequently executed
- The amount and type of reworks which are frequently done
- Concerning all of the above, those which were caused by human error, lack of training and/or inadequate design

In the short time since introducing SAT based training for maintenance personnel, the following advantages have been found

- Training has been given on realistic needs for day-to-day activities.
- An increase in training attendance has been noted, which means that personnel find the training is useful

In connection with maintenance personnel training, the following is pointed out:

- In some cases a shortening of the unavailability time of a component or system has been observed. Unavailability was longer as in the past due to the lack of certain specific knowledge which was not covered in training
- A reduction in time necessary to do the job, and on reworks has also been observed

5.14.3. Role of the Mexican regulatory body with respect to the training, qualification and competence of nuclear power plant personnel

The Mexican regulatory body, Comisión Nacional de Seguridad Nuclear y Salvaguardias (CNSNS) has a department in charge of operations verification One branch of this department has the responsibility for training certification At this branch they are organized to verify:

- Licensed personnel
- Non-licensed personnel
- Requalification programmes

The regulatory body in 1995 required Laguna Verde to implement SAT methodology for the training of maintenance personnel (mechanical, electrical and I&C). They certify and review the training according to the US regulations stated in 10 CFR 50.55, Regulatory Guide 1.8 and ANSI/ANS 3 1-1993

The cost of application of SAT at Laguna Verde for the positions required by the regulatory body is expected to be on the order of one million US dollars, or about 0 66% of the overall operating budget

5.15 ROMANIA

5.15.1. General description of SAT methodology used at Cernavoda nuclear power plant

Cernavoda nuclear power plant (Cernavoda) is a second generation design of the basic CANDU reactor plant. Today, several similar CANDU 600 plants are in operation worldwide.

For Cernavoda the training concept is based mainly on the training systems established in other CANDU utilities. This allow an easy integration of the off-shore training opportunities with the domestic programme

The SAT methodology was part of the know-how transfer under the Canadian–Romanian contract. Starting in 1993, the basis of the training functions was put in place, and started with two reference documents: "Station Training Plan" and "SAT" From these two station policy documents the whole procedural framework for training at Cernavoda was derived

General international guidance that has been developed and published by the IAEA, was also used in establishing the Cernavoda training concept

5.15.2. Role of the regulator

The National Commission for Nuclear Activities Control (CNCAN) is the governmental regulatory body, responsible for full surveillance and control in all areas relevant to nuclear safety and environmental protection in siting, construction, commissioning and operations of nuclear plants, research reactors and other nuclear facilities in Romania.

With respect to nuclear power plant personnel training, CNCAN issue licenses for shift supervisors, control room operators and managers

Although use of SAT is not a formal requirement, it is strongly recommended Through regular evaluations of training programmes, CNCAN assess the level of compliance by the utility with their own procedural framework which reflects SAT

5.15.3. Experience gained through the introduction and use of SAT

5 15 3 1 Use of the existing CANDU experience

As per the station policy SAT, on the recommendation of the training manager, the station manager may approve exceptions to the strict application of SAT principles, e.g in the case of standard courses based on analysis, design and development done at other CANDU stations

This type of analysis heavily relies on the results from the analysis of the job functions associated with operation and maintenance from earlier and existing CANDU operations.

A second step to this type of analysis involves the adaptation and translation of the very significant volume of training programmes, training materials (training specifications, objectives, lesson plans, course notes and presentation materials and test items), in order to meet the specific Cernavoda requirements

5 15 3 2 Job related training requirements (JRTRs)

This type of analysis relies on the production of the JRTRs. These are an identification of the training and development programmes (i e. formal courses and on-the-job skills training) required for each job classification within the station work groups

The main work groups are

(1) Operations (shift supervisor, control room operator, senior field operator, nuclear operator, assistant nuclear operator)

(2) Maintenance (mechanical, electrical, I&C, general services)
(3) Fuel handling (operation/maintenance/technical support)
(4) Chemistry
(5) Technical unit (system engineer, engineering support)
(6) Health and safety (radiation protection, industrial safety)
(7) General services (administrations, fire fighters, security, etc.)
(8) Management and supervisors

The JRTRs preparation is the responsibility of line supervision in the station, with training department assistance Previous CANDU experience is also used when the generic JRTRs are prepared.

5 15 3.3 Design and development

A very significant volume of existing CANDU training materials is available, and they are, subject to translation, applied to training programmes at Cernavoda.

However, for the new programmes and courses, specific for Cernavoda, the "criterion reference instruction" and "instructional module development" technologies are used.

Classroom training is well organized and documented.

Simulator training is used in six different ways

- Initial training for licensed staff
- Examination by regulatory body
- Refresher training
- Requalification
- Team training
- Non-licensed control room staff training.

For each of these six aims different training packages are developed The development process has just started, and for each of the six areas there is a different percentage of completion.

5 15 3 4 On-the-job training

Specially trained people work as training co-ordinators in each of station departments. They are trained on a regular basis at the training centre, on SAT, principles of adult learning, etc. An attempt to provide more consistency for OJT training is ongoing, by publishing a station procedure.

5 15 3 5 Implementation

The procedural framework is in place for the implementation phase. Implementation activities have been identified and the station training plan has been prepared. OJT has to be implemented on a more consistent basis

5 15 3 6 Evaluation

All training courses done at the training centre or in the station are evaluated using the opinions of the trainee At Cernavoda this type of feedback is considered as being part of implementation phase.

Continuous feedback from plant supervisors is collected through regular meetings between training department supervisors and station supervisors. Also the feedback is collected from training co-ordinators, from each work group.

Formal procedures are in place to integrate operational experience feedback (internal in the station — unplanned event reports, and external — COG and WANO). Prompt informal feedback is given from training department to station departments regarding the potential need for changes in procedures, design, etc. There are also procedures in place to link the changes in the station (procedures, equipment, etc.) with the training packages.

5.15.3.7. How are SAT based training programmes maintained

1. All training activities, having a unique identification, are recorded in a centralized database (central training records database — CTR). To date, CTR has 65 000 records, with an average of 500 records processed per day (new or updates).

2. From the CTR, using the JRTRs a training qualification index (TQI) indicator is derived (individual, department, station):

$$\mathbf{TQI} = \frac{\textbf{Number of courses/skills done}}{\textbf{Number of courses/skills to do}} \quad [\%]$$

1. Each course or skill has an unique identification number
2. All changes in the training packages are formally approved
3. A computer database links training documents with the originating sources
4. All JRTRs are maintained in CTR, linked with each individual, through the job position JRTR unique number
5. The IAEA "Nuclear Power Plant Personnel Training and its Evaluation" software version is on the Cernavoda network
6. An internal project started to ensure compliance with the criteria stated in IAEA "Nuclear Power Plant Personnel Training and its Evaluation"

5.15.4. Responsibilities

The training responsibilities of line management at Cernavoda are to:

- Ensure that training and qualification requirements for their staff are identified, documented and requisite training is given
- Identify all training and qualification requirements leading to the preparation of JRTRs for their staff
- Implement a practical on-the-job skills training programme for these tasks and skills which can be best taught in a field training environment
- Ensure that staff are qualified to perform assigned work

- Define a work environment which supports the knowledge, skills and attitudes gained through training.

The responsibilities of the training department at Cernavoda are to

- Help line management fulfil their responsibilities
- Help line management to establish training and qualification requirements, through revision of JRTRs
- Ensure a systematic approach to the development of the training programmes necessary to support the JRTRs
- Co-ordinate the training given to station staff by other station work groups and/or outside organizations
- Evaluate training effectiveness and provide regular reports to line management
- Operate the Cernavoda Nuclear Training Centre (CNTC) located in the vicinity of the plant

5.16. RUSSIAN FEDERATION

5.16.1. General description of SAT methodology used

- SAT is being implemented or planned to be introduced at all Russian nuclear power plants.
- SAT methodology used fully corresponds to the IAEA recommendations and uses the experience of the countries and utilities which have implemented SAT on a large scale and in a relatively cost-effective way.
- SAT technologies being used or being implemented at Russian nuclear power plants cover all necessary phases and steps to ensure reliable training based on:
  - clear measurable job requirements,
  - explicit training objectives, and objectives-driven knowledge and performance test development,
  - use of necessary training materials and tools taking into account resource limits and characteristic features of the national nuclear training system,
  - careful instructor training,
  - constant attention to an obvious aim to really implement training and not be satisfied only with the developmental activities,
  - identification of new training needs, and training evaluation establishment.
- Russian nuclear power plants and nuclear power plant personnel current training system, as all over the world, have their characteristic features, mostly related to national educational system, plant design, plant procedure status, job classifications and total amount of personnel, regulatory approach towards training and qualification, plant business conduct, funds available, and social features. Consequently, SAT models and technologies used as samples at the beginning of SAT implementation in Russian Federation went through a long evolution, considerable developmental and customization process. Plant personnel and local developers, as well as overseas consultants have been involved and have contributed greatly to the establishment of SAT technologies which are intended to provide reliable and cost-effective training.
- SAT implementation status at Russian nuclear power plants corresponds to Government and operating organization training policies, as well as to plant management commitment. SAT is viewed not as an ultimate goal, but as a tool to enhance nuclear safety, to provide quality assurance for training, and to meet international standards and recommendations.

- There have been various sources for SAT or performance based training (PBT) implementation at Russian nuclear power plants, e.g. National fundamental research and experience in personnel training system development, local experience from nuclear industry and the military field, previous plant experience, international initiatives and mechanisms (the IAEA, Soviet Design Reactor Safety Programme — former Lisbon Initiative, CEC TACIS projects, G-24, WANO), bilateral initiatives, and the projects initiated by the plants themselves with the support of Russian and overseas companies. Specialists from various countries, Belgium, Canada, Germany, France, Japan, Spain, the UK, the USA participated in training-related projects. The variety of SAT models explored have played a positive role on providing the opportunities to extract something better, and challenges to co-ordinate training development. But it is considered as normal process of national nuclear training further development Russian Ministry for Atomic Energy co-ordinates training-related activities and projects. ROSENERGOATOM has a primary responsibility to co-ordinate SAT implementation at Russian nuclear power plants (eight nuclear power plants belong to the ROSENERGOATOM concern, and Leningrad nuclear power plant is a separate operating organization), and at centralized training centres (tcs) (i.e. Novovoronezh and Smolensk TCs).
- Up to now three enterprises have had the largest hands-on experience in SAT introduction for nuclear power plant personnel training, Novovoronezh TC, Balakovo nuclear power plant, and Kursk nuclear power plant. The SAT projects are implemented with the direct involvement and large support of Russian companies, such as ATOMTECHENERGO, VNIIAES, ENIKO MIFI, and some others
- SAT is implemented for practically all plant job classifications. operations, maintenance personnel, engineering technical support personnel, supervisors and management, and training staff. Further contractors' personnel have to be included in the range of SAT based training and qualification processes.
- More attention will be paid to use of SAT in senior and top management training and qualification

5.16.2. Examples of SAT project implementation

5.16.2.1. Balakovo nuclear power plant

SAT introduction at Balakovo started in 1993. The first steps in SAT were made within the contract with S3 Technologies/USA and VNIIAES. Then a large-scope SAT implementation project was launched in the framework of the former Lisbon Initiative (now Soviet Design Reactor Safety Programme) This project includes SAT implementation for 12 training programmes (both initial and continuing):

- unit shift supervisor
- turbine field operator
- reactor field operator
- senior duty electrical technician
- I&C shift supervisor
- shift chemistry technician
- reactor mechanical maintenance technician
- rotating mechanism mechanical maintenance technician
- electrical maintenance technician
- I&C maintenance technician
- HP shift supervisor
- fire inspector

The current status (as of March 1997) of these 12 SAT based training programmes is as follows. On average, 50% of developmental and implementation work is done, resulting in pilot courses conduct. Now three more SAT based training programmes' development have been initiated at the plant, reactor control system maintenance technician, refueling machine maintenance technician, and MCR turbine operator.

Six more general purpose training courses have been implemented:

- SAT methodology
- Safety culture
- Industrial safety
- Instructor training course, including classroom training development and conduct, on-the-job training development and conduct, full-scope simulator instructor training course
- Administrative procedures development
- Supervisor training course

Within the project, plant and training organizational structures were modified, necessary administrative and development documents were elaborated and implemented, and training infrastructure was upgraded.

All project activities are supported by the US specialists of Sonalysts, Inc., a company subcontracted by the US Brookhaven Laboratory. The DOE/USA co-ordinates project implementation from the US side Sonalysts' experts are directly involved in all project activities, coaching, facilitating project team, and providing sample materials, as well as providing consulting services. Balakovo nuclear power plant project team members, including the instructors, are now practically ready for independent work to further develop the plant training system. One of the most important achievements of project implementation resulted in the co-ordination of Balakovo nuclear power plant policies in the fields of safety and training.

5 16.2 2 Kursk nuclear power plant

Exitech International Corporation/USA and Joint-Stock Company ENIKO MIFI/Russian Federation now are upgrading the Kursk nuclear power plant training system, based on SAT Exitech and ENIKO MIFI are directly involved in all on-site development, coaching, and project management activities. The project was initiated in December 1994, and should be completed in 1997.

SAT training programmes are being developed for:

- Instructor
- Supervisory personnel
- Plant shift supervisor (all technical operation job positions are for the second stage of Kursk nuclear power plant)
- MCR reactor operator
- Turbine department shift supervisor
- Reactor equipment maintenance supervisor
- Unit shift supervisor
- MCR senior unit operator (BOP)
- MCR turbine operator
- Electrical department shift supervisor
- New cost-effective approach to and training programmes for all plant maintenance personnel
- MCR personnel team-work training programme.

This Kursk nuclear power plant project is complex and is contributing not only to training, but also to procedure upgrades, safety culture enhancement, nuclear power plant organizational structure optimization, HPES implementation, job position description upgrades, etc.

One of the most important achievements is a new vision and commitment of plant and line management towards training ownership.

5.16.2.3. Novovoronezh TC

SAT introduction at Novovoronezh TC (NVTC) had started in 1991 in the framework of former USSR/USA-DOE Initiative (WWER-440 Design Reactor Safety Enhancement Programme). This project included the development of special SAT based continuing training on symptom based emergency procedures. This training was delivered to Novovoronezh nuclear power plant MCR crews.

Large-scope SAT implementation at NVTC began in 1993 for training programmes (both initial and continuing) as shown in Table II

TABLE II. SAT BASED PROGRAMMES AT NVTC.

(A) Training for WWER-1000	(B) Training for WWER-440
1. Unit shift supervisor	1. Unit shift supervisor
2. Turbine field operator	2. MCR turbine operator
3. Reactor field operator	3. MCR reactor operator
4. MCR reactor operator	
5. MCR turbine operator	
6. Reactor core engineer	
7. Reactor mechanical maintenance technician	
8. Rotating mechanism mechanical maintenance technician	
9. Electrical maintenance technician	
10. I&C maintenance technician	
11. QA engineer	
12. Surveillance & testing engineer	
13. Line managers training	

Current status (as of March 1997) of these SAT based training programmes is as follows. On the average 80% of implementation work is done for WWER-1000, 40% of development and implementation work is done for WWER-440. Now some more SAT based training programmes' development are initiated at TC.

Four more general purpose training courses are being implemented:

- Introduction to SAT
- Industrial Safety and Radiation Protection
- Instructor training course
- Supervisory training course.

Six special safety courses (for MCR crews and nuclear power plant managers) as well as instructor training are being implemented now.

Within the projects, the TC organizational structure was modified, overall TC infrastructure was upgraded, new training tools were installed, including simulators, CBT complex, and tools for maintenance personnel training

Resources for SAT implementation include local Russian ones, TACIS-91 projects, ROSENERGOATOM/EDF (France) Cooperation Programme, Russian/Japan Cooperation Programme, and others NVTC had a chance to compare different SAT models in practice Now a transformation of the training being delivered to nuclear power plant personnel at the NVTC to SAT based training is close to completion

5.16.3. Experience gained through the introduction and use of SAT

5 16 3 1 Visible benefits

- It is too soon to say that newly implemented SAT based training programmes have greatly increased personnel qualification or competence, and plant performance records But what might be stated is that new SAT based training is positively viewed by plant management, by the trainees and trainers

- SAT introduction visibly and positively influenced plant management, QA/QC processes, procedure modifications, organizational structures upgrade
- Features of training staff and plant personnel involved in SAT project such as teamwork, competence, attitudes, communication skills (and other soft skills) were significantly developed
- SAT activities such as training needs analysis, evaluation, have activated and upgraded plant personnel understanding in root cause analysis, human performance evaluation techniques, etc
- Overall training infrastructure was upgraded, and now it more effectively supports training conduct and development
- Cost-effectiveness of training methodology and tools is acknowledged by plant and training managers
- Expensive training tools (such as full-scope simulators) are becoming real training tools through performance based and consistent training material development

5 16 3 2 Implementation problems

- Lack of funds influenced many projects, the understanding of a need for careful resource planning was not from the very beginning
- In some cases the analysis phase was cost-ineffective In other projects a more effective analysis approach was in use
- In some cases the initial set of SAT procedures was absent In other projects the sequence of project activities was planned more carefully
- Instructor competency was a challenge for training system development Many opportunities were explored and many efforts taken to achieve instructor competency These included instructor job design and analysis, instructor training programme development (using SAT methodology), conduct of various training courses (at training departments and in foreign countries), visits and fellowships to overseas training centres and companies, instructor involvement in SAT project teams, pilot courses conduct with video recording, etc To co-ordinate instructor training activities we decided to establish the so-called instructor school at Novovoronezh Training Centre

- Instructors and plant personnel involved in training material development but had no writers' experience. Training on this matter was conducted, but time was needed to fix this problem

- QA for training, and for project conduct as well, had been not practically implemented at nuclear power plants and in training centres in the past. SAT projects where QA development was focused brought many positive advantages to the conduct of plant business.

- Local project managers or group leaders assigned by their managers did not have enough knowledge, skills, and attitudes to perform their new duties. The development of these managerial competencies became one of the aims of SAT projects.

- In some cases the quality of project and training material was rather low. It dictated necessary upgrade of project and training infrastructure, as well as special training activities. In other projects, when training system needs analysis was performed carefully, that problem was fixed from the very beginning But this challenge is still present, as the project budget is restricted, the plants sometimes not had enough resources for maintaining training infrastructure.

- A big problem was to modify plant and training departments' organizational structures in order to develop training systems and to support SAT implementation. Within comprehensive projects (e.g. Balakovo and Kursk nuclear power plants, NVTC) this problem was successfully resolved.

- Regulatory base does not strictly require the use of SAT. But, in principle, this is not so significant It is more important to have clear regulatory requirements that lead to reliable training and qualification of nuclear power plant personnel. Necessary regulatory developments in this connection are going on.

- Co-ordination of and co-operation between SAT projects needs more attention, and sharing of the results obtained should be very useful. An effective mechanism should be created for this purpose, as some projects have the nature of technical support and are funded by other countries or communities, others are performed on a contractual basis, and many activities are .performed by the plants themselves. The need for co-operation of the plants, operating organizations, and organizations providing training services should naturally result from the nuclear regulatory body requirements for nuclear power plant personnel training and qualification, an effective information exchange, and management understanding of significantly high costs of SAT introduction.

5.16 3 3 Support and involvement of management

Some SAT projects received management support, others not.

To obtain real management support at the plant level the following activities were actually performed:

- Conduct SAT seminar for management

- Demonstrate to them in overseas training centres how SAT works, what are direct and indirect benefits of SAT implementation.

- Involve plant management directly in needs analysis, evaluation, resource planning, and training review committees activities.

- Involve plant management in development of some supervisory courses, to understand SAT better.

- Provide to plant management inputs from training development, and from procedure and other plant documentation upgrading.

- Provide an opportunity for plant management to show to the international community and to national organizations their training ownership and achievements.

5.16.3.4 Use of previous training capabilities

Use of training materials and tools developed earlier depends upon their quality and content. Computer training tools, e.g. simulators and CBT systems, are in use in SAT based training programmes, but sometimes need additional or new training materials. As for training materials, it is not unusual, with table-top analysis, that training objectives and tests are developed and incorporated into old training programme, and it appears that this is sometimes cost-effective.

5.16.3.5. Assessment of trainee performance

Concerning job-related performance, objective assessment of trainees needs further development and improvement. But the basis absolutely exists. The problem is a lack of training tools, laboratories, and workshops for the OJT now. Testing of knowledge and cognitive task performance is conducted on high level, but sometimes not so performance based as needed. This is one of the reasons for the implementation and further promotion of SAT projects.

5.16.3.6 Evaluation of training programmes

New training needs are identified. Feedback from trainees, instructors, and plant managers (including line management) is obtained and incorporated. Concerning use of plant performance indicators in training effectiveness evaluation, we consider this problem as an important one but one not resolved for many countries and utilities.

5.16.3 7. SAT based training programmes maintaining

The approaches and the range for maintaining SAT programmes are very large at Russian nuclear power plants and training centres. At the plants and in the organizations where SAT projects have considerable and comprehensive nature, special people are assigned and trained to maintain paper documentation and databases generated from all SAT phases. The training manager or his deputy has the primary responsibility for maintaining materials, as well as for all training QA activities. In modern training centres/departments special software and databases are in use to develop and maintain SAT and other training data and materials. But a configuration management system should be an issue of exclusive management attention, as it provides reliability, quality, and cost-effectiveness of training. SAT gives an excellent technological basis for configuration management.

5.17. SLOVENIA

5.17.1. Development of training procedures

Four years ago, specific training procedures did not exist. As a first step, a selected set of procedures was developed to cover the areas of urgent need. The intention was that the already existing process would be enhanced through a systematic approach. For this reason, procedures for the design, development and implementation phases were written first. A simple procedure was written for the analysis phase Some elements of the evaluation are contained in procedures describing implementation. Some procedures are being developed and others are planned to be developed to cover all phases of SAT. Training system development procedures and their status is shown in Table III.

5.17.2. Training programme development

As an example, a structured programme and guidelines for non-licensed operator on-the-job training was recently developed using a SAT approach. For the group working on the development of this programme, a guideline was written based on SAT A job competences analysis was performed to determine the task groups

The tasks were grouped in the following seven states:

- system startup
- system normal operation
- system shutdown
- system abnormal operation
- startup tests
- surveillance tests
- system tagout

Based on the groups of associated tasks, the knowledge items required to perform specific activities are.

- Purpose, general description and use of the system
- Flow diagrams
- System operating procedure
- Test procedures
- Relations of interconnected systems
- Reasons for alarm states at local panels.

The specific activities are·

- System walk down
- Parameter monitoring and log keeping
- System local controls manipulation
- System line-up establishment
- Communication

5.17.3. Role of the regulator

The Slovenian Nuclear Safety Administration is monitoring plant training activities. The annual training plan which defines the training courses for plant personnel is submitted to the regulatory body for review and approval. During the year, training activities are reported to inspectors through interviews. An annual report on the training completed is submitted to the regulatory body for review. Occasionally, training activities on the simulator are audited.

The activities related to the progress of the full scope simulator project are monitored. It is a regulatory requirement for nuclear power plant Krsko to acquire a full-scope replica simulator

The regulatory body has a special commission of experts which is responsible to conduct periodic examinations for licensed operators The commission proposes the validity period for the operator's license to the regulatory body Licenses are granted based on successful completion of the examination The validity period for the licenses can be from one to four years When the license is granted for the first time, it is valid for one year In subsequent relicensing, it can be granted for up to four years

SAT as such is not a regulatory requirement SAT is considered as a method used to appropriately conduct training in accordance with the requirements set in FSAR (USAR)

TABLE III TRAINING SYSTEM DEVELOPMENT PROCEDURES

PROCEDURES	Planned — PL Preparation — PR Approved — AP
ANALYSIS	
- Training needs identification and analysis	AP
- Job analysis	PR
- Task analysis	PR
DESIGN	
- Job performance measures	AP
- Instructional settings, methods and aids	AP
- Learning objectives	AP
- Test construction	AP
DEVELOPMENT	
- Training materials and aids	AP
- Lesson plan	AP
- Revision of training material	AP
- Training material naming convention	PR
- Course naming convention	PR
IMPLEMENTATION	
- Classroom utilization, lecture conduction and course administration	AP
- Training documentation retention and archiving	AP
- Testing and test documents treatment	AP
- Training waivers	AP
- Course planning and preparation	PR
- On-the-job training	PR
- Training archive organization	PL
EVALUATION	
- Instructor observation	PR
- Training course evaluation	PR
- Training programme evaluation	PL

5.17.4. Experience gained through the introduction and use of SAT

The advantages of SAT at this point are mainly in the implementation of a better defined and structured maintenance cycle for training materials and transparent documentation and, to a certain degree, the evaluation of training programmes. For the future development of training programmes, it is envisaged that SAT will reduce the possibility that important tasks are not covered in training and, on the other hand, the overtraining which is present in some cases.

The biggest problems in the application of SAT are with the conduct of the analysis and evaluation phases, which would require large amount of interdepartmental communication and are too manpower consuming if implemented fully with JTA. Currently, there is no intention to fully implement the analysis phase with complete job and task analysis. A simplified approach is considered, using generic task lists with table-top analysis of applicability.

Trainee assessment during classroom training has been enhanced and is now conducted consistent with established procedures and learning objectives stated in training material. Job performance measures are still not implemented. For the final examination after completion of on-the-job training, job performance measures are planned to be developed.

The evaluation of training programmes is still based mainly on the experience of the instructors and the feedback from trainees and line managers.

5.17.5. How are SAT based training programmes maintained?

The responsibility for the maintenance of the existing training programmes is with the training department As was mentioned, the procedures already developed are being implemented. Now in progress is the revision of all existing training materials consistently with the procedures Human resources for this work are of course limited and the work is conducted in parallel with the normal conduct of training A computerized tracking system was developed to follow training activities. Currently, the database is being filled with historic data available from different training records.

5.18. SLOVAKIA

5.18.1. Introduction

After an accident at the first Czechoslovak nuclear power plant the decision to establish a national training system for nuclear power plant personnel was made. A new training centre was established for this purpose in 1978.

The training needs were defined for various groups of nuclear power plant personnel using table top analysis. On the basis of the defined training needs, training courses were developed. Theoretical parts of the training and simulator training were conducted by the nuclear power plant personnel training centre while on-the-job training was conducted by the nuclear power plant The aims of the sessions as well as the learning objectives for those parts of the training conducted by the nuclear power plant personnel training centre were designed and appropriate training materials developed. Unfortunately only topics for on-the-job training were defined and the aims and learning objectives were defined only for several job positions. To overcome this discrepancy the decision to apply SAT for upgrading existing training programmes was made.

To upgrade existing training programmes a project "Upgrading of nuclear power plant Personnel Training infrastructure" has been prepared To be able to share experience in SAT application with the countries, which have experience in this field Slovakia asked the IAEA to support this effort, on the basis of which an IAEA Technical Co-operation project — Upgrading of nuclear power plant Personnel — was established for the years 1995–1997.

The first job positions for which the SAT methodology should be applied were:

- Turbine operator
- Reactor operator
- Reactor maintenance worker
- Pump maintenance worker.

Later three additional job positions were added

- Radiation protection foreman
- Chemistry foreman
- Electrical maintenance worker.

5.18.2. Description of SAT methodology which is used in Slovakia

In Slovakia the decision was made to use job competencies analyses to define knowledge, skills and attitudes The working groups for the purpose of analyses were created for each job position Each group consisted of two subject matter experts, the line supervisor for the specific job position and one or two analysts.

On the basis of the analyses results the training modules were designed. The aims, prerequisites and training settings were defined for each module. At present, experienced trainers together with subject matter experts are developing trainee's and trainers' manuals, training aids and training tools

The trainee's and trainers' manuals and training aids which have been finished are used in the existing training The training course as a whole will be implemented after the development of all necessary materials, training aids and tools.

The skills which are necessary for maintenance personnel can now be trained only during on-the-job training. To have better training possibilities, a design for the new maintenance training centre is being prepared

5.18.3. Role of regulator

The regulatory body has a large involvement in the nuclear power plant personnel training. There are routine inspections to check performance, compliance with the regulations and training programmes at both the nuclear power plant personnel training centre and the plant. A comprehensive review of existing standards and regulations is being done to verify compliance with current nuclear standards in the field of nuclear power plant personnel training The new standards and new regulations will be developed as demanded in order to strength the quality of trainers, trainees and consequently the training process itself.

5.18.4. Experience gained through the introduction and use of SAT

- It is necessary to have the support for SAT application not just from the nuclear power plant top management but also from the line managers and supervisors for the chosen job positions.

- On the basis of results gained from the analysis and design phases of SAT for turbine and reactor operators it was demonstrated that the existing training programme covers 95 % of required competencies. The main deficiencies are in the field of training for "soft skills". Almost all existing trainee's materials and training aids can be used further with only small modifications.

- Owing to the fact that the various parts of the training are carried out by different companies (nuclear power plant and nuclear power plant personnel training centre) it is necessary to assure consistency of the training. The training committees will be established for this purpose.

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5.18.5. Maintaining of the training programmes

The whole mechanism to assure the maintaining of SAT based training programmes is being developed.

5.19. SPAIN

5.19.1. Description of the methodological process employed in Spain

In 1985 Spain begun using SAT methodology based upon the decision of the Almaraz nuclear power plant organization, a power plant of PWR-W design, 3 loops, to develop the specific design process of the training of its nuclear power plant personnel in the way being done in that time in USA.

The company assigned to accomplish the process was Tecnatom, S.A.[3] and the methodology selected, TSD "Training system development" of INPO, was adapted to the technical and associated — occupational Spanish environment and specifically for Almaraz nuclear power plant (CNA).

Around 1995 the process developed in Almaraz nuclear power plant was considered finished for 23 job positions of this power plant, related to the areas of: licensed operations, operation without license auxiliaries, radiological protection and chemistry and radiochemistry.

The accomplishment of the SAT methodology project developed in Almaraz nuclear power plant gave Tecnatom, S.A., a wide experience in the SAT process, something which permitted it to analyse the application of the TSD process to all areas and organizations related or not to the electrical generation. From all this the redesign of the process was done, elaborating three methodological analysis options that covered all possible situations in which the process could be performed. These three options were designated as: complete, (similar to that known as TSD and applied in Almaraz nuclear power plant (CNA), simplified and correlation.

In order to make a comparison with the analysis methods proposed in the review of the earlier IAEA Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel (IAEA-TECDOC-525), and current IAEA Guidebook on Nuclear Power Plant Personnel Training and its Evaluation (Technical Reports Series No. 380), the correspondence between the methodological analysis options of this guidebook and of Tecnatom can be established, as:

- JTA corresponds to the complete option
- JTA/JCA corresponds to the simplified option

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[3] Tecnatom, S.A. is a company for training, engineering and inspection services for nuclear, thermal and hydro power plants which generate electrical power.

- JCA corresponds to the correlation option.

It should be emphasized that the process developed in the project for application of the SAT methodology at Almaraz nuclear power plant was informally inspected on three occasions by INPO technicians, who issued favorable reports on the results obtained and on the contribution in favor of the basic methodology, TSD

Finally, related to this description of the process carried out in Spain, it is necessary to emphasize that it was continuously being applied in different organizations, obtaining through this experience a flexible view of the methodology At the beginning of each project, the initial selection of the most suitable option, is then adapted to the environment in which the designer works, carrying out in some cases a new separate option from the basic one initially proposed.

In addition to all of the above, the UNESA organization, that supports all the Spanish electric companies, it has accomplished a guide, UNESA CEX-37 "Qualification, Theoretical and Practical Training and Experience for Nuclear Power Plant Personnel", in which it recommended the use of the SAT methodology to define the training plan of job position groups as follows :

- Turbine operator
- Field operator
- Radiological protection monitors
- Chemical analysts
- Instrumentation and control
- Electrical technical personnel
- Mechanical technical personnel
- Intermediate command chiefs.

In fact, this guide uses as references those qualification guides of INPO and the ANSI-3 1/87 which are clearly related to the SAT methodology

5.19.2. The situation of Spanish regulatory organization

The guide of the Spanish regulatory organization, Nuclear Security Council (CSN), related to training of production personnel of nuclear power plants applies only to licensed control room personnel. There are no training guides issued that apply to the rest of the job groups Nevertheless, in the provisional operation permits of nuclear power plants and in the training aspects, it is stated that in the absence of Spanish regulation, the regulations existing in the design country of the power plant, in the Spanish case USA and Germany, are to be applied.

During all the development of the methodological SAT process in Almaraz nuclear power plant, the Spanish CSN has been kept informed of its development and CSN has paid technical visits to the power plant to evaluate the progress and application of SAT

Currently, the Spanish CSN recommends the use of the SAT methodology not only for licensed personnel, but also for non-licensed personnel of the Spanish nuclear power plants.

5.19.3. Experience obtained in Spain in the application of the SAT methodology

At Almaraz nuclear power plant the training process based on the SAT methodology project has been carried out for several years, fundamentally related to the retraining and requalification of the production personnel, since the Spanish nuclear "breakdown " put a hold on obtaining new licenses and the incorporating new personnel into the nuclear power plants.

Related to this above-mentioned application the following fundamental aspects are to be emphasize

- The flexibility of the database used to establish and implement the needs of annual retraining, in a tasks database, containing data related to prioritized parameters (frequency, importance and difficulty), design modifications, foreign and the plant's operating experiences, organizational adjustments, etc.
- The capacity of the training personnel to accomplish the quality control of the training through the use of the database with relation to the definition of the training needs, its implementation and the control of its results.
- The quickness of response of training to urgent and emerging requirements, based on the use of the database, together with the ERT document (evaluation of the yield by task), which permits the training to be done task-by-task and on an individual basis.
- The usefulness of the OJT document, grouped in relation to the plant systems, allows the maintenance of the specific knowledge of each group with relation to the lay-out of the plant.
- Self-study through the above-mentioned documents and the ERT, OJT and videos related to these.
- The review of the documentation developed through the use of the data-base prior to obtaining information related to design organization modifications, as well as operating experiences.

From the perspective of the process developed in Almaraz nuclear power plant and of the experience gained in its development, and application, Tecnatom, S.A. has developed applied SAT, with its different options based on detailed analysis of the initial situation in each case, in various Spanish nuclear power plants of different types: PWR-W, PWR-KVW and BWR-GE. SAT has been applied for the training of:

- Field operators in Trillo nuclear power plant (PWR-KVU). Using the JCA option.
- Mechanical technician maintenance, electrical and I&C; engineering; radiological protection; chemistry and radiochemistry; field operators in Cofrentes nuclear power plant (BWR-GE); in process at present. using the JCA option.
- Control room licensed personnel, including turbine operator, for Cofrentes nuclear power plant (BWR-GE); in process at present. Using the JTA option.
- Control room licensed personnel, including turbine operator, for Asco nuclear power plant.
- (PWR - W); process to begin within year 1997. Using the JTA & JCA option and as reference the process developed in Almaraz nuclear power plant (PWR -W).
- I&C maintenance technicians of Trillo nuclear power plant (PWR-KWU); process to begin within year 1997. Using the JCA option

In addition, it is foreseen to widen the demand of accomplishing the SAT application to all the Spanish nuclear power plants and in all its areas of development during the next years.

In addition to this Tecnatom, S.A. has applied the SAT methodology, in its JCA option, to all the production positions of fossil power plants (coal, fuel and gas) and hydraulic plants of Iberdrola company, designing for all of them the training plans for operation, maintenance, engineering, technical support personnel. The application of the methodological SAT process in this case has been motivated fundamentally by the change of the new European generation environment, transportation and electrical energy distribution, that in view of the emerging competition requires greater emphasis in the competencies and many-sided capabilities of the workers.

Finally, the JCA option has been applied in a engineering services company, Tecnatom, S A., for all the personnel groups responsible for the tasks of: training in electrical generation and human factors, operation engineering, in-service inspection, maintenance, I&D, etc.

5.19.4. Maintenance of the training programmes obtained with SAT methodology

The basic information of all the methodological SAT process developed in Spain by Tecnatom, S.A it is entered into the database that serves to transact the formative design as well as to control from the aspects: technical, quality, pedagogical and associate: occupational the training requirements that establish the competencies of each worker.

The sources that permit maintaining this database are:

- Parametrization of evaluation of the task/activities according to importance, difficulty, frequency
- Design modification and procedures
- Organizational modifications
- Plant's own operating experiences
- Foreign operating experiences
- Requirements of the regulatory body
- Recommendations of systems and component manufacturers
- Information from personnel and of their supervisors
- Audit reports of the preceding year's training
- Other

All this is handled by a technician of the organization, who knows the database and how it was developed, and who introduces the necessary information in the database. This generates information to:

- Accomplish training actions for annual individual requalification
- Accomplish urgent and emerging training actions, in groups or individually
- Accomplish modifications in the training programmes
- Accomplish modifications in the documents and means of training such as·
  - Documentation
  - ERT
  - OJT
  - Videos
- Accomplish training of instructors, etc

5.20 SWEDEN

5.20.1. Experience in the use of SAT

SAT, as a methodology to guarantee that training programmes corresponds to qualifications needed for a safe and reliable operation of the nuclear power plant, has been introduced in Sweden by KSU.

KSU has developed and conducted training for personnel responsible for implementation of SAT.

In general the present training programmes at the Swedish nuclear power plants are developed by the earlier experience based method, without any formalized analysis method.

SAT methodology is now used at all Swedish nuclear power plants when developing new training programmes. Implementation of SAT based training programmes differs from plant to plant, owing to the companies' needs and priorities. Up to now the development of training programmes has been focused on direct operating personnel.

The managers responsible for training and qualification are also responsible for the development and use of SAT based training programmes.

Instructors at the nuclear power plant work together with experienced operators on implementation of SAT in training using among other things a specific database.

KSU offers, if requested, support, service, training and a database tool in order to effectively implement SAT.

5.20.2. Role of regulator

Since the reason for issuing a regulation is to help the utilities to improve in a certain area, co-operation between the regulator, SKI, and the utilities is needed. The regulations are not written in a detailed manner; they simply give some framework which guide the utilities in creating their own system.

The SKI regulation concerning training and qualification consists of five principal requirements:

- Knowledge, skills and abilities shall be defined based on a systematic work analysis.
- A training programme shall be developed based on the knowledge, skills and abilities requirement.
- An annual assessment of individual competence by the responsible manager shall take place.
- Documentation shall be available on regulated positions, knowledge, skills, abilities requirements, training programmes, training activities and assessment of individual competence.
- An annual report shall be submitted to ski on changes to documented information and safety-related training activities conducted during the year.

The regulation for continuing training of shift supervisors, reactor operators and turbine operators has the following general form:

- The yearly retraining shall be conducted within a 12-month period.
- The minimum is two weeks of retraining of which at least one week on a full-scope simulator.
- Training on a full-scope simulator should normally be conducted with normal shift teams.
- Needs analysis should be systematically performed for each year's training.

- On every nuclear site training programmes shall be established for each year and there shall also be a continuous programme for training.
- Every training session should be described in advance and records of these shall be kept.
- After the yearly training an individual competence assessment shall be performed by the responsible manager The assessment shall address both performance during simulator training and the every day job during the past year. The assessment shall be documented by the responsible manager
- To keep "normal" competence in a certain position the person must conduct a minimum of 21 shifts per six months
- There are some circumstances when a person can be considered to have "minimum" competence in a certain position, which means he can perform duties under the supervision of someone who has "normal" competence
- Every year a report shall be submitted to the ski containing training efforts during the year and the names of the operators who have been considered competent in the above mentioned assessment.

The SKI reviews the report and usually holds an informal meeting with representatives from the nuclear power plants in May each year where different training aspects and inspection findings are discussed.

The SKI also conducts theme inspections in some training areas every year

5.20.3. Specific positions for which SAT based training is provided

5 20 3 1 Operations

All Swedish nuclear power plants have SKI-approved training programmes for operators. The programmes have been developed using the experience based method. development of new training programmes are done with the use of SAT

Job analysis has been accomplished for all categories of operators. Task analysis is a continuing work.

Newly developed parts of the training programmes have thoroughly worked through the whole SAT process with good results These programmes are now in the phase of evaluation, an example being an initial training programme for field operators in Forsmark nuclear power plant.

Furthermore, SAT methodology is used in development of new training programmes for training of operators in new equipment implemented in the nuclear power plant. An example is new computerized control systems, control rod maneuver and indicating systems.

5 20.3 2 Maintenance

Training of maintenance personnel is up to now mostly individual and has to a large extent been training provided by manufacturers.

Training of maintenance personnel has now been identified as very important area for improvement. The question is under further consideration how an extensive programme for the training of maintenance personnel should be developed In these discussions the SAT methodology is an important tool

5.20 3 3 Technical support

Training of technical support personnel has, as well as for maintenance personnel, been focused on individual training, although the training has been conducted by training personnel at the nuclear power plant. Also in this area a discussion is going on how to improve the training.

An example of this is a training programme developed in a collaboration between the Swedish nuclear power plants and KSU for initial training in radiation protection.

The project of developing the course has also served as a pilot project for developing methods for training on SAT methodology, implementation and working tools

5 20 3 4 Instructors

An instructor training programme was developed in 1983–1984 based on a structured job analysis. A new analysis was done in 1995, which is the basis for the present training programme.

Checklists derived from the analysis have proved to be useful tools in the on-the-job training for instructors in initial training as well as retraining.

5 20 3 5 Other

An example of the use of SAT methodology for other categories is the development of a training programme for operators at a centralized storage for spent fuel from nuclear power plants at CLAB in Oskarhamn

5.20.4. Experience gained through the introduction and use of SAT

Experience gained from the training programmes developed by the use of SAT methodology are mainly very positive The training has become more structured and oriented towards training objectives The trainees have in general performed very well. Still, the experiences gained are preliminary, since a complete evaluation has not yet been done.

Implementing new working methods always arise new questions and problems to be solved and the need for new routines. Examples of problem areas discussed and experiences gained are as follows.

- Projects developing training programmes using SAT methodology must be well defined and organized. The different phases must be divided into stringent sub-projects. A common experience is that it is very easy to overdo the analysis phase. (The analysis is sometimes too detailed.)
- Personnel working with SAT must be trained and must also be familiar with the SAT methodology In a group working with SAT there should be one or two persons with experience from earlier projects
- Management support and a sufficient number of manpower must be allocated to a SAT project in order to be efficient There should also be a continuity among the personnel.
- Short cuts in the work with SAT are rarely possible. Maintaining traceability is a condition for the effective maintaining of a SAT based training programme.
- Training of management in the use of SAT methodology is important in order to create an understanding of SAT as a tool for quality assurance of training programmes
- A well-structured database is needed to administrate SAT

- If a functioning training programme (experience based) already exists it is important, in order to achieve rapid, demonstrable results and attain acceptance for SAT, that existing training material is revised and as far as possible used in the new SAT based programme

It is very hard to develop measurable indicators which objectively indicate an improvement of staff qualification or plant availability

In Sweden, two minor pilot projects have worked with methods measuring the effectiveness of the SAT methodology

One pilot project proved that after developing a training programme for field operators, using SAT, the number of reported malfunctions in maintenance of some specific valves, decreased more than 30%. The positive result is undoubtedly to some extent due to training, but probably also depends on other technical measures taken the same time. Another pilot project to measure the effectiveness of SAT was organized as follows

- Training material on two minor systems (hydraulic scram system and boron injection system) in the nuclear power plant (BWR) was developed with two different methods One was the traditional experience based method and the other one was SAT based.

- A comparison between the training material developed with the two methods showed that the "traditional material" contained 80% (hydraulic scram system) respectively 50% (boron injection system) of the needed knowledge and skills analysed by SAT.

- The SAT based training material was easier to develop The training material developed from SAT analysis was produced in 7 weeks compared with traditional method 12 weeks.

5.20.5. Maintaining SAT based programmes

Our experiences gained from maintaining SAT based programmes are not sufficient since the ongoing programmes are under development. However the following can be noted:

- SAT based training programmes should be looked on as quality assurance programme to preserve the qualifications of the nuclear power plant personnel

- Maintenance of SAT based training programmes must follow established routines and be conducted by experienced training personnel in order to achieve efficiency and continuity

- It is very important that maintenance of the training programmes is made continuously in order to keep the programmes alive. Implementation of new equipment in the nuclear power plant requires an ongoing analysis of training programmes A well-structured and maintained database is then essential

5.21. UKRAINE

5.21.1. General description of type of SAT methodology used

The basis of the Ukrainian training system for nuclear power plant personnel is the "Concept of a National Training System of Ukrainian Nuclear Power Plant Personnel." This concept requires the use of the SAT for nuclear power plant personnel.

The process of development of a modern training system in Ukraine began at Khmelnitsky nuclear power plant (KhNPP) in 1992, under the Lisbon initiative.

One of the activities performed was to improve the methodology and organization of training materials development and the conduct of instruction.

This section reviews the improvements made to personnel training system at KhNPP with US assistance.

The SAT was chosen as the basis for personnel training system improvement, since it was widely used at nuclear power plants in the US and other countries.

Application of the SAT methodology was done in several stages between 1993 and 1996:

- An analysis of needs, time scales and identification of priorities for SAT principles application was carried out in 1993 by a joint Ukrainian–US expert working group, (General Physics Corporation (GPC) with participation of plant specialists).
- In 1994, Khmelnitsky plant and training centre management received training on SAT methodology (lectures at KhNPP by US experts and two-months training for three training centre managers at GPC company in US).
- 1994–1995: Development of pilot courses for operating and maintenance personnel by GPC with participation of KhNPP specialists and simultaneous training of training centre instructors.
- 1995–1996: Pilot courses were implemented, mainly by KhNPP specialists.
- 1995–1996: Development of a normative-methodical base for training system implementation on the principles of SAT. The following documents were developed or revised: "Training Materials Development Manual", "Training Centre Provisions", "Provisions for Training Centre Divisions and Job Position Instruction of Training Centre Personnel" and a comprehensive "Provisions for Personnel Training System".
- 1996: The independent development and implementation of training courses commenced.

SAT based programmes and documentation have been developed at Khmelnitsky nuclear power plant, following the use of job and task analysis (JTA). To ensure that a variety of job positions were covered, several job positions were selected for pilot courses and training materials development:

- CRTO pilot training course and complete course of the CRRO — as the example of the control room operations personnel training.
- Chemistry operator pilot training course — as the example of the field operators training.
- Refueling machine operator pilot training course — as the example of the training for the personnel who perform nuclear hazardous works during refueling outages.
- Reactor vessel repair technician pilot course — as the example of the maintenance personnel training (repair of the main equipment).
- Motor operated valve repair technician pilot training course — as the example of the maintenance personnel training (for the most common equipment at the plant).
- Fire safety, radiation safety, industrial safety pilot courses — as the example of the general courses training for a broad scope of employees.

- Safety culture pilot courses — as the example of the management training and training for specific aspects of the plant.

As a result of the work which was completed in the period 1994–1996, a significant set of pilot training materials, which cover a broad spectrum of the operations and maintenance jobs, and training materials for other job positions have been produced.

It is planned that SAT will be applied at other nuclear power plants in 1997–1998 by adopting the pilot courses developed for Khmelnitsky nuclear power plant. In the framework of the project TACIS NUCUK 9301, "Development of a National Training System for Ukrainian Nuclear Power Plant Personnel" the nuclear power plant personnel training procedures have been produced.

SAT as described in the IAEA-Technical Reports Series 380 was used in the preparation of these procedures Procedures were developed for each of the three analyses types

- Job and task analysis (JTA),
- Job competencies Analysis (JCA),
- Combined JTA and JCA.

Based on these procedures, the pilot training programme for turbine-driven feed pump field operator has been developed for Zaporizhe nuclear power plant. This programme is a standard one and can be used as an example for elaboration of training programmes for other job positions The individual training programmes can be produced based on the developed programmes, taking into account the initial training level.

Project TACIS NUCUK 9301 is now being finalized while the elaborated procedures and training programme are being implemented.

In the framework of IAEA's Project UKR/4/003 a SAT- based needs analysis was conducted for South Ukraine nuclear power plant (SUNNP). A QA manual, training system conceptual document and other documents were developed.

It is planned to carry out a job analysis applying SAT at SUNPP for 4 job positions·

- Stage (plant) shift supervisor
- Reactor operator
- Turbine operator
- Senior duty electrical technician.

To develop documents on nuclear power plant's personnel training, it is planned to use both the training concept and SAT procedures developed in the framework of projects TACIS NUCUK 9301, in order to generate site-specific documents. Inputs from the Lisbon Initiative Project at Khmelnitsky nuclear power plant may also be used in this project.

The major responsibility for SAT application lies with·

- KhNPP and General Physics at KhNPP
- SUNPP and TECNATOM at SUNPP
- Consortium EDF-SIEMENS-TECNATOM — with regard to project TACIS NUCUK 9301.

5.21.2. Role of regulator

MINEKOBEZOPASNOSTI (Ministry of Environment Protection and Radiation Safety) is the regulatory body with respect to the training of nuclear power plant personnel.

Its basic functions are:

- Examination and co-ordination of documents regulating the initial and continuing training of nuclear power plant personnel,
- Licensing training centres and nuclear power plants training departments, for the right to conduct nuclear power plant personnel training,
- Supervision of nuclear power plant personnel training,
- Testing managers and specialists of operating organizations and nuclear power plants for their knowledge on safety rules and standards,
- Establishing normative documents in personnel training and implementing licensing procedures for the personnel of nuclear power plants (operators).

The use of SAT is recommended by MINEKOBEZOPASNOSTI.

5.21.3. Experience gained through the introduction and use of SAT

The main results in SAT implementation were observed at Khmelnitsky nuclear power plant. Learning the SAT methodology was through "on-the-job training", i.e. learning in the process of specific courses development. The focus of this approach was to take a short but extensive course of "introduction to SAT" developed by GPC and translated into Russian followed by the creation of the joint GPC-KhNPP working groups to develop training courses. These groups went through all phases of SAT (analysis, design, development, implementation and evaluation) developing and implementing the specific courses

The groups visited some US nuclear power plants for the detailed review of SAT, to train on instructor skills and learn the long-term experience of the US training centres using SAT. This approach trained 4 to 5 instructors and experts for each pilot course developed. As a result, it turned out to be more efficient to learn in the process of development rather than just having time-consuming classroom sessions. This approach is suggested tobe used in the process of training technology transfer to other Ukrainian nuclear power plants.

Job, task and needs analyses which were performed by the leading research institutes in the former Soviet Union for most of the job positions were used. General task/qualification reference book, standard training programmes, and job descriptions were developed on the basis of this research. The use of these documents significantly reduces labor consumption in the analysis stage. The work is performed on the basis of the already made standard forms, with corrections made during discussions with subject master experts (SMEs). The time required for analysis could be reduced to the minimum if the Instructor Technologist and SME are combined in one person. The list of skills and knowledge required for training could be extensive, when targeting the less trained and less experienced employee to be trained for the given position

Orientation for a specific employee is carried out on the basis of the results of skills and an entry knowledge test. After that, certain training modules of the course may not be have to included in the training programme for that specific employee. The work at the training centre is currently aimed at ensuring the formal character of the approach, identifying the contents of the initial documents for preliminary analysis and the format of the final documents.

During the design and development phases, in order to reduce the amount of working hours for the development of training material and to exclude its incompleteness due to developers' oversights and errors, KhNPP has prepared standard computer based forms of the "lesson plan", "student's study guide", "examination bank items" and "overheads" The forms for other types of documents such as "job performance procedure", "on-the-job training performance" and "system description" are at the development and implementation stage. These forms were developed in accordance with the SAT requirements, with regard to the interrelation of the training material development and the training documents For example, learning objectives, identified and entered in the computer at the design stage, are automatically grouped together at the development stage of the training document creation The system controls the completeness of a created document The document is not considered complete until all the sections provided by the forms have been completed The forms are prepared in Word Perfect 6 1 template.

The implementation stage of all training courses starts with a presentation, i e. pilot training Invited to the presentation are colleagues from all Ukrainian nuclear power plants and from the Balakovo nuclear power plant in Russian Federation.

A presentation means actual training delivery to a group of trainees (6–10 students). The pilot course is included in the programme of initial and continuous training of that personnel, i.e. it is an integral part of the training process. Both trainees and instructors approved of the wide use of videotapes with actual job performance on real equipment, overheads of real equipment and control panels, produced by means of a digital camera, and dynamic computer presentation of the performed job and plant systems, etc.

Each training course in the training centre starts with an entry test and finishes with a mandatory exit test, with a number of interim tests. The exit written test covers the contents of the whole training course. Training evaluation is carried out by.

- Trainees in the process of learning, if the course is very long, at training completion, and three months after training completion,
- Instructors who attend the classes of the colleagues according to the schedule and fill in the sheet of pedagogical skills,
- The psychologist, who is committed not only to evaluate the training quality but also to help the instructor to find the common language with the trainees,
- Training centre and nuclear power plant divisions management;
- The immediate trainee's supervisor three months after training is completed

Analysis of each feedback is performed immediately upon being received and is integrated into monthly, quarterly, biannual and yearly reports.

The three-year experience showed that the participation of skilled psychologists was also of great importance during the evaluation process. Their recommendations, especially for beginners, allowed instructors to quickly correct their behavior, to master skills and peculiarities involved in teaching adults.

The major results of the SAT implementation are as follows·

- Wide-range introduction of SAT to the Khmelnitsky NPP staff, including all full- and part-time training centre instructors, division managers and experts.
- Capability of the KhNPP personnel to develop and implement SAT based training courses.
- Adoption of SAT, taking into account specific features of existing Ukrainian staff training system.
- Improvement of the overall industrial culture as a result of the application of SAT.

In the process of SAT application the indirect positive influence of this work on the industrial culture was revealed. The SAT based training process is a well-planned, organized and documented process, designed in the form of procedures

Personnel who used the well-prepared documentation (drawings, equipment section views, explicit technological diagrams, concentration of attention by means of highlighting of certain pieces of the texts) will naturally demand a high quality of operating documentation at the work place Training documentation to serve two purposes ("Technological system description" as study-guides and as operations reference information) is being currently developed This positive influence on performance will increase due to the expansion SAT based nuclear power plant personnel training

5.21.4. How SAT based training programmes are maintained

At present, financial problems in nuclear power in Ukraine do not allow the implementation of SAT on a broad scale at nuclear power plants. Under this condition, the assistance rendered by IAEA, governments and companies of the USA, Germany, Spain, France, etc is of great importance.

Activities on SAT implementation which are currently underway in Ukraine are mostly performed by the personnel of the training centre, which is a part of the nuclear power plant organization, with participation of western specialists as experts.

It is planned to establish a uniform databank on personnel training developed for different projects, and to adapt it for use at Ukrainian nuclear power plants.

5 22 UNITED KINGDOM

5.22.1. General description of type of SAT methodology used

Scottish Nuclear, Magnox Electric, Nuclear Electric and their predecessors, the Central Electricity Generating Board and South of Scotland Electricity Generating Board, have always approached the training of their staff at their nuclear power plants in a systematic way. A combination of job task analysis and job competencies analysis has been used with "expert" table top discussions to determine training needs Training sessions and courses were developed to meet the defined training aims and objectives Evaluation and expert knowledge of training personnel is used extensively to ensure that the developed training programmes continue to meet nuclear power plant staff's training requirements. The same methods are used to ensure that new training needs are identified and met with new training programmes

5.22.2. Role of regulator

In the United Kingdom the Nuclear Installations Inspectorate (NII) is responsible for the regulation of the nuclear industry Each nuclear site must have a nuclear site license to allow it to operate. Attached to each of these site licenses are a set of conditions to be met, covering a wide range of topics from emergency arrangements to operating rules and include training of staff. In the case of training the condition is "The licensee shall make and implement adequate arrangements for suitable training of all those on site who have responsibility for any operation which may affect safety" Company directives and detailed site documentation are used to ensure that the specification, achievement and monitoring of adequate training can be demonstrated

The NII monitors compliance with the submitted arrangements with regular site inspection visits and in addition special visits to the training centres.

5.22.3. Experience gained through the introduction and use of SAT

Oldbury Training Centre, which opened in 1973, based its nuclear training programmes on an analysis of the needs of nuclear power plant staff. As stated above, this analysis was job task analysis and job competencies analysis combined with "expert" table top discussion This analysis produced the knowledge, skills and attitudes that are required by nuclear power plant staff to perform their jobs safely and effectively.

In the 1970s the training provided was restricted to concentrating on the knowledge aspects of the required training. Whilst very basic simulation was available, it was used to consolidate and reinforce theoretical knowledge based presentations To learn skills meant operating the actual plant under direct guidance This was possible at this time since a large number of nuclear power plants were being constructed and commissioned, enabling staff to develop the required skills before the plant was operating continuously The development of computer technology in the 1970s paved the way for simulators to be produced that could replicate the behavior of the plant under various operating conditions This allowed training programmes to be developed to address the skills training requirements of nuclear power plant staff, the opportunity to gain those skills on the actual plant safely no longer being available

Through the 1980s the sophistication of simulators increased, allowing a wider range of skills to be addressed in a simulator training setting In addition, the reduction in cost of simulation enabled small portable simulators to be developed and used to satisfy other identified skills training needs. Feedback from skills based training was used to develop and modify knowledge based training programmes, ensuring that they continued to meet the training needs of staff and provided all the underpinning knowledge that would be called upon later in the skills based training programmes. Also in the 1980s significant improvements were made in the techniques of using full scope simulators to provide realistic, meaningful training Again the advances in computers assisted with the provision of increasingly sophisticated and user-friendly simulator instructor facilities

Through the 1970s and 1980s improved technical training in knowledge and skills had in turn improved plant and staff performance However, towards the end of the 1980s it was becoming apparent that further improvements to plant and staff performance would require behavioral skills training to be developed further than in the past and integrated with technical training.

Thus, the 1990s behavioural competencies that staff were required to possess were defined using a matrix of areas of competence and level of competence. Training programmes were then designed and developed to address the training needs of staff in those areas Training in team skills was developed and integrated with simulator based technical skills training. In addition, specialist training modules were developed to address the non-technical skills required of staff in the rapidly changing nuclear industry, owing to the privatization of the electricity supply industry. An example of this is the Shift Charge Engineer Seminars, developed following a detailed analysis of the skills required of a "modern" shift charge engineer, building on and integrating with the knowledge and skills already possessed by those staff

As discussed above, a full job and task analysis (JTA) has not been carried out in the UK As is well known this is an extremely cumbersome and expensive process, requiring a full and detailed knowledge of the tasks carried out by the post-holder However the introduction of PWR technology into the UK required an analysis of the tasks to be undertaken by staff on this type of nuclear power plant. In 1983 the Central Electricity Generating Board (CEGB) decided to establish a specialist team to examine in detail the training requirements of Sizewell 'B' staff. A team of seven professional staff, who had extensive experience in the operation of existing gas-cooled nuclear plants, were recruited and undertook a programme to develop their expertise in PWR technology and to study overseas PWR training practices. To fulfill these tasks members of the team worked for 12–18 months with PWR operating utilities in France, Germany, Sweden and the USA and successfully completed one of the training programmes for the positions of licensed reactor operator, senior reactor operator or shift technical advisor. On their return to the UK the team commenced the analysis, design and development of appropriate programmes for PWR station staff and the specification for the PWR full-scope replica simulator.

In the analysis phase for the operator training program, use was made of a job task analysis database published by the US Nuclear Regulatory Commission in 1985. This was in itself a re-analysis of a much larger database produced by INPO This database was modified to accommodate differences between US and UK operating cultures and was further developed to cover systems which were specific to the UK PWR design. The database also provided most of the core training requirements for understanding the theory of PWR design and operation for other professional groups. Further development for these groups was performed using the "desk top" analysis technique previously developed for gas-cooled reactor training programmes. The knowledge and skill catalogues produced in this way were then verified by comparison with the training requirements developed by overseas utilities Design and development of the training programmes followed the approach taken when designing gas-cooled reactor training, that of integrating formal training modules with the performance of practical tasks In addition, the PWR training programmes developed using the more detailed analysis process were used to verify that the gas-cooled training programmes were correctly addressing the knowledge and skills required by those staff. This was performed not only for the introductory training courses which are common to the different reactor technologies but also for the plant-specific and specialist training.

A further example of establishing SAT based training programmes is the system engineer training programme now being used for staff who will perform this job at Sizewell 'B'. The Systems Engineer approach was developed to provide a flexible approach to maintenance of the equipment Since the post holder is responsible for all aspects of several systems, the knowledge and skills required crossed the traditional engineering boundaries. The analysis, design and development produced 71 individual training sessions making up 9 weeks of training.

5.22.4. How SAT based training programmes are maintained

Training programmes are maintained by feedback from courses, instructors, plant personnel and plant management. In additional an operational experience feedback system is operated jointly by all the nuclear operating companies in the UK, and this mechanism is used to relay training-related aspects from operational experiences to all nuclear power plants, including relevant aspects from experiences worldwide. New or changed training requirements also arise from organizational or plant changes and lead to changes to existing training courses or the development of new training courses or modules.

5.23. UNITED STATES OF AMERICA

5.23.1. Use of SAT methodology in the United States of America

The history of the application of SAT to the training of nuclear power plant personnel in the USA can be traced to the TMI accident. Post-TMI evaluations identified serious deficiencies in the training of nuclear power plant personnel in the US. As a direct result of the accident, the nuclear utility industry founded INPO. One of INPOs main missions was to assist the utilities in developing effective training programmes at each nuclear power plant

"Performance based training" was chosen as the standard for the industry, and was largely *based on the experience of the military. The US utilities operating nuclear power plants initiated self* regulation of the training process by establishing the INPO-managed accreditation process in 1982 for operations, maintenance and technical personnel training programmes Utilities committed themselves to achieve and maintain accreditation of their training programmes by the end of 1988 INPO guidance documents on the application of SAT were issued in the early 1980s and revised in the mid- and late 1980s These documents include

Training System Development Model Overview (INPO 84-032)
Principles of Training System Development Manual (INPO 85-006)

All utility programmes were accredited by the end of 1988 Training for the following positions in the USA is based on the SAT methodology

- Non-licensed operator
- Reactor operator
- Senior reactor operator
- Operations shift supervisor
- Licensed operator requalification
- Shift technical advisor
- Electrical maintenance technician
- Mechanical maintenance technician
- I&C technician
- Maintenance supervisor
- Chemist technician
- Radiation protection technician

The SAT methodology is also applied to other programmes SAT has been applied to QC technician and emergency response organization training programmes at some utilities

5.23.2. National Academy for Nuclear Training

The National Academy for Nuclear Training was established in 1985 by the US nuclear industry to focus and unify industry efforts to continue improvement in training and qualification programmes and to enhance professionalism and provide nuclear personnel The Academy accredits all utility nuclear power plant training programmes It integrates the training-related activities of all nuclear stations, the Accrediting Board and INPO The Accrediting Board is an independent body charged with making accreditation decisions Accreditation is granted for four years The Accrediting Board may grant or renew accreditation, place a programme on probation or revoke accreditation To date accreditation has not been revoked

The Academy conducts a review of each programme, based on the utility's self-evaluation report, as part of the initial accreditation and accreditation renewal processes The Academy's review is included in the self-evaluation report that is presented to the Accrediting Board

5.23.3. Regulations applicable to training

United States Nuclear Regulatory Commission (Code of Federal Regulations)

- Utilities are to maintain the accreditation of their nuclear power plant training programmes
- NRC conducts initial senior reactor operator (SRO) and reactor operator (RO) license examinations and issues SRO and RO licenses to individuals

- Utilities are to conduct requalification training and examination for licensed operators (RO and SRO licensed individuals).

National Academy for Nuclear Training

- Accredits utility training programmes. An independent accrediting board is charged with making accreditation decisions.
- Accreditation is renewed every four years. The accrediting board may renew accreditation, place a programme on probation or revoke accreditation. To date accreditation has not been revoked.

5.23.4. Inspections and reviews

Nuclear Regulatory Commission

- The NRC conducts an inspection of the licensed operator requalification training programme once per review cycle. Review cycles are determined by overall plant performance and typically range from 12 to 24 months.
- The NRC also conducts "for cause" inspections of training programmes based on plant performance that may be linked to training deficiencies.

Institute of Nuclear Power Operations (INPO)

INPO conducts reviews of training as part of the periodic comprehensive review of plant performance. These review are typically conducted on a 12 to 18 month interval.

National Academy for Nuclear Training

- The Academy conducts a review of each programme, based on the utility's self-evaluation report, as part of the initial accreditation and accreditation renewal processes. The Academy's review is included in the self-evaluation report that is presented to the Accrediting Board.
- The Academy may conduct special reviews of a training programme when the INPO comprehensive review indicates the utility is not maintaining a training programme in accordance with the accreditation requirements

5.23.5. Experience gained through the introduction and application of SAT

5 23.5 1 Early experiences with SAT (1980–1990)

The initial applications of SAT focused on technical knowledge and skills The goal of this training can be characterized as to "identify, teach, evaluate and learn the technical content of a job." The "first" plants to seek accreditation conducted extensive JTA. Subsequent plants used JTA of "similar" plants as starting point. These nuclear power plants validated and modified job and task lists to make them plant specific. Tasks were usually documented in procedures so that it was not necessary to extend the JTA below the task identification level. The typically JTA made frequent use of table top sessions. Line management could be classed as "indirect management involvement." Line managers frequently viewed training as a drain on resources. The training department lead the way towards accreditation. Line managers usually concurred with the training department's recommendations.

Databases were developed to maintain JTA, lesson plans and student records. Training made the transition from being less classroom based lecture to more simulator, laboratory and on-the-job training using effective evaluation tools Industry performance indicators associated with training showed an improving trend Root cause analyses and human performance evaluations identified a smaller fraction of errors associated with technical knowledge and skill competencies and more associated with human factor related competencies. Communication problems were frequently identified as contributing to errors

5 23.5 2 Management ownership and teams

Analyses of industry experience showed that training on knowledge and skills was not sufficient to achieve desired level of performance. Attitude, team work and safety culture were identified as key elements to achieve the desired level of performance.

The new shift supervisor training programme and the revised engineering support personnel ACAD guidelines were issued based on industry-wide job analysis which was to be adapted for plant-specific application National training courses for shift supervisors, maintenance supervisors, and station engineering supervisors were conducted by INPO to focus on human factor competencies

Management ownership of training programmes is characterized by line management assuming active leadership of the training effort Line managers worked with curriculum committees to determine the content of and standards of conduct for training.

Groups of utilities developing and implementing shift and maintenance supervisor continuing training to continue to address human factor competencies. Simulator training has evolved to the control room supervisor lead self critiquing of crew performance in the simulator Line management is actively involved in field observations and critiques to provide immediate feedback during work

5 23 5 2 Maintenance of the SAT process

The SAT process is maintained by the utilities operating nuclear power plants in the United States of America through the National Academy for Nuclear Training accreditation process.

Annexes

PRACTICAL EXAMPLES OF SAT APPLICATION

INTRODUCTORY REMARKS

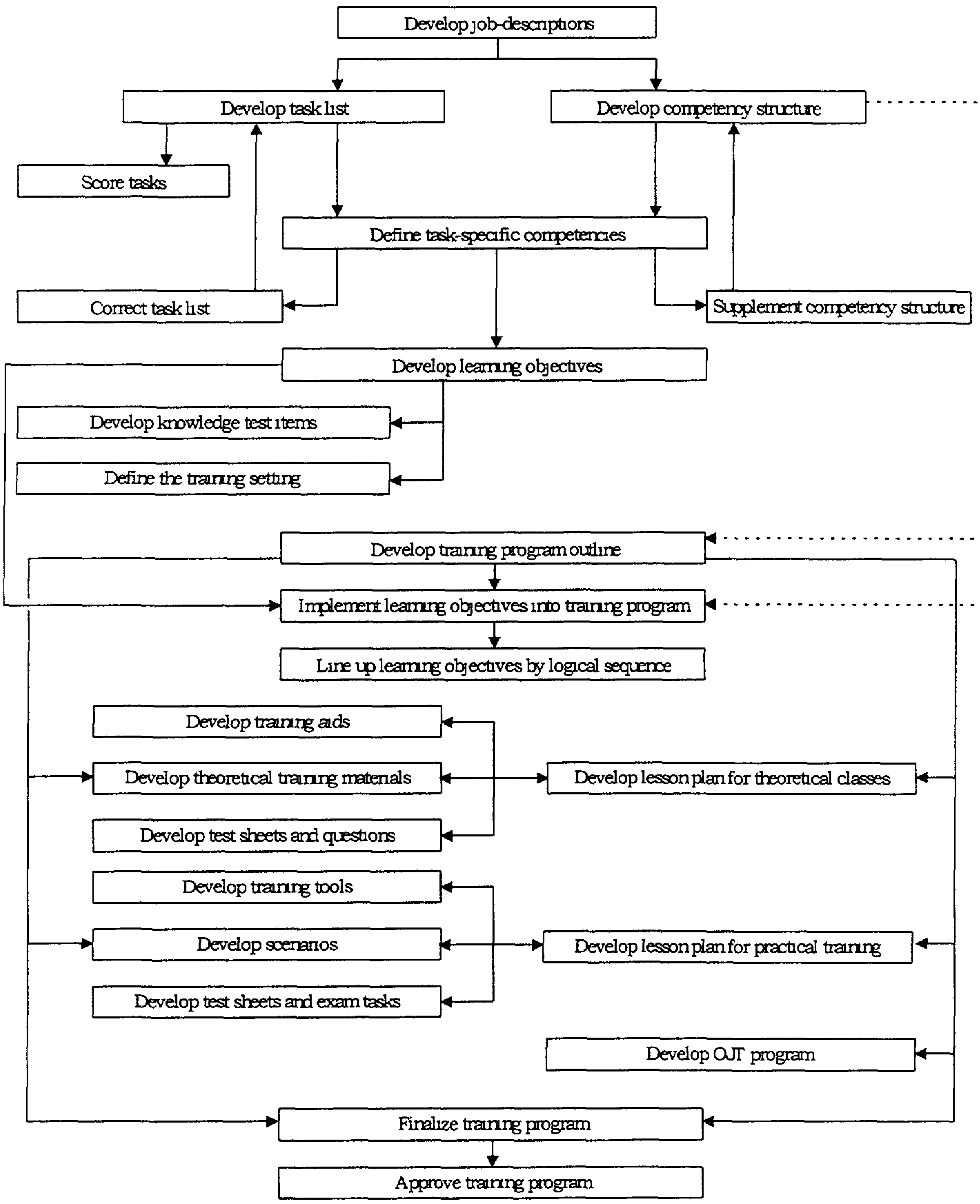
The annexes are an important part of this technical report and fulfill two main objectives Firstly, they elucidate how individual countries have gone about implementing various phases of the SAT process — these are the countries who have contributed overviews of their experiences in the application of SAT contained in the body of the document. It was strongly felt by those preparing this technical document, representing 22 Member States of the IAEA, that not only a summary of their experiences but also actual examples of how they apply SAT should be presented. SAT examples are particularly useful for the transfer of information on how an individual country, nuclear power plant or training organization goes about providing SAT based training. Such examples are valuable not only for those embarking now on SAT application but for all those involved in SAT based training, providing a means of comparison of practices as well as information exchange.

The second main objective deals with the fact that the examples were chosen carefully to demonstrate both overall SAT application related to all SAT phases as well as examples of each of the specific SAT phases, namely, analysis, design, development, implementation and evaluation. For those for whom the technical document is intended, the examples are both useful and self-explanatory, describing in the necessary detail specific parts of the SAT process. Furthermore, the user of the document can and should contact any of the experts who were involved in the preparation of the technical report, for further information where desired.

ANNEX A. OVERALL PRODUCTS

A.1. SAT ANALYSIS, DESIGN, AND DEVELOPMENT PHASES APPLIED FOR MAINTENANCE PERSONNEL (HUNGARY)

A.1.1. Flow-chart of sat analysis-design-development phases (Hungarian model project, Paks NPP)



A.1.2. Details of job-description

Job position: Primary circuit valve maintenance senior mechanic

Purpose of the job position: Periodic maintenance, repair, trouble-shooting of primary circuit manual-, power-operated-, air-operated valves, planning of work, documenting and participation in structural inspections

General tasks:

- To manage, supervise and control work performance of subordinate group members
- To distribute work orders
- To keep subordinates' dosimetry data
- To document maintenance and repair information
- To manage shift turnover
- To call spare parts, materials off the warehouse
- To prepare work area
- To monitor contractor workers
- Other tasks as ordered by the supervisor.

Professional tasks:

- Maintenance, repair of the primary circuit valves
- Trouble shooting
- Perform periodic maintenance work
- Service routes
- Refurbishment of dismounted valves
- Revision of valves to be installed
- Pressure test in laboratory, workshop
- Participation in plant/regulatory structural inspections
- Other tasks as ordered by the supervisor.

Prerequisite academic education: General Certificate of Education

Prerequisite special education: Secondary technical or grad. technician

Special nuclear qualification: pass on nuclear plant knowledge course
pass on nuclear techniques final exam

Other exams required: Industrial safety, Fire protection, Health Physics, QA

A.1.3. Details of task list

Job position: Primary circuit valve maintenance senior mechanic

Duty area	System, equipment	Task	Task element	Task steps
Maintenance work under normal operation				
	Manual valves			
	Manual gate-valves			
		PT 26164 type valve revision		
		U26362 type valve revision		
			Decoupling of plane of split	
			Repairing of sealing surface	
				Regrinding of case sealing surface
				Substitution of teflon sealing of plane of split
				Silfon dismounting from the upper unit of valve
				Substitution of teflon packing ring of locking dog
				Truering up of packing ring by grinding
				Assembly of locking dog onto the silfon, fixing
				Truering up of silfon plane of split
			Repairing of upper unit of valve	
			Assembly	
	Power-operated valves			
	Power operated-gate valves			
	Power operated control valves			
	Air operated valves			
	Non-return valves			
	Condensers			
	Line blinds			
Maintenance works during outages				
Trouble shooting operations				
Prescribed test-related activities				
Preparatory activities				
Admin works				

A.1.4. Details of competency structure

Job position: Primary circuit valve maintenance senior mechanic

Entry level knowledge						
	Mathematics					
	Physics					
	Study of mechanical structures					
General employee knowledge						
	Labour law					
	Company policies					
	General safety principles					
	QA principles					
General skills and knowledge						
	Knowledge of NPP					
	General safety considerations					
	General safety consideration					
	Nuclear safety					
Job specific skills and knowledge						
	Site-level professional and safety consideration					
	Plant level knowledge					
	System level knowledge					
	Equipment, instrument level knowledge					
		Pipeline valves				
			closing valves			
				gate valves		
					role, objective	
					structure, constructions	
					modes of operation	
					maintenance	
						service activity, periodic control
						maintenance experience
					documentation	
Aptitudes and attitudes						

A.1.5. Competency structure and learning objectives

Job position: Primary circuit valve maintenance senior mechanic

Job specific skills and knowledge						
	Site-level professional and safety consideration					
	Plant level knowledge					
	System level knowledge					
	Equipment, instrument level knowledge					
		....				
		Pipeline valves				
			....			
			closing valves			
				gate valves		
					role, objective	
					The trainee is to be able to state the role and objective of a gate valve	
					structure, constructions	
					After the practical training the trainee is to be able to show on a given valve the gate valve-specific structural elements and state their roles	
					maintenance	
						service activity, periodic control
						The trainee is to be able to decide on necessity of replacement of parts or mode of repairs
						....
						maintenance experience
						The trainee is to be able to provide the essence of safety or quality event reports of a given gate-valve to summarise the causes and the methods of prevention
					documentation	

A.1.6. Details of training program outline

Job position: Primary circuit valve maintenance senior mechanic

Initial training			
	Entry training		
		Corporate knowledge	
		Safety principles	
		QA principles	
	General plant knowledge training		
		General plant	
		General safety	
		Nuclear plant technology	
	General mechanical maintenance		
		Maintenance knowledge	
		Technical knowledge	
		Maintenance safety	
	Primary circuit valve maintenance		
		Theoretical training	
			System under control of job
			Requirements against primary circuit valves
			Piping valves
			Binding and sealing techniques
			Allowable base and aux materials
			Use of tools and equipment
			Procedures, codes, rules
		Practical training	
			Introductory theory
			Practices
		OJT	
	Senior mechanic training		
		Theory	
		Practice	
Continuing training			
	Periodic training		
	Pre-outages training		
Related course			
	Rigging		
	Crane control		
	Crane operation		
	Barrow driving		
Eventual courses			

A.2. CASE STUDY: SAT APPLICATION FOR MAINTENANCE QUALIFICATION (INDIA)

INTRODUCTION

This case study is an example of a typical SAT-based application in Indian NPP's for the qualification of its maintenance personnel. This case study is organised on the following logic:

(1) What are to be achieved ? (NPP targets)

(2) What need to be done, where and by whom (job tasks)

(3) Target equipment, specific task and
Target personnel (competency structure)

(4) Knowledge & ability/skills statements (design)

The systematic approach to training methodology (SAT) adopted for qualifying maintenance personnel is based on identification of competencies that directly contribute to the NPP performance indicators. This positive contribution simply means reducing the frequency of events connected with equipment failures and maintenance — elated causes.

Job Tasks

To achieve such a goal, the objectives of maintenance qualification have to necessarily focus on maintenance quality. Such a quality assurance in turn, calls for tasks of good maintenance planning, good maintenance execution and good maintenance feed back. To explain further :

- Good planning means that all aspects of the maintenance work have been understood and arranged in a systematic manner. All deviations experienced in the past during similar executions have been used for improvement of plans and procedures.

- Good execution implies performing exactly as per above plans and procedures and keeping good feed back is analysis of above performance data, establishing root causes of failures and implementing corrective actions.

In order now, to convert above program into day-to-day maintenance tasks, the following criteria for shortlisting were used.

• SURVEILLANCE	to demonstrate reactor safety at all times
• PREVENTIVE MAINTENANCE (INSPECTION, TESTING, CALIBRATION, REPLACEMENT OVERHAUL)	to prevent abnormal equipment conditions
• PREDICTIVE MAINTENANCE	to reduce frequency of forced outages or spurious actuations
• TROUBLE SHOOTING & REPAIR	prompt response to equipment problems

- POST MAINTENANCE TESTING — to avoid negative results due to faulty planning or execution

- ROOT CAUSE ANALYSIS/ RECORDS

Target Equipment

Even though the above title applies to all plant equipment, as a practice, performance of only certain specific safety - related class of equipment are periodically reported in NPP performance reports Accordingly only such equipment were short listed for purpose of maintenance qualification. Such equipment meet the following criteria

- mitigate transients or accidents
- used in emergency operating procedures
- whose failure fail critical safety equipment
- whose failure cause plant trips or set back

Equipment so identified were grouped according to the NPP systems they belong for qualification purposes

Typical Tasks

Specific tasks for such equipment now need to be shortlisted for defining the needs of qualification. It is because it is neither necessary nor feasible to qualify personnel for all tasks, for the following reasons

- Many tasks are generic support tasks that are common to equipment regardless of whether they are safety related or otherwise.
- Many tasks do not require formal certification as personnel who work on safety related equipment are already trained formally in class room as well as on job, on all duty areas of other systems.
- Resources needed including time frames for an exhaustive task listing are prohibitive and not justified as NPP systems and organisational aspects keep changing to meet new challenges.

A desirable approach evolved by us then was as below:

- List all preventive, predictive and analytical tasks done during, and, 3 months preceding successful operations of the NPP. Call this set T-1.
- List all corrective tasks done during last three years in the above NPP including analysis of root causes. Call this T-2
- List all corrective tasks as at (ii) in other sister NPP's in the county Call this T-3

Set T-1 are frequent tasks that must be done to keep the NPP operating. Set T-2 revealed deficiencies in the NPP for which readiness (plans) must exist to promptly diagnose and repair Set

T-3 are generic, common mode, culture specific deficiencies for which detailed pro-active capability must exist. All these tasks were reported in the monthly performance reports of the NPP. This led to easy shortlisting and segregating of typical tasks for qualification.

Target Personnel

Maintenance personnel in this context, are organised in four disciplines at five levels of designations. The disciplines are :

Mechanical
Electrical
Instrumention & cntrol
(On-power) refuelling systems.

The broad criteria for allocation of duties and tasks are given below in Table-I.

TABLE-I. DUTIES OF QUALIFIED MAINTENANCE STAFF

Qualification	Position	Duties & Capability
1. Level-I	Senior Maintenance Engineer	Overall administration and quality management in his discipline
2. Level-II	Maintenance Engineer	Planning, Supervision and QA checks, Analysis for 100% target equipment
3. Level-III	Assistant Maintenance Engineer	Planning, Supervision and QA checks, Analysis for 50% target equipment.
4. Level-IV	Senior Maintainer	Conduct or Execution for 50% target equipment.
5. Level- V	Maintainer	Conduct or Execution for 25% target equipment

Maintenance engineers work as planners and evaluators for the identified equipment. They are specifically responsible to ensure the following:

- The equipment must fulfil the system function under all (normal, abnormal or emergency) modes of operation.
- Its design intent must be retained through its economical service life.
- Reported deficiencies are eliminated including root cause corrections.
- No new deficiencies as a result of the maintenance done, should get added.

They facilitate the execution of maintenance by providing up-to-date procedures, qualified human resources, spares and know-how, in their area of responsibility. These form bases for design of their training and qualification. Maintainers need to be knowledgeable and skilled for the execution of work as per approved safety and maintenance procedures including work control, diagnosis and recording.

Final job specific competencies (KSA's) structure

Based on all above logic, job specific KSA's (competencies) for the typical tasks of the target equipment for each position has been developed Table-2 is a typical example for mechanical maintenance

DESIGN & DEVELOPMENT

Based on such analysis as in Table-II, detailed syllabi and test items for knowledge checks and on-job training check sheets for skills and attitude checks have been developed Only those who are already trained on the preparatory program through the nuclear training centres and have adequate and certified field experience at least in the routine maintenance tasks of the NPP are admitted to the maintenance qualification program described here. The entry level requirements are completion of training and adequate experience in

- Science fundamentals
- NPP technology
- NPP Systems and layout
- Radiation protection and safety rules
- Tools & equipment skills
- Advanced equipment skills

The candidates admitted must clear skills checklist on job. The last section is an extract from "test questions and skills checks" for mechanical maintenance engineers. The candidates write and must pass such ten written examinations on the maintenance specifics, plant walk through and final assessment interviews before obtaining the qualification for the maintenance position This system has been recently implemented at our Kakrapar Atomic Power Station.

SAMPLE TEST QUESTIONS

This section is a set of sample test questions and skills checks for mechanical maintenance engineers The candidates write and must pass such ten written examinations on the maintenance specifics, plant walk through and final assessment interviews before obtaining the qualification for the maintenance position This system has been recently implemented at our Kakrapar Atomic Power Station.

MECHANICAL MAINTENANCE

GROUP MODERATOR SYSTEM & REACTIVITY MECHANISM(CODE - M-1)

SUBSYSTEM MODERATOR MAIN SYSTEM (M-1/1)

01 List functional requirements of moderator pumps including during
 (i) normal operation
 (ii) reactor shutdown
 (iii) class IV power failure
 (iv) class III power failure
 (v) air supply **failures**
 (vi) LOCA and such accidents

TABLE-II. TYPICAL JOB SPECIFIC KSA's (Mechanical Maintenance Engineers)

	(*) GROUP-A	GROUP-B	GROUP-C	GROUP-D
	MODERATOR SYSTEM& REACTIVITY MECHANISM	REACTOR COOLANT& AUXY EQPT & SERVICES	TURBO-GENERATOR FEED WATER	STANDBY POWER& SAFETY SUPPORT
1.SAFETY PROCEDURE Radiation Protection ALARA Practices *Technical Specifications*				
2.PERFORMANCE PLANNING Performance Indicators Work Control & Priorities Material Management				
3.QUALITY REQUIREMENTS Design Specifications & bases Construction features Performance Requirements Preventive Maintenance requirements & bases and procedure Predictive Techniques Root Causes Analyses Documentation Requirements				
4.QUALITY IMPLEMENTATION Records of Maintenance Checks of Preventive Mtce Quality checks on tools,etc Human Factors Procedure for execution				

(* indicates critical pumps, valves, heat exchangers already identified in the list approved)

02 List **functional specifications** of Moderator Pump

03 List **protections** provided to the Moderator Pump and their bases

04 Explain **construction** of Moderator Pumps including of
- (i) Impeller arrangement
- (ii) Wearing ring locking
- (iii) Air Labyrinth
- (iv) Coupling
- (v) Bearing
- (vi) Temperature limits
- (vii) Lubrication

05 Explain **maintenance procedure** for moderator pumps including
- (i) Seal replacement
- (ii) Wearing ring replacement
- (iii) Checking pump lifts
- (iv) **Overhauling**
- (v) Spares requirement

06 Discuss the major **inspection and measurements** on a new or suspect Moderator pump tripping on overload frequently as well as showing high vibration time to time for analysis of causes including
- (i) Pump shaft critical dimensions, TIR value, coaxiality of key ways
- (ii) Impeller accuracy
- (iii) Wear ring clearances
- (iv) shaft sleeve
- (v) coupling

07 Inspect and clean suction strainer of moderator pump 3211 - P-1 during planned shut down as per procedure Conduct functional test to ensure no leakage and delta-P as per plant requirements

08 Attend weld joint leak in moderator heat exchanger #1 inlet PT/PG-108 tapping and perform integrity checks as per code requirement

09 Crack has developed at socket weld joint of PG line (No-3211-4) in moderator system Repair the crack weld and perform integrity checks as per code requirement

10 Given that the moderator pump 3211-P-3 bearing indicator is in red zone, perform pump bearing inspection

11 Perform overhauling of 3211-P-3 moderator pump to bring downs its vibration level from 40 micron to acceptable (30 micron) levels Perform vibration analysis of 3211-P#1

12 Given the symptom that 3211-MV-#8 is passing, rectify by stroke adjustment

13 Inspect and clean suction strainer of moderator pump necessary post maintenance check and functional tests

ANNEX B. ANALYSIS

B.1. COMPETENCE PROFILE AND SOFT SKILLS NEEDS ANALYSIS TOOL FOR MANAGERS (UNITED KINGDOM)

NUCLEAR ELECTRIC plc

OUTLINE COMPETENCE PROFILES

Production Manager

1. **Performance Criteria (Job-related):**

1.1. Contributions to policy and strategy, through the station executive, are authoritative and support the achievement of Station commercial objectives in accordance with Company policy.

1.2. Plant operating strategy developed, endorsed by station executive and implemented, (following consultation with appropriate staff) to meet station objectives and procedures.

1.3. Production department managed in accordance with required plant performance, safety and environmental criteria.

1.4. Production department policies meet legislative, safety and environmental requirements.

1.5. Operation and maintenance standards achieved through effective direction and motivation of staff, comply fully with the nuclear site Licence and other legislative and organisational requirements.

1.6. Functional advice and guidance provided by the company is implemented at the station in accordance with management control procedures.

1.7. Structure change, improvement, delegation and staff development within the department meets business, training and QIP plans.

1.8. Section budgets accurately prepared, effectively monitored and controlled to time and cost criteria.

1.9. Capital and revenue schemes managed to time and cost criteria.

1.10. Production department managed in accordance with the following requirements:

- Change programme
- Staff structure and task analysis
- Group business plans and performance reporting arrangements
- Skill/competence enhancement programme
- Harmonious industrial relations.

1.11. Production department resources reviewed regularly and optimised to achieve Station objectives.

1.12. Identified maintenance and operations needs met by periodic review of station policy (through station executive), and recommendations made to other departments lead to improvements in safety and commercial performance.

1.13. Operational experience feedback requirements met in full by provision of appropriate information and feedback report assessment.

1.14. Staff recruited, selected and developed in accordance with legislative and organisational requirements.

1.15. Staff assessment and authorisation for operational, site licence (duly authorised person) and safety rules fully accords with legislative and organisational requirements.

1.16. Planning and scheduling systems optimised to meet organisational requirements.

1.17. Production department activities reviewed regularly to ensure compliance with company and station quality assurance requirements

1.18. Safety rules compliance reviewed regularly and documentation audited in accordance with departmental procedures.

1.19. Records, returns and reports are complete, accurate, legible, up-to-date and comply fully with organisational requirements.

2. Performance Criteria (Role-related):

2.1 Duties undertaken as "emergency controller", "technical officer" or "operational support centre manager" in accordance with the station emergency plan comply fully with legislative and organisational requirements

3. Underpinning knowledge:

3 1 Technical and academic knowledge commensurate with an engineering/science degree and chartered engineer status.

3.2 Operational and maintenance principles of nuclear and conventional plant.

3.3. Design of components and systems required for safe commercial operation and shutdown of Reactors and associated plant.

3 4. Principles and practice of radiological protection, reactor physics and chemistry at nuclear locations.

3.5. Application of nuclear site licence conditions and legislation associated with the safe operation and maintenance of plant.

3.6 Company requirements relating to plant modifications at nuclear sites, and the maintenance of the safety case

3 7. Company and station structure, organisation and interfaces.

3.8. Organisation and function of on-site and off-site services that support operational activities at the Station under normal and abnormal conditions.

3.9. Company and local procedures, including rules, instructions, codes of practice and memoranda applicable to the safe and commercial operation of the Station under all conditions.

3.10. Procedures for the application of quality assurance at the station.

3.11. Content of company and local agreements.

3.12. Statuary acts and regulations relevant to operational nuclear power Stations.

3.13. Standards required in personal, industrial, radiological and nuclear safety and procedures.

3.14. Company philosophy, attitudes and policies on safety issues, together with the underlying principles and supporting procedures.

3.15. Company public relations procedures and methods of promoting the company and station to the general public in a good light.

3.16. Company and station resource management policies and procedures.

3.17. Company financial analysis and control procedures.

3.18. Company and station business and strategic objectives.

3.19. Company and station business planning policies and procedures.

3.20. Project management principles and practice.

3.21. The authority to whom matters outside own area of competence are to be referred.

3.22. Legislative and organisational procedures for the recruitment, selection and development of staff.

3.23. Legislative and organisational procedures required to undertake nominated duties in accordance with the station emergency plan.

4. Non-technical competencies:

(NB numbers in brackets relate to the non-technical competencies identified in the company staff appraisal scheme.)

4.14. Achieving results:
Challenges subordinates to improve effectiveness and achieve critical business objectives. (14.6)

4.15. Project management:
Establishes structures and procedures for major projects, overcoming functional conflict. (15.6)

4.16. Managing change:
Implements major change programmes obtaining full commitment of subordinates. (16.6)

5. Additional competencies

(Not yet identified — can be selected from other outline competence profiles)

1. **Breadth of vision:** We need to understand how every one of us can contribute to the business

Recognises that the team has goals	Understands the team's main business objectives	Takes initiatives which contribute to achieving location/department business objectives	Encourages others to understand their priorities in the context of company objectives	Proposes new functional strategies which contribute to improving performance	Evaluates options and implements strategies and policies to achieve substantial performance improvement on a 1-5 year timescale.	Contributes to the development of the corporate vision and strategies beyond 5 years

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

2. **Judgement:** We need to make decisions at the lowest appropriate level in our organisation

Seeks appropriate guidance when problems arise	Solves straightforward problems	Makes confident decisions where precedent and full information is available	Analyses issues logically and selects solutions when faced with several options	Determines most appropriate solution if faced with conflicting advice/demands or where not all facts available	Weighs up the implications and assesses the risk when analysing complex problems	Resolves conflict and ambiguity, providing a clear future direction for the business

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

3. **Influencing:** We need to be able to put across our point of view clearly and effectively

Puts forward views or opinions when appropriate	Makes constructive suggestions in one to one or small group situations	Makes a positive contribution in discussions/ meetings with some effect on outcome	Prepares own case, emphasises the facts of the situation to win others over	Identifies others' objections and underlying needs then stresses the benefits which meet these	Bargains assertively anticipating others' objections and altering approach to achieve own objectives	Manoeuvres discussion to create win-win agreement in highly sensitive situations

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

4. **Open communication:** We need more open communication up and down the organisation

Communicates with colleagues when necessary	Exchanges information openly with colleagues	Presents and exchanges information with colleagues and other groups	Consults and briefs others regularly, ensuring full understanding is achieved	Facilitates open dialogue across teams, creating frequent opportunities for open communication with staff/suppliers	Handles difficult situations confidently and removes restrictions to communication	Conveys complex company messages clearly, encouraging open communication throughout the company

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

5. **People development:** We need to develop everyone in the Company continuously

Welcomes opportunities to broaden own experience	Pursues own self development	Trains others on specific tasks when requested	Improves others competence by identifying and implementing their training needs	Creates opportunities to broaden other's experiences and encourages self development	Encourages subordinates to support development initiatives personally acting as a role model and mentor	Creates a climate of continuous improvement, implementing company-wide developmental initiatives

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

6. **Team building:** We need to encourage team spirit and team working

Helps colleagues when requested	Shows commitment to team efforts	Plays a positive role in the team, offering and suggesting help to others	Unites colleagues within own team, supporting and praising effort and achievement	Gives time to understand related teams' issues and puts self out to ensure common goals are achieved	Promotes interfunctional co-operation, actively pulling teams together to deliver business objectives	Implements and supports company-wide initiatives to promote team working

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

7. **Empowering:** We need to encourage a sense of ownership and responsibility for work at all levels

Recognises own areas of responsibility	Takes on newly delegated tasks willingly	Accepts ownership of several priority areas taking initiatives as appropriate	Allows subordinates freedom to act on own tasks providing advice and support, readily praising their efforts and progress	Encourages independent problem solving and full ownership, removing barriers where necessary	Provides opportunities for others to assume responsibility for the delivery of business objectives and the running of day to day operations	Actively creates an organisational environment that encourages decision making at the lowest possible levels

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

8. **Performance management:** We need to focus attention on priority work and ensure it gets done efficiently

Knows what needs to be done	Understands own performance standards and priorities and asks for assistance when necessary	Plans and monitors own work systematically taking corrective action on own initiative	Allocates tasks, checks achievements against expectations and gives constructive feedback	Sets targets and analyses performance against business plan, redirecting efforts to achieve objectives	Identifies trends in performance over time, reviewing procedures and goals to enhance standards	Identifies the key areas of development required to meet corporate objectives and resolves potential conflicts

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

9. **Safety Management:** We need to ensure a safe working environment at all times

Complies with health and safety requirements	Identifies and reports potential hazards in own work areas	Adheres to safety standards for self and colleagues, suggesting solutions to potential hazards	Ensures team adheres to set rules and checks that safety measures are met, removing potential hazards	Assesses risks to identify and remove the causes of potential hazards	Creates a positive commitment to safety, establishing systems to avoid major dangers	Promotes the company safety programme, providing the resources and creating the environment to encourage safety

10. **Commercial awareness:** We all need to play our part in reducing costs and achieving commercial success

Understands the need for value for money	Monitors and minimises costs in own work area wherever possible	Analyses costs of current work practices and proposes cost savings initiatives	Ensures cost-effective use of resources by own team to achieve commercial objectives	Recognises and responds to commercial pressures and possibilities, ensuring value for money is always achieved	Takes risks and pursues viable business opportunities to improve profitability or reduce costs	Sets and controls corporate commercial policy and targets for the department which support the company business plan

11. **Customer focus:** We need to ensure we provide what our customers want, when they want it

Understands that everyone has customers	Understands who main customers are and standards of service required	Assesses and reacts quickly to customer needs and resolves their concerns	Focuses the team on developing and achieving clear customer service standards	Introduces improvements to existing levels of service	Seeks out and acts on customer feedback setting high professional standards for the team	Anticipates major changes in customer needs and drives the business to meet them

12. **Financial focus:** We need to work within agreed financial targets

Recognises the need to work within financial limits	Understands the impact of own activity on team budget	Contributes to preparation of budget and ensures that cost of own activities remain within budget	Analyses, monitors and controls expenditure to ensure team achieve their financial targets	Sets own budget which supports the unit's business plan	Creates a climate which encourages continuous improvement in financial performance	Takes company wide initiatives to improve profitability in line with shareholder's requirements

13 **Company networking:** We need a better understanding of the company to help us to do our jobs better

Knows how own department/location is organised	Understands the role of other sections/teams in contact with	Knows who to contact to ensure tasks are completed in line with own unit's business plan	Demonstrates understanding of main activities of relevant departments building a network of useful contacts	Uses and develops personal networks to achieve wider company goals	Shares functional information to ensure others can prioritise and deliver complex projects	Encourages cross fertilisation of corporate strategies maximising opportunities to achieve company goals
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐

14. **Achieving results:** We can all contribute to achieving results

Completes the tasks set	Achieves beyond set tasks when asked	Meets required standards putting in extra effort when under time and resource pressure	Strives to improve quality of results/service continuously	Overcomes difficult problems and setbacks focusing on priorities to achieve goals with limited resources	Challenges subordinates to improve effectiveness and achieve critical business targets	Focuses others on overcoming conflict and exceeding targets, actively contributing to strategic thinking outside own area
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐

15. **Project management:** We all need to complete projects or tasks to agreed plans

Works to a day to day plan	Plans and monitors key elements of own work	Handles several major tasks within normal workload	Schedules own project(s) and controls resources to meet budget and time specifications	Co-ordinates full project cycle, dovetailing activities to increase efficiency and meet quality standards	Establishes structures and procedures for major projects, overcoming functional conflict	Co-ordinates corporate activity, focusing efforts on key initiatives
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐

16. **Managing change:** We can all help to change things for the better

Accepts the need for change in Nuclear Electric	Complies with changes to working practices as they exist	Responds to change positively, implementing required alterations to normal practices	Contributes ideas for change to meet new business objectives	Identifies when change is required, overcomes resistance to it and redirects the team effort	Implements major change programmes obtaining full commitment of subordinates	Delivers strategy for long term change in support of company-wide change process
☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐

Competence Course Development Matrix

When considering an individuals development needs you may have highlighted a number of competence gaps . You can use this table to identify which courses can assist in the development of particular competences. Then you will need to refer to the relevant course information sheet(s) to ascertain whether the course is suitable. The Training (HR staff) on site should have a computer software system (MIDAS) which will have access to more information on how competences can be developed. N.B A training course is only one way of helping indivivduals develop competence.

1 Breadth of Vision
2 Judgement
3 Influencing
4 Open Communication
5 People Development
6 Team Building
7 Empowering
8 Performance Management
9 Safety Management
10 Commercial Awareness
11 Customer Focus
12 Financial Focus
13 Company Networking
14 Achieving Results
15 Project Management
16 Managing Change

*(Key * indicates that competence is covered)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Management , Leadership and Team Building																
Building & Leading Teams					*	*	*	*								
Enhancing Safety Management	*	*		*				*	*	*						
Henley Diploma in Management	*This course does not link directly to the competences but covers all 16*															
Management Of Change		*	*													*
Managing In The 90's				*	*	*	*					*	*			*
Henley Certificate in Management	*This course does not link directly to the competences but covers all 16*															
Intro to Supervision (Supervisory Prog) PART 1	*	*	*	*			*	*	*							*
Leadership Skills (Supervisory Prog) PART 2	*	*		*	*	*	*	*								
Team Building				*	*	*	*									*
Project And Strategic Management																
Effective Project Management	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Implementing Strategy	*							*						*	*	*
Management By Projects (Ashridge)			*			*									*	
Development Programmes																
Career Management Workshop for Women					*								*			
Development Programme	*This course does not link directly to the competences but covers all 16*															

Competence Course Development Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Commercial And Financial Management																
Commercial Awareness Workshop	*			*						*		*	*			
Commercial Negotiating Skills		*	*	*				*		*					*	
Finance For The Non-Accountant										*		*				
Gaining Commercial Advantage	*									*		*				*
Improving Contract Management								*		*		*		*		
Managing Budgets & Schemes In N.E										*		*				
Specification Writing				*				*		*						
Interviewing Skills																
Appraiser Skills Workshop					*			*								
Interviewing For Supervisors				*												
Selection Interviewing		*	*	*												
Personal Effectiveness Skills																
Assertiveness			*	*		*							*			
Consultantcy Skills for Professional Advisors			*	*							*			*		
Customer Care				*		*					*			*		
Effective Business Writing			*	*												
Influencing Skills			*	*												
Instructional Techniques				*	*		*									
Making The Most Of Meetings			*	*		*								*		
Managing for Performance			*	*	*		*									
Negotiating Skills - General		*	*													
Personal Organisation & Effectiveness		*						*						*	*	
Presentation Skills			*	*												
Professional Presentations			*	*												
Stress Management				*This course does not link directly to the competences*												

B.2. JCA ON INDUSTRIAL SAFETY AND RADIATION PROTECTION (FRANCE)

1. GENERAL PROCESS

In France, EDF has chosen the job competency analysis or JCA approach to define knowledge, skills and attitudes required to be acquired to develop the necessary competencies to hold a given job This approach based on determining the competencies to be demonstrated in specific job conditions, allows us to overcome the tendency by utility staff to eliminate elements of knowledge which are not directly linked to one task. Indeed, it has been shown that comprehension of the physical process behind the manipulation enhances performance. The "Why" is as important as the "How".

All NPP jobs in EDF are progressively analyzed using JCA. This results in specific documents called "référentiel-métier" (translated into Job Reference Frame) which list, for each job, the inter-relationships between job activities, the conditions of performance, the competencies involved, the expected results and the knowledge, skills and attitudes to be acquired.

This first phase of the SAT process could be triggered by three different sources of needs:

- technical problems repetitively encountered in operations
- strategic projects launched at the company (quality awareness program, safety culture...) or the plant level (new computer...)
- job/trade evolution due to new technologies, new organization..

Job reference frames allow human resources managers and section heads to compare the competencies needed for a given job with the competencies already demonstrated by the personnel in charge of the job. They can then identify the competencies to be produced and decide if training is one or the only solution for that they could study other possibilities such as a new work organization, a recruitment program or subcontracting

When training is chosen as the most efficient way to produce the needed competencies, the latter become the overall training objectives. They are the purposes of the design, development, implementation and evaluation phases to be constructed. The associated KSAs will then form the raw material for building operational training objectives. These job reference frames are thus the source of generic KSAs. Training engineering staff will add in collaboration with plant managers and section heads other plant specific KSAs

From there, the design phase of the SAT process takes over.

2 APPLICATION TO INDUSTRIAL SAFETY & RADIATION PROTECTION (SRP)

Two special project groups were set up. The "production" group comprised four plant SRP section heads, two SRP engineers, two dedicated SRP trainers, four SRP technicians, two corporate SRP experts, three human resources experts. As needed experts in risk analysis, auditing activities, or management were called upon to shed light on specific topics. This group reported to a steering committee composed of one plant manager, one deputy plant manager, one operation section head, one maintenance section head and one corporate SRP expert.

The first group met 4 times during two consecutive days over the nine months between September 94 and July 95. The steering committee met twice, once in February 94 and a second time at the end of the project last week of June 95.

2.1. Review of SRP mission

It is in the framework defined by all French legal texts and industry guidelines that the mission of SRP professionals is determined. The pivotal principle is that risk prevention is based on self-protection: Safety can not be dissociated from all work activities. "Safety is business of all, safety is implemented by each of us". The hierarchy responsibility is to ensure that conditions of application are filled with that implementation is effective.

The mission of SRP professionals is then to co-ordinate and facilitate all actions of risk prevention in domains like industrial safety, radiation protection and fire protection. As expert he advises and assists plant sections and subcontractors working on the plant equipment. He is also in charge of checking and verification activities as well as promoting risk prevention through participation in specific training and communication.

2.2. SRP Job Reference Frame

The following pages represented copy of the actual document. Activities have been regrouped into domains with a global definition for each of them. Competencies are also regrouped around large ones common for all domains such as getting information, investigating and analyzing, treating to make proposals, checking and verifying, reporting.

Competencies and performance levels have to be read horizontally, line to line whereas conditions of realization and associated knowledge have to read vertically as they refer to the whole domain.

This job reference frame is the source from which another project group composed of SRP professionals and trainers has designed and developed training programs.

This document represents the common reference from for all SRP job in EDF NPPs. The generic competencies have to be completed by those associated with plant specific requirements. Also, even if this reference document is first aimed toward training and the other phases of the SAT process, it could be used as a valuable information resource for other activities such as management, communication or auditing.

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

CONSULTING ACTIVITIES	Definition The consulting activities take place off line, upstream from the action to be carried out Thanks to documents and methodologies, the risks prevention professionals participate in preparing the action and helping in the decision making, especially in the selection of protective equipment and measurements to be taken in regard to safety rules

<table>
<tr><th>Conditions of achievement (information, equipment, obligations)</th><th>Abilities/Competencies</th><th>Performance requirements
(expected results, indicators)</th><th>Related KSAs
(general & theoretical Knowledge Skills & Attitudes)</th></tr>
<tr>
<td rowspan="5">From :

- a request from a team supervisor, a section head or a contractor,

- the Industrial Safety and Health Physics Section, its possibilities and availabilities,

- the safety, security, quality rules and regulations,

- the use of equipment and its availability,

- the constraints due to the customer/the situation (place, schedule, budget, environment,),

- the means available (staff, equipment,)

- simulations</td>
<td>Being informed
- gathering facts and data, expectations, the request items,
- update on environment, the context, the conditions and the chronological accounts of the problem raised,
- identifying and selecting technical relevant information</td>
<td>- New wording of request and problem raised (items described, put into relation,),
- similar situations checked in various experience feedbacks,
- updating on required regulations and documents</td>
<td rowspan="5">In fields of industrial safety, health physics, fire prevention, environment protection:
- state-of-the-art practices,
- equipment technology,
- company doctrine and manufacturer's specifications,
- risks prevention

Laws and regulations :
- law nr 91 1414 of 31 12 91 on prevention of risks,
- laws nr 75 306 of 28 04 75 and nr 88 662 on health physics in Basic Nuclear Facilities (1988",
- law nr 92 158 (1992) on works carried out by other companies
- quality decree of 10 08 84,
- basic rules applying to labor law (working hours, business trips,...),
- texts and doctrines concerning fire (RCCI Design and Construction Rules related to Fire of PWR Nuclear Islands)

Knowing the company :
- organization, circuits, operations (EDF/other companies, plant/site technical support group, nuclear power plant/corporate resources departments,)
- procedures, quality plan,
- safety rules,
- authorization requirements

Methodology and « general tools » :
- written and oral expression,
- office automation (word processing, spreadsheet),
- problems analysing and solving
- basic calculations,
- paying attention/listening/ readjustment,</td>
</tr>
<tr>
<td>Analysing
- identifying and characterizing the problem,
- assessing its extent and its degree of emergency,
- clarifying and relating all the data gathered (context, chronological accounts)</td>
<td>- Physical measurements carried out if necessary,
- comparison with the existing texts and information sources,
- diagnosis established and confirmed</td>
</tr>
<tr>
<td>Dealing with.
- making proposal for the solution(s) best adapted to context according to technical and socio-economic criteria,
- identifying and taking into account the logistic support required for action,
- expressing various scenarios and identifying the feasibility conditions</td>
<td>- Explanatory scenarios proposed,
- action decisions considered in their achievement and implication</td>
</tr>
<tr>
<td>Checking :
- checking the validity and the adaptation of the scenarios to the problem(s) raised
from the customer viewpoint
from the generating facts</td>
<td>- Proposals and figures checked as compared to standards and/or experience feedback,
- solution withheld modelized,
- request satisfied</td>
</tr>
<tr>
<td>Reporting
- formalizing one's proposals
- generating an experience feedback</td>
<td>- Documents established with clarity and accuracy (reports, objectives book, good practices file,),
- traceability of the consulting activities guaranteed</td>
</tr>
</table>

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

ASSISTANCE ACTIVITIES	Definition :
	The assistance activities are distinguished by the following : - real time development (during and on the site work, including the prevention « act » if necessary), - following a request for advice or, more on an ad hoc basis, - helping in the action (« giving a hand » rather than « doing for someone » The assistance may also be defined as a technical support to workers.

Conditions of achievement (information, equipment, obligations)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes))
From : - *a request from a team leader*, a section or a contractor, - the Industrial Safety and Health Physics Section, its possibilities and availabilities, - the safety, security, quality rules and regulations, - the work permit, - possible work and reference procedures, - *the use of equipment and its availability*, - the constraints due to the customer/situation (place, deadlines, budget, environment,...).	*Being informed* : - gathering facts and data, expectations, the request items, - updating on environment, the context, the conditions and the chronological accounts of the problem raised - identifying and selecting technical relevant information.	- Relevant information gathered (problem, chronological accounts,...).	In fields of **industrial safety, health physics, fire prevention, environment** : - state-of-the-art practices, - equipment technology, - company doctrine and manufacturer's specifications, - risks prevention. **Laws and regulations :** - law nr.91.1414 (1991) on the prevention of risks, - laws nr.75.306 (1975) and nr.88.662 (1988) on health physics in Basic Nuclear Facilities, - law nr.92.158 (1992) on the works carried out by other companies - quality decree of 10.08.84, - basic rules applying to labor law (working hours, business trips,...), - texts and doctrines concerning fire (RCCI : Design and Construction Rules related to Fire of PWR Nuclear Islands). **Knowing the company :** - organization, circuits, operations (EDF/other companies, plant/site technical support group, nuclear power plant/corporate resources departments,...). - procedures, quality plan,... - safety rules, - authorization requirements. **Methodology and « general tools » :** - written and oral expression, - office automation (word processing, spreadsheet), - basic calculations, - paying attention/listening/ readjustment,...
	Analysing : - identifying and characterizing the problem, - assessing its extent and degree of emergency, - identifying its feasibility.	- Problem raised in one's field of skills, - intervention features identified, - required blockings defined, - key points established.	
	Dealing with: - carrying out specific measurements and implementing special equipment, - completing with the participant the analysis of risks liable to be encountered on site, - participating in implementations.	- Intervention limits defined, - *measurement sheets well-informed*, - deviations dealt with, - prevention plan well-informed.	
	Checking : - *checking if the intervention is correctly carried out* and its relevance with regard to the problem raised.	- *Self-protection rules observed*, - blockings and key-points respected, - continuation of action feasible under the best conditions, - risks abolished.	
	Reporting : - formalizing the updates and results of one's intervention, - generating experience feedback.	- Documents established with clarity and accuracy	

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

CHECKING ACTIVITIES	Definition : Set of operations carried out by the structures of the Industrial Safety and Health Physics Section according to a systematic method enabling to check the achievement and the quality of its own activities.

Conditions of achievement (information, equipment, obligations)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes)
From : - check lists, procedures - safety, security, quality rules and regulations, - risks analysis carried out, - compilation of local requirements and instructions,	*Being informed* : - knowing the nature of the activity to be checked, - knowing the activity-related instructions, - identifying the check key points.	- Documents used (check lists and procedure) corresponding to the activity to be checked, - accurately established check points concerning the activities to be carried out.	In the fields : **industrial safety, health physics, fire prevention, environment protection:** - state-of-the-art practices, - equipment technology, - company doctrine and manufacturer's specifications, - risks prevention.
- general knowledge regarding the activity, - relationship with the person in charge of the activity, - site knowledge, - knowledge of the site's security organization, - taking part in meetings dealing with work requests, unit shutdown and scheduling.	*Analysing* : - establishing the check scenarios	- relevance and validity of scenario suggested, - prior examination of various points to be checked.	**Laws and regulations :** - law nr.91.1414 (1991) on the prevention of risks, - laws nr.75.306 (1975) and nr.88.662 (1988) on health physics in Basic Nuclear Facilities, - law nr.92.158 (1992) on the works carried out by other companies - quality decree of 10.08.84, - basic rules applying to labor law (working hours, business trips,...), - texts and doctrines concerning fire (RCC-I : Design and Construction related to Fire of PWR Nuclear Islands).
	Dealing with : - checking if the rules and regulations are applied, - checking the quality of the syntheses, - verifying that the individuals' attitude and behavior are in compliance.	- Selection of check points met, - correct site housekeeping, - Assessment and compliance of authorizations, permits, isolation documents...	**Knowing the company :** - organization, circuits, operations (EDF/other companies, plant/site technical support group, nuclear power plant/corporate resources departments,...). - procedures, quality plan,... - safety rules, - authorization tasks.
	Checking : - verifying that all the keypoints have been checked, - carrying out experience feedback.	- Check list verified.	**Methodology and « general tools » :** - written and oral expression, - office automation (word processing, spreadsheet), - problems analysing and solving - basic calculations, - paying attention/ listening/ readjustment,. - audit methodology.
	Reporting : - sounding the alarm if necessary, - setting up a checking follow-up file.	- Report filled out (tidily, clearly) - alarm given if necessary.	

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

VERIFICATION ACTIVITIES	Definition :
	All operations enabling to check the system's actual and permanent operation set up by the department to obtain and guarantee the protection of people and prevent fires.

Conditions of achievement (information, equipment, obligations)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes)
From : - Access to information *, - the regulations, - the safety rules, - the regulations and procedures compendium, - all organization procedures, - the doctrine, - **reporting to line management**, - near accident situations, - work request meetings, - unit shutdown meetings, -work scheduling meetings. * (scheduling the activities, software data base, evolution of inconveniences,...).	*Being informed :* -...of the scheduling of activities, - ...of the schedules, procedures and safety system implemented.	- Meeting attendance, - quantitative and qualitative documents checking, - knowledge of the procedures.	In the fields : **Industrial safety, health physics, fire prevention, environment** : - state-of-the-art practices, - equipment technology, - EDF doctrine and manufacturer's specifications, - risks prevention. **Laws and regulations :** - law nr.91.1414 (1991) on the prevention of risks, - laws nr.75.306 (1975) and nr.88.662 (1988) on health physics in Basic Nuclear Facilities, - law nr.92.158 (1992) on the works carried out by other companies - quality decree of 10.08.84, - basic rules applying to labor law (working hours, business trips,...), - texts and doctrines concerning fire (RCCI : Design and Construction Rules related to Fire of PWR Nuclear Islands). **Knowing the company :** - organization, circuits, operations (EDF/other companies, plant/site technical support group, nuclear power plant/corporate resources departments,...). -procedures, quality plan,... - safety rules, - authorization tasks. **Methodology and « general tools » :** - written and oral expression, - office automation (word processing, spreadsheet), - problems analysing and solving - basic calculations, - paying attention/ listening/ readjustment,... - Chairing groups/regulation,... **Ergonomics**
	Analysing : - finalizing a strategy, - selecting the instructions and procedures to be tested, - detecting the possible incoherences, - relying on experience feedbacks.	- Overall view of the system, - set relevant instructions, - control key points according to selected activities.	
	Dealing with : - verifying if the instructions and various documents have been correctly carried out as per the doctrine, - making sure the risks inherent in all the activities have been considered, - organizing the general exercises.	- Checking compliance with the selection of instructions, - correct site housekeeping, - informed prevention plans.	
	Checking : - making sure all the instructions have been correctly inspected, - carrying out an experience feedback.	- List, description of the established instructions inspection, - inspection of exhaustiveness of the carried out risks analysis.	
	Reporting : - establishing a compliance to system report.	- Document produced (written, oral, software).	

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

RADIATION AND SAFETY MONITORING ACTIVITIES	Definition All operations enabling the structure of the Industrial Safety and Health Physics section to check that the contractors' personnel apply the arrangements appropriate to risks prevention in their activities

<table>
<tr><th>Conditions of achievement (information, equipment, obligations)</th><th>Abilities/Competencies</th><th>Performance requirements (expected results, indicators)</th><th>Related KSAs
(general & theoretical Knowledge Skills & Attitudes)</th></tr>
<tr><td rowspan="5">From
- knowledge of the individual acces booklets (Health Physics authorization and validation),
- knowledge testing,
- software applications,
- CEFRI certification
- operational dosimetry,
- risks analysis,
- existence of prevention plan,
- knowledge of minor accidents</td><td>Being informed
- consulting the basic data,
- knowing the points to be checked,
- knowing the doctrine related to these points,
- finding out the nature of the activity,
- knowing all local instructions</td><td>- Main doctrine points overcome,
- instructions sent to those concerned</td><td rowspan="5">In the fields industrial safety, health physics, fire prevention, environment
- state-of-the-art practices,
- equipment technology,
- company doctrine and manufacturer's specifications,
- risks prevention
Laws and regulations :
- law nr 91 1414 (1991) on the prevention of risks,
- laws nr 75 306 (1975) and nr 88 662 (1988) on health physics in Basic Nuclear Facilities,
- law nr 92 158 (1992) on the works carried out by other companies
- quality decree of 10 08 84,
- basic rules applying to labor law (working hours, business trips,),
- texts and doctrines concerning fire (RCCI Design and Construction Rules related to Fire of PWR Nuclear Islands)
Knowing the company :
- organization, circuits, operations (EDF/other companies, plant/site technical support group, nuclear power plant/corporate resources departments,)
- procedures, quality plan,
- safety rules,- authorization requirements
- test doctrine and DSRE questions file
Methodology and « general tools » :
- written and oral expression,
- office automation (word processing, spreadsheet),
- problems analysing and solving
- basic calculations,
- paying attention/ readjustment,
- group chairing/regulation
- DOSINAT/ DOSIMO investigation thresholds,
- DOSINAT, SYGMA, A22, MRH softwares</td></tr>
<tr><td>Analysing
- assessing individuals' profile (dosimetry, tests)</td><td>- Scales applied to tests,
- relevant progress axes suggested</td></tr>
<tr><td>Dealing with
- making sure the instructions are known (fire permit, solvent,),
- handing out, explaining the local instructions,
- calling, if necessary, the physician and/or the person in charge of the contractor's personnel</td><td>- Strictness of inspections (statistically meaningful results),
- quality of relationship,
- inspection of documents</td></tr>
<tr><td>Checking
- Referring to, in case of availability, the check list of these operations,
- carrying out an experience feedback</td><td>- Synthesis of the operation,
- verification of minimum knowledge required</td></tr>
<tr><td>Reporting
- drawing up a statistical document,
- writing out a general activity report,
- informing the quality/purchase section</td><td>- Clear and easy-to-read documents,
- Ability to make the most of thecnical documents</td></tr>
</table>

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

WORK GROUP STEERING AND COMMUNICATION ACTIVITIES (for site personnel and contractors'personnel if any)	Definition : Voluntaristic process aiming at organizing the risks prevention promotion with the support of in line management (due to the behavior dimension).

Conditions of achievement (information, equipment, obligations)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes)
- Upon request of the structures, and the management of the nuclear plants, of the sections, of the CHSCT, - upon request of the internal and external magazines (Vigilance, Vie Electrique,...) - upon request of the corporate departments (DSRE, SPS, Corporate Resources Departments,...), - during unit shutdowns, in preparation, - on the Industrial Safety and Health Physics Section's structure initiative, relying on specialized resources and means (CRAM, INRS,...).	*Being informed* : - taking part in meetings, committees (ALARA, fire, communication,...). - organizing exchanges between companies and sites, - going through the specialized publications and documents.	- Relevant information selected, - quality of exchanges, - documents used as compared to the situations to be dealt with (for example : iodine, xenon,...).	- Expertise in one's field, - written and oral documents, - group organization and leading techniques.
	Analysing : - ...the documents received, - ...the accidents, the near accident, the experience feedback, the statistics.	-Information adapted and checked prior to circulation, - risks identified taken into account.	
	Dealing with : - setting up working groups, - organizing conferences, - writing articles, reports, - taking part in meetings (safety update), - taking part and contributing to start up meetings, - achieving prevention campaigns.	- Creativity of suggestions, - interest shown by participants, - information carriers adapted to the audiences : panels, videos, documents, papers,..., - security campaigns (tournaments, open days, contests, exhibitions).	
	Checking : - Observing safety actions taken over from and assumed by other Sections, - verifying that the policy is assumed by management contracts and indicators, - carrying out surveys and inquiries.	- Initiatives taken by other Sections on the theme of security, - modifications of organization (appointment of safety correspondents for instance), - messages taken into consideration for different fields, - Industrial safety and Health Physics structure considered as welcoming and open to exchanges, - behavior evolution.	
	Reporting : - achieving action follow-up and assuring appropriate reporting, - organizing meetings.	- Synthetic communications document with a reference, - followed up distribution of the documents established, - direct contact on site.	

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

TRAINING ACTIVITIES :	Definition : All activities implemented by the risks prevention professionals (either in an organized or a co-organized session) to enable the personnel to attain the level of knowledge and know-how in the various risks prevention fields (health physics, fire, traditional safety) and to develop the related skills.

Achievement conditions (information, equipment, obligations,...)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes)
From : - according to laws and regulations (fair labor standards act, doctrine, standard training plan, local professional training programme, policies,...), - local initiatives and Section managers, - co-operation with site external sections and training sections, - fields of special concern (dangerous products, ALARA process, experience feedback,...).	*Being informed* : - studying the site policies and measurements specific to the fields of concern, - improving one's knowledge in one's field of expertise.	- Training specifications and training file used in the training action, - items related to one's intervention field identified, - anticipation and preparation of the audience's and the structures' expectations, - needs definition re-written and specified.	The interventions are carried out in a confirmed field of skills (industrial safety, health physics, fire,...). Compulsory prerequisites : pedagogical training [2452 : transfer of knowledge, pedagogical initial training,...]. Interventions carried out within Pers.888 (Health and Safety at Work Committee, CMP,...). Voluntary service and good relationship qualities welcome.
	Analysing : - identifying training objectives, - designing and developing adapted actions.	- Audience's expectations and needs identified, - training aims formalized, - fields of knowledge specified.	
	Dealing with : - scheduling the participants to the training sessions, - organizing specific training sessions, - motivating the staff and the structures, - compiling one's own organization guide and one's own documents, - chairing (or co chairing) training actions or sequences.	- Training specifications and pedagogical files achieved, - prerequisites respected, - aims, contents, action modes adapted to situation and audiences, - quality of training delivery	
	Checking : - assessing and synthesizing the trainees' acquired knowledge, - validation of actions, - participating in the syntheses (concerns line management).	- Relevance of the analyses, - taking into account the notes and suggestions made in the syntheses, - individual assessment files used.	
	Reporting : - taking part in experience feedback, - achieving quantitative evaluations, - comparing the achievements and the aims to the management contract, - checking the integration of the training actions in individual training plans.	- Attendance and participation to the training sessions (rate), - Section heads experience feedback used and taken into consideration, - results of training actions forwarded (syntheses, assessments).	

PROFESSIONAL ACTIVITIES AND COMPETENCIES REFERENCE FRAME

ENGINEERING ACTIVITIES IN THE FIELD OF RISKS PREVENTION (industrial safety, health physics, fire) :	**Definition :** All the methodological steps linked, carried out off line, based on experience feedback analysis and multidisciplinarity. They are applied to the designing of action systems and prevention devices to effectively reach the goal set (preventing risks, limiting accidents). They aim at helping decision making thanks to reflection and anticipation, as well as an off-line event analysis They include the definition of the aims, the follow-up and the implementations and their associated indicators. Engineering is a suggestive force as well as an aid in decision making. Risks prevention engineering includes analyses of risks and of prevention needs, the prevention project design, the implementation co-ordination and control, as well as the assessment of the prevention's effects (according to AFNOR, Training lists).

Conditions of achievement (information, equipment, obligations,...)	*Abilities*/Competencies	Performance requirements (expected results, indicators)	Related KSAs (general & theoretical Knowledge Skills & Attitudes)
From : - requests and orders coming from internal sections (or from those of other Nuclear Power Plants), the Corporate Resource Departments, or other companies, - processes based on experience feedback* - preparation and site engineering structures,	*Being informed* : - regular check at all information sources (chronological accounts, Experience feedback, SAPHIR,...), - taking part in symposiums and work sessions within the company (Corporate Resources Departments), as well as outside the company (INRS; DRIRE, OPRI, the fire brigade, subcontractors, French Atomic Energy Commission,...).	- Mastering the specialized information in one's field, - standing and efficient listening capacity, - relevance of selected information, - identification of multidisciplinary aspects of problem to be solved.	- Expertises in the fields of conventional safety, health physics, fire (knowledge, experience, technicality, regulations,..), - techniques related to project management, - mastering the use of data banks (computerized maintenance management system, SAPHIR, ISOE,...), - techniques of analysis and problems solving,
- contributions and requests from various local or national committees (ALARA, fire prevention, industrial safety, ...) - modification files (Design Department for Thermal and Nuclear Projects)	*Analysing* : - considering the aims of the PSE and PSU, - integrating the laws and regulations, - integrating experience feedback.	- Decision-taker identified and request clarified, - coherence between research and the problem raised, - accuracy in the information selection and analysis, - timeliness in the choice of information.	- written and oral expression (new wording, synthesis, clarity,...), - Steering of groups, management of meetings
- a large autonomy and a position within the organization enabling freedom of operation and independence in getting information and performing analyses, - regulations,	*Dealing with* : - Carrying out studies and research, - formalizing and suggesting scenarios aiming at helping decision taking as well as implementation, - developing innovating processes, - participating in the implementations (facilitation, countervailing means,...).	- Quality of the works (form and content), - feasibility items identified (costs/timeliness), - taking into account additional expertises, - anticipation and innovation, - suggestion within the context from the concerned actors' viewpoint (preparation, intervention, control,...).	- experience feedback/good practices (safety, ALARA process), - knowledge of the installation operation and of the site general organization.,
* « *The experience feedback consists in drawing lessons from the progress of an operation to improve the performances of comparable subsequent operations* » (EDF policy regarding control. Letter of EDF CEO dated 16.03.94). Experience feedback to be considered : to and from preparation, engineerings, nuclear generation capacity.	*Checking* : - achieving the self-checking of one's activity, - contributing to the validation of suggestions, - adopting transverse communication processes with site engineers, - validating one's works through exchanges with other entities (Corporate Resources Departments, other, NPPs	- Strictness and transparency in backed up, well-argued and referenced documents, - contribution to attaining the general aims (personnel exposure to radiation, accidents,...), - variety of suggestions (professional code of practice).	
	Reporting - Prior to preparation : - writing out and distribution of reports Once the action is achieved : - feeding data banks (SAPHIR, ISOE,...) and other information sources (experience feedback system)	- Means of communication adapted to information significance and/or urgency (reactivity, accuracy, clarity,...), - resources available for structures and actors (advice, assistance, expertise, training,...).	

B 3. CHEMICAL TECHNICIAN TASK LIST (CANADA)

NUMBERING SYSTEM FOR DUTY AREAS, ACTIONS, TASKS, & JPMs

Criteria

1 Each task number is unique

2 A task number identifies

- the duty area
- the action
- the actual, sequential task number

3 A JPM number identifies

- the duty area
- the individual, sequential JPM number

4. The JPM number does not identify the tasks it contains or addresses. That information is put in the body of the JPM

5. The action numbers are 1 Analyze 2. Monitor
3 Sample 4. Perform

6. Each Task Number has 3 fields, eg, 11 1 05, 15 4 10

- The first field is the Duty Area (0-99), eg, 11
- The next field is the Action (1-4), eg, 1
- The third field is the actual task (0-99), eg, 05

Examples

Tasks - Task No 11 1 05 is the fifth task in duty area 11 and is associated with action 1 which is "analyze"
Task No 15 4 10 is the tenth task in duty area 15 and is associated with action 4 which is "perform"

JPMs -JPM No. 11 01 is the first JPM for duty area 11.
-JPM No 12 03 is the third JPM for duty area 12.

Duty Area -Duty area 20 is Liquid Scintillation
-Duty area 21 is Gamma Ray Spec

Typical Numbers -Duty Area 11
JPM 11 01
Task 11 4 01

Definitions

SETUP	Setup corresponds to the "setup" statement in the P-CLPs.
MAINTENANCE	Maintenance means general good housekeeping, ie, leaving the instrument ready for the next person to use It does not imply servicing to electronic components

General — Duty Areas 01-19

01 Administration — OJT — Task List

01 4 05 0029	PERFORM LAB INFO MGMT SYSTEM OPERATIONS
01 4 10 0121	PERFORM ISSUING OF SHIFT REPORTS
01 4 20 0127	PERFORM LAB SAFETY AUDIT
01 4 25 0128	PERFORM USE OF PND WMS
01 4 30 0329	PERFORM REVISION OF CHEMISTRY PROCEDURE
01 4 35 0330	PERFORM DEVELOPMENT OF CHEMISTRY PROCEDURE
01 4 40 0343	PERFORM ORDERING OF MATERIALS FROM OUTSIDE SUPPLIER
01 4 45 0428	PERFORM COMPLETION OF A TRANSFER PERMIT
01 4 50 0125	PERFORM REPLENISHMENT OF LAB STATIONERY
01 4 55 0580	PERFORM DOSE TRACKING

02 Laboratory Skills — OJT — Task List

02 4 05 0117	PERFORM EMPTYING OF PROCESSED D_2O CONTAINERS
02 4 10 0118	PERFORM REPLENISHMENT OF CHEMICAL REAGENTS
02 4 15 0119	PERFORM DATE CHECK & DISCARD EXPIRED REAGENTS/STDS
02 4 20 0120	PERFORM RADIATION CONTAMINATION SURVEY
02 4 25 0133	PERFORM LABORATORY AREA CLEANUP
02 4 30 0213	PERFORM D_2O STANDARD PREPARATION
02 4 45 0381	PERFORM OPERATION OF WATER PURIFIER
02 4 50 0382	PERFORM MAINTENANCE OF WATER PURIFIER
02 4 55 0383	PERFORM WATER PURIFIER QA PROCEDURES
02 4 60 0435	PERFORM DILUTION OF CONCENTRATED SAMPLES/STANDARDS
02 4 65 0581	PERFORM CORRECTION FOR D2O DENSITY
02 4 70 0543	PERFORM FUME HOOD PERFORMANCE CHECK
02 1 75 0078	ANALYZE CRUD CONCENTRATION GRAVIMETRICALLY
02 1 80 0354	ANALYZE SPECIFIC GRAVITY (HYDROMETER)
02 4 85 0210	PERFORM MECH PIPETTE PRECISION AND ACCURACY CHECK
02 4 90 0211	PERFORM LAB BALANCE CALIBRATION CHECKS
02 1 95 0345	ANALYZE FOR O_2 (CHEMETTES)

03 Quality Assurance — OJT — Task List

03 4 05 0234	PERFORM MDL CHECKS/CALCULATIONS
03 4 06 0582	PERFORM PRECISION CHECKS/CALIBRATIONS
03 4 07 0583	PERFORM ACCURACY CHECKS/CALIBRATIONS
03 4 10 0240	PERFORM UPDATING & REVIEW OF CONTROL CHARTS
03 4 15 0255	PERFORM PREPARATION OF STANDARDS/CHECK STANDARDS
03 4 20 0256	PERFORM RECORD-KEEPING OF STANDARDS
03 4 25 0257	PERFORM INTERNAL ROUND ROBIN ANALYSES
03 4 30 0258	PERFORM EXTERNAL ROUND ROBIN ANALYSES (COGIS)

03 Quality Assurance — OJT — Task List (Cont'd)

03 4 35 0436	PERFORM INSTRUMENT MAINTENANCE QA CHECKS
03 4 40 0437	PERFORM INSTRUMENT CALIBRATION QA CHECKS
03 4 26 0258	PERFORM COORDINATION OF EXTERNAL RND ROBIN ANALYSES (COGIS)
03 4 08 0820	PERFORM LAB STATS OPERATION

04 Worker Health And Safety - OJT - Task List

04 3 05 0130	SAMPLE DOMESTIC WATER FOR BACTERIA
04 4 10 0584	PERFORM DUTIES OF "CONFINED SPACE GAS SURVEYOR"
04 1 15 0056	ANALYZE FOR CONFINED SPACE COMBUSTIBLE GASSES
04 1 20 0308	ANALYZE FOR CONFINED SPACE BREATHABLE OXYGEN
04 1 25 0585	ANALYZE FOR CONFINED SPACE TOXIC GASSES
04 1 30 0034	ANALYZE FOR CO_2 IN AIR
04 4 40 0586	PERFORM PCB SCREEN TEST
04 1 45 0587	ANALYZE GENERATOR AREA ATMOS FOR COMBUSTIBLES
04 4 50 0107	PERFORM CHEMICAL TREATMENT OF PLANT ACUs/CHILLERS
04 3 55 0512	SAMPLE BREATHING AIR
04 1 65 0588	PERFORM URINE BIO ASSAY FOR H^3

05 Environmental Monitoring - OJT - Task List

05 3 05 0589	SAMPLE DOMESTIC WATER
05 3 07 0151	SAMPLE CCW EFFLUENTS
05 3 10 0152	SAMPLE SEWAGE SYSTEMS
05 3 12 0590	SAMPLE SULZER EFFLUENTS
05 3 13 0591	SAMPLE UPP EFFLUENTS
05 3 15 0592	SAMPLE REACTOR BUILDING SERVICE WATER EFFLUENTS
05 3 20 0593	SAMPLE IFB GROUND WATER TUBES
05 3 21 0595	SAMPLE AIFB SERVICE WATER EFFLUENT
05 3 22 0150	SAMPLE FOREBAY WATER
05 3 26 0596	SAMPLE AREA ENVIRONMENTAL MONITOR FOR H^3
05 3 27 0246	SAMPLE STACK SILICA GEL COLUMN FOR H^3
05 3 30 0597	SAMPLE STACK SILICA GEL/NaOH COLUMN FOR C14
05 1 34 0594	ANALYZE IFB GROUND WATER
05 1 36 0115	ANALYZE RESIDUAL CHLORINE IN DOMESTIC WATER
05 1 38 0792	ANALYZE AREA ENVIRONMENTAL MONITOR FOR H^3
05 1 39 0247	ANALYZE STACK SILICA GEL FOR H^3
05 1 40 0598	ANALYZE STACK NaOH FOR C14
05 1 45 0599	ANALYZE STACK IODINE CARTRIDGE
05 1 50 0600	ANALYZE STACK PARTICULATE FILTER
05 1 51 0601	ANALYZE STACK NOBLE GAS SAMPLE
05 4 60 0602	PERFORM FLOW RATE CHECK ON ZEB MUSSEL Cl_2 ANALYZER
05 1 61 0603	ANALYZE FOR SERVICE WATER Cl_2 CONCENTRATION CHECK

05 Environmental Monitoring - OJT - Task List (Cont'd)

05 4 62 0604	PERFORM REPLENISHMENT OF ZMCA REAGENTS
05 4 63 0605	PERFORM PREP OF LIQ EFF SAMPLES FOR LOW BETA ANALYSIS
05 4 65 0149	PERFORM STACK CHECKS
05 4 70 0153	PERFORM RLWMS TANK COMPOSITE
05 4 71 0158	PERFORM PREPARATION OF RLWMS TANK PRINTOUT
05 4 73 0363	PERFORM PREPARATION OF D_2O LOSS REPORT
05 4 75 0606	PERFORM RECORDING OF NOBLE GAS READINGS
05 4 77 0162	PERFORM PREPARATION OF EFFLUENT REPORTS
05 4 79 0901	CHANGE NOBLE GAS COMPUTOR BACKGROUND FILES

06 MISA - OJT - Task List

06 2 05 0367	MONITOR MISA ON LINE INSTRUMENTS
06 3 10 0369	SAMPLE WTP NEUT SUMP

06 3 12 0413	SAMPLE INACTIVE DRAINAGE SUMP
06 3 15 0607	SAMPLE RLWMS TANKS
06 3 20 0412	SAMPLE UNIT BOILERS
06 4 25 0387	PERFORM MTCE OF MISA SOFTWARE
06 4 30 0291	PERFORM MISA REPORT TO MINISTRY
06 4 35 0375	PERFORM OPERATION OF SAMPLE CART
06 4 36 0376	PERFORM MTCE OF SAMPLE CART

14 Emergency/PARMS - OJT - Task List

14 4 15 0399	PERFORM DETERMINATION OF FAD STACK H^3 RELEASE RATE
14 4 20 0400	PERFORM DETERM OF FAD STACK PARTICULATE RELEASE RATE
14 4 25 0401	PERFORM DETERM OF FAD STACK IODINES RELEASE RATE
14 4 30 0402	PERFORM DETERM OF FAD STACK NOBLE GASES RELEASE RATE

Laboratory Instrumentation - Duty Areas 20-58

20 Liquid Scintillation Counter- OJT - Task List

20 4 05 0609	PERFORM SETUP OF LSC
20 4 10 0202	PERFORM LSC ENERGY CALIBRATION
20 4 20 0195	PERFORM BACKGROUND CHECK OF LSC
20 4 15 0196	PERFORM GENERATION OF LSC QUENCH CURVE
20 1 25 0001	ANALYZE LOW LEVEL TRITIUM
20 1 30 0024	ANALYZE HIGH LEVEL TRITIUM
20 4 40 0610	PERFORM PRESCREENING OF C14 SAMPLES
20 4 45 0611	PERFORM OXIDATION OF C14 PARTICULATE SAMPLES
20 4 50 0612	PERFORM SETUP/OPERATION OF NaOH C14 BUBBLER
20 1 55 0613	ANALYZE FOR C14
20 4 60 0614	PERFORM MAINTENANCE OF OXIDIZER
20 4 65 0173	PERFORM MAINTENANCE OF LSC
20 4 70 0201	PERFORM LSC DAILY EFFICIENCY CHECK

21 Gamma Ray Spectrometer- OJT - Task List

21 4 05 0615	PERFORM SETUP OF GAMMA RAY SPEC
21 4 10 0112	PERFORM FILLING OF LAB LIQUID N_2 DEWARS
21 4 15 0192	PERFORM GAMMA SPEC ENERGY & FWHM CALIBRATION
21 4 16 0616	PERFORM GAMMA SPEC EFFICIENCY CALIBRATION
21 4 20 0194	PERFORM GAMMA SPECTROMETER EFFICIENCY CHECK
21 4 25 0193	PERFORM GAMMA SPECTROMETER BACKGROUND CHECK
21 1 30 0023	ANALYZE GAMMA SCAN (GeLi)
21 1 35 0243	ANALYZE GROSS BETA GAMMA COUNTING (Nal)
21 4 40 0617	PERFORM CLEANUP AND WASTE SEGREGATION

22 Gas Chromatograph - OJT - Task List

22 4 05 0618	PERFORM SETUP OF GC INSTRUMENT/INTEGRATOR
22 4 10 0206	PERFORM CALIBRATION OF GC He AND N_2 FLOW
22 4 15 0207	PERFORM STANDARD CALIBRATION OF GC
22 4 16 0619	PERFORM CHECK OF CALIBRATION OF GC
22 1 20 0073	ANALYZE FOR D_2/H_2, O_2, N_2
22 1 25 0039	ANALYZE FOR CO_2

22 2 30 0111	MONITOR GAS SUPPLY FOR LABORATORY INSTRUMENTS
22 4 35 0455	PERFORM MTCE OF GC
22 1 08 0731	ANALYZE HIGH HELIUM SYSTEMS FOR D_2/H_2, O_2, N_2
22 1 09 0732	ANALYZE HIGH HYDROGEN SYSTEMS FOR H_2, O_2, N_2, CO_2

23 IR Spectrophotometer- OJT - Task List

23 4 05 0625	PERFORM SETUP OF IR SPECTROPHOTOMETER
23 4 10 0626	PERFORM GENERATION OF IR SPECT CALIBRATION CURVE
23 4 15 0208	PERFORM CHECK OF IR SPECT CALIBRATION CURVE
23 1 20 0021	ANALYZE HIGH RANGE D_2O ISOTOPIC
23 1 25 0047	ANALYZE MEDIUM RANGE D_2O ISOTOPIC
23 1 30 0055	ANALYZE LOW RANGE D_2O ISOTOPIC
23 1 35 0309	ANALYZE AQUEOUS SAMPLE FOR OIL
23 4 45 0170	PERFORM IR SPECT MAINTENANCE
23 4 50 0209	PERFORM D_2O STANDARDS CANISTER CHECKS

24 FTIR- OJT - Task List

24 4 05 0902	PERFORM SETUP OF FTIR
24 4 10 0735	PERFORM GENERATION OF FTIR SPEC CALIBRATION CURVE
24 4 15 0903	PERFORM CHECK OF FTIR CALIBRATION CURVE
24 1 20 0837	ANALYZE HIGH RANGE D_2O ISOTOPIC (FTIR)
24 1 25 0838	ANALYZE MEDIUM RANGE D_2O ISOTOPIC (FTIR)
24 1 30 0839	ANALYZE VERY LOW RANGE D_2O ISOTOPIC (FTIR)
24 4 45 0840	PERFORM FTIR MAINTENANCE

25 Densiometer - OJT - Task List

25 4 05 0627	PERFORM SETUP OF DENSIOMETER
25 4 10 0212	PERFORM DENSIOMETER CALIBRATION
25 4 11 0628	PERFORM CHECK OF DENSIOMETER CALIBRATION
25 1 15 0344	ANALYZE MID RANGE D_2O (DENSIOMETER)
25 4 20 0438	PERFORM DENSIOMETER MAINTENANCE

26 UV-VIS Spectrophotometer- OJT - Task List

26 4 05 0629	PERFORM SETUP OF UV-VIS SPECT
26 4 10 0216	PERFORM UV-VIS SPECT CALIBRATION
26 4 15 0630	PERFORM CHECK OF UV-VIS SPECT CALIBRATION
26 1 20 0025	ANALYZE FOR BORON
26 1 25 0026	ANALYZE FOR GADOLINIUM
26 1 30 0034	ANALYZE FOR HYDRAZINE
26 1 35 0069	ANALYZE FOR SILICA
26 1 41 0439	ANALYZE FOR MORPHOLINE
26 4 50 0441	PERFORM UV-VIS SPECT MAINTENANCE

27 Atomic Absorption - Flame Spectrophotometer - OJT - Task List

27 4 05 0631	PERFORM SETUP OF M-FLAME SPECT
27 4 10 0217	PERFORM AA SPECT CALIBRATION
27 4 15 0632	PERFORM VERIFICATION OF AA SPECT CAL
27 1 20 0032	ANALYZE FOR TRACE METALS
27 4 25 0171	PERFORM MAINTENANCE OF AA SPECT

28 Atomic Absorption - Furnace spect - OJT - Task List

28 4 05 0904	PERFORM SETUP OF AA - FURNACE
28 4 15 0910	PERFORM CALIBRATION CHECK OF AA - FURNACE
28 4 10 0905	PERFORM AA - FURNACE SPECT CALIBRATION
28 4 07 0172	PERFORM MTCE OF AA - FURNACE SPECT
28 1 03 0845	ANALYZE LOW LEVEL IRON
28 1 04 0906	ANALYZE LOW LEVEL SODIUM
28 1 05 0846	ANALYZE LOW LEVEL COPPER
28 1 06 0907	ANALYZE LOW LEVEL SILICA
28 4 26 0219	PERFORM PREPARATION OF FILTERS

29 Ion Chromatograph - OJT - Task List

29 4 05 0633	PERFORM SETUP OF ION CHROMATOGRAPH
29 4 10 0218	PERFORM CALIBRATION OF ION CHROMATOGRAPH
29 4 15 0634	PERFORM CAL CHECK OF ION CHR USING QA STANDARD
29 1 20 0635	ANALYZE FOR ANIONS/CATIONS BY ION CHROMATOGRAPHY
29 4 25 0442	PERFORM ION CHROMATOGRAPH MAINTENANCE

30 Specific Ion Meter/Electrodes - OJT - Task List

30 4 05 0636	PERFORM SETUP OF CHLORIDE SPECIFIC ION METER
30 4 10 0219	PERFORM CALIBRATION OF CHLORIDE SPECIFIC ION METER
30 4 15 0637	PERFORM CAL CHECK OF CHLORIDE SPECIFIC ION METER
30 1 25 0109	ANALYZE FOR CHLORIDE ION CONCENTRATION BY SP ION ELECTRODES
30 4 30 0168	PERFORM FOR CHLORIDE SPECIFIC ION METER MAINTENANCE

31 pH Meter/Electrodes - OJT - Task List

31 4 05 0669	PERFORM SETUP OF pH METER
31 4 01 0219	PERFORM CALIBRATION OF pH METER
31 4 10 0911	PERFORM CAL CHECK OF pH METER
31 4 04 0019	ANALYZE pH
31 1 20 0168	PERFORM pH METER MAINTENANCE

32 Conductivity Meter- OJT - Task List

32 4 05 0642	PERFORM SETUP OF CONDUCTIVITY METER
32 4 10 0220	PERFORM CALIBRATION OF CONDUCTIVITY METER
32 4 15 0643	PERFORM CALIBRATION CHECK OF CONDUCTIVITY METER
32 1 20 0020	ANALYZE SPECIFIC CONDUCTIVITY
32 4 30 0169	PERFORM SPECIFIC CONDUCTIVITY METER MAINTENANCE

33 Low Beta Counter- OJT - Task List

33 4 05 0644	PERFORM SETUP OF BETA COUNTER
33 4 06 0204	PERFORM EFFICIENCY CHECK OF BETA COUNTER
33 4 07 0645	PERFORM CAL Q/A CHECK OF BETA COUNTER
33 4 08 0646	PERFORM MTCE OF BETA COUNTER
33 1 10 0647	ANALYZE FOR LOW BETA

NOTE: This Duty Area references to two different manufacturers, and requires four separate JPMs.

34 Autotitrator - OJT - Task List

34 4 05 0908	PERFORM SETUP OF METROHM 701 TITRATOR
34 4 10 0452	PERFORM CALIBRATION/MTCE OF METROHM 701 TITRATOR
34 4 15 0853	PERFORM CALIBRATION ONLINE OF METROHM 701 TITRATOR
34 1 20 0092	ANALYZE OIL FOR MOISTURE

36 Dewpointer- OJT - Task List

36 4 05 0651	PERFORM SETUP OF DEWPOINTER
36 4 06 0225	PERFORM CAL ONLINE OF DEWPOINTER
36 1 10 0100	ANALYZE DEWPOINT AT VARIOUS SITES
36 4 15 0175	PERFORM DEWPOINTER MTCE

38 Hydran Dissolved D_2 Analyzer - OJT - Task List

38 4 05 0649	PERFORM SETUP OF HYDRAN DISSOLVED D_2 ANALYZER
38 4 06 0177	PERFORM HYDRAN DISSOLVED D_2 ANALYZER MTCE
38 4 07 0650	PERFORM CAL OF DISSOLVED D_2 ANALYZER
38 1 10 0027	ANALYZE FOR DISSOLVED D_2

39 Particle Counter / Analyzer - OJT - Task List

39 4 05 0656	PERFORM SETUP OF PARTICLE COUNTER
39 4 10 0214	PERFORM CAL/MTCE OF PARTICLE COUNTER
39 4 15 0657	PERFORM CAL ONLINE OF PARTICLE COUNTER
39 1 20 0093	ANALYZE OIL FOR PARTICLE COUNT

40 Resistivity Meter - OJT - Task List

40 4 05 0658	PERFORM SETUP OF HYDRAULIC FLUID RESISTIVITY METER
40 4 10 0228	PERFORM CAL/MTCE OF HYD FLUID RESISTIVITY METER
40 4 15 0659	PERFORM CAL ONLINE OF HYD FLUID RESISTIVITY METER
40 1 20 0096	ANALYZE HYDRAULIC FLUID FOR RESISTIVITY

43 TOC/DOC Analyzer - OJT - Task List

43 4 05 0660	PERFORM SETUP OF TOC/DOC ANALYZER
43 4 10 0661	PERFORM CALIBRATION OF TOC/DOC ANALYZER
43 4 15 0662	PERFORM CAL ONLINE OF TOC/DOC ANALYZER
43 4 20 0663	ANALYZE FOR GROSS ORGANICS
43 4 25 0664	PERFORM TOC/DOC ANALYZER MAINTENANCE

44 Turbidity Meter- OJT - Task List

44 4 05 0648	PERFORM SETUP OF TURBIDITY METER
44 4 06 0221	PERFORM CALIBRATION OF TURBIDITY METER
44 1 10 0012	ANALYZE FOR TURBIDITY
44 4 15 0166	PERFORM TURBIDITY METER MAINTENANCE

45 Viscosity Meter- OJT - Task List

45 4 05 0653	PERFORM SETUP OF VISCOSITY METER
45 4 10 0223	PERFORM VISCOSITY METER CALIBRATION/MTCE
45 4 15 0654	PERFORM VISCOSITY METER CALIBRATION ONLINE
45 1 20 0091	ANALYZE OIL FOR VISCOSITY

46 Karl Fischer Titrator - OJT - Task List

46 4 05 0222	PERFORM SETUP OF KARL FISCHER TITRATOR
46 4 10 0174	PERFORM CAL/MTCE OF KARL FISCHER TITRATOR
46 4 15 0655	PERFORM CAL ONLINE OF KARL FISCHER TITRATOR
46 1 20 0092	ANALYZE OIL FOR MOISTURE

47 Gross Alpha Counter - OJT - Task List

47 4 05 0638	PERFORM SETUP OF ALPHA COUNTER
47 4 06 0639	PERFORM CALIBRATION OF ALPHA COUNTER
47 4 07 0640	PERFORM CAL Q/A ONLINE OF ALPHA COUNTER
47 4 08 0641	PERFORM MTCE OF ALPHA COUNTER
47 1 10 0391	ANALYZE FOR GROSS ALPHA

Process Instrumentation- Duty Areas 59

59 Process Instrumentation - OJT - Task List

59 4 05 0665	PERFORM SETUP OF TURBIDITY ANALYZER
59 4 06 0166	PERFORM CAL/MTCE OF TURBIDITY ANALYZER
59 4 07 0666	PERFORM INTERPRETATION ONLINE OF TURBIDITY ANALYZER
59 4 10 0667	PERFORM SETUP OF CRUD SAMPLING SYSTEM
59 4 11 0668	PERFORM OP/MTCE OF CRUD SAMPLING SYSTEM
59 4 15 0669	PERFORM SETUP OF pH ANALYZER
59 4 16 0189	PERFORM CAL/MTCE OF pH ANALYZER
59 4 17 0292	PERFORM INTERPRETATION ONLINE OF pH ANALYZER
59 4 20 0670	PERFORM SETUP OF CONDUCTIVITY ANALYZER
59 4 21 0190	PERFORM CAL/MTCE OF CONDUCTIVITY ANALYZER
59 4 22 0297	PERFORM INTERPRETATION ONLINE OF COND'Y ANALYZER
59 4 23 0671	PERFORM CATION COLUMN MTCE
59 4 25 0672	PERFORM SETUP OF SILICA ANALYZER
59 4 26 0179	PERFORM CAL/MTCE OF SILICA ANALYZER
59 4 27 0294	PERFORM INTERPRETATION ONLINE OF SILICA ANALYZER
59 4 30 0673	PERFORM SETUP OF SODIUM ANALYZER
59 4 31 0180	PERFORM CAL/MTCE OF SODIUM ANALYZER
59 4 32 0181	PERFORM INTERPRETATION ONLINE OF SODIUM ANALYZER
59 4 35 0674	PERFORM SETUP OF ALKALINITY ANALYZER
59 4 36 0675	PERFORM CAL/MTCE OF ALKALINITY ANALYZER
59 4 37 0676	PERFORM INTERPRETATION ONLINE OF ALKALINITY ANALYZER
59 4 45 0677	PERFORM SETUP OF HYDRAZINE ANALYZER
59 4 46 0191	PERFORM CAL/MTCE OF HYDRAZINE ANALYZER
59 4 47 0296	PERFORM INTERPRETATION ONLINE OF HYDRAZINE ANALYZER
59 4 50 0678	PERFORM SETUP OF DISSOLVED O_2 ANALYZER
59 4 51 0182	PERFORM CAl/MTCE OF DISSOLVED O_2 ANALYZER
59 4 52 0295	PERFORM INTERPRETATION ONLINE OF DISSOLVED O_2 ANALYZER
59 2 55 0074	MONITOR IN-LINE GC READINGS

Conventional Systems - Duty Areas 60-79

60 Water Treatment Plant - OJT - Task List

60 3 05 0298	SAMPLE WTP-RAW WATER
60 3 06 0679	SAMPLE WTP-DENSATOR
60 3 07 0300	SAMPLE WTP-SAND FILTER
60 3 10 0301	SAMPLE WTP-CARBON FILTER
60 3 15 0302	SAMPLE WTP-CATEXER
60 3 20 0304	SAMPLE WTP-ANEXER
60 3 25 0305	SAMPLE WTP-IONEXER
60 3 30 0306	SAMPLE WTP-DEMIN STORAGE
60 1 35 0250	ANALYZE FOR %ACID
60 1 40 0251	ANALYZE FOR % CAUSTIC
60 1 45 0044	ANALYZE FOR 2P-M

61 Recirculating Cooling Water System - OJT - Task List

61 3 05 0043	SAMPLE RECIRCULATING COOLING WATER SYSTEM
61 3 10 0680	SAMPLE RCW SYSTEM PURIFICATION LOOP
61 4 15 0681	PERFORM ADDITION OF CHEMICALS TO RCW SYSTEM

62 Boiler Feedwater System - OJT - Task List

62 4 05 0132	PERFORM HOUSEKEEPING OF FEEDWATER SAMPLE ROOMS
62 3 10 0066	SAMPLE BOILER-FEEDWATER SYSTEMS
62 2 15 0067	MONITOR BFW PROCESS INSTRUMENTATION
62 3 20 0078	SAMPLE SECONDARY SIDE CRUD
62 4 25 0682	PERFORM CRUD PROBE MTCE
62 4 35 0683	PERFORM ADDITION OF CHEMICALS TO FW SYSTEM

63 Stator Cooling Water System - OJT - Task List

63 3 05 0059	SAMPLE STATOR COOLING SYSTEM
63 3 10 0684	SAMPLE STATOR COOLING IX COLUMN OUTLET
63 3 15 0685	SAMPLE STATOR COOLING DE-OX COLUMN OUTLET

64 Generator Hydrogen Cooling System - OJT - Task List

64 3 05 0097	SAMPLE GENERATOR HYDROGEN COOLING SYSTEM
64 1 10 0893	ANALYZE DEW POINT (GEN H_2) - COMPARE TO ONLINE RESULT

66 Instrument Air System - OJT - Task List

66 1 05 0100	ANALYZE DEWPOINT AT SITE

Nuclear Systems - Duty Areas 80-99

80 Moderator System - OJT - Task List

80 3 05 0017	SAMPLE MODERATOR MAIN SYSTEM
80 3 10 0018	SAMPLE MODERATOR PURIFICATION OUTLET
80 3 15 0686	SAMPLE MODERATOR COVER GAS
80 3 20 0687	SAMPLE MODERATOR COVER GAS RECOMBINER OUTLETS

81 Shield Cooling Systems - OJT - Task List

81 3 05 0030	SAMPLE END SHIELD COOLING SYSTEM
81 3 10 0688	SAMPLE END SHIELD COOLING SYSTEM COVER GAS
81 3 15 0031	SAMPLE END SHIELD COOLING PURIFICATION SYSTEM
81 3 20 0689	SAMPLE BIOSHIELD COOLING SYSTEM
81 3 25 0690	SAMPLE BIOSHIELD COOLING PURIFICATION SYSTEM
81 4 30 0691	PERFORM ADDITION OF CHEMICALS TO ES COOLING SYSTEM
81 4 35 0692	PERFORM ADDITION OF CHEMICALS TO BS COOLING SYSTEM

82 Annulus Gas System - OJT - Task List

82 3 05 0038	SAMPLE ANNULUS GAS
82 1 15 0100	ANALYZE DEW POINT AT SITE

83 Heat Transport System - OJT - Task List

83 3 05 0045	SAMPLE HEAT TRANSPORT MAIN SYSTEM
83 3 10 0693	SAMPLE HTS MAIN SYSTEM USING CRUD PROBE
83 3 15 0046	SAMPLE HEAT TRANSPORT PURIFICATION LOOP
83 3 20 0694	SAMPLE HTS STORAGE TANK COVER GAS
83 4 25 0695	PERFORM ADDITION OF CHEMICALS TO HTS

84 Emergency Coolant Injection System - OJT - Task List

84 3 05 0054	SAMPLE EMERGENCY COOLANT INJECTION SYSTEM

85 Liquid Zone System - OJT - Task List

85 3 05 0057	SAMPLE LIQUID ZONE SYSTEM
85 3 10 0696	SAMPLE LIQUID ZONE PURIFICATION SYSTEM
85 3 15 0697	SAMPLE LIQUID ZONE COVER GAS SYSTEM
85 3 20 0698	SAMPLE LIQUID ZONE COVER GAS RECOMBINER OUTLET

B.4. EXCERPT OF UNIT SHIFT SUPERVISOR TASK LIST, BALAKOVO NPP (RUSSIAN FEDERATION)

1. Administer operator actions when turbine trips
2. Administer operator actions when condensate pump trips
3. Administer operator actions when all condensate pump trips
4. Administer operator actions when circulating pump trips
5. Administer operator actions when two circulating pump trip
6. Administer operator actions when feedwater pump trips
7. Administer operator actions when feedwater pumps trip
8. Administer operator actions when auxiliary steam collector ruptures
9. Administer operator actions when steam generator level exceeds emergency setpoints
10. Administer operator actions when feedwater collector ruptures
11. Administer operator actions when condensate pump discharge collector ruptures
12. Administer operator actions when secondary side radioactivity goes high
13. Administer operator actions when reactor scram occurs
14. Administer operator actions when containment isolation valves close
15. Administer operator actions during component cooling system malfunctions
16. Administer operator actions when reactor coolant pump trips

17 Administer operator actions when two reactor coolant pump trip
18. Administer operator actions when all reactor coolant pumps trip
19 Administer operator actions when reactor parameters exceed Tech Spec limits
20 Administer operator actions when steam generator steam line ruptures
21 Administer operator actions in response to small primary leak
22 Administer operator actions in response to major primary leak (leak flow may not be recovered by injection and make-up flow)
23. Administer operator actions in response to minor steam generator tube or collector leak
24 Administer operator actions in response to major SG collector leak
25 Administer operator actions when pressurizer safety valve stucks open and major leak exists
26. Administer operator actions when emergency feedwater system is actuated due to main feedwater system failure
27. Actuate safety system if it fails to start automatically
28. Administer operator actions in response to safety system power loss
29 Administer operator actions in response to power controller failure
30 Administer operator actions in response to power restrictor failure
31. Administer operator actions in response to preventive protection malfunction
32. Administer operator actions in response to emergency protection malfunction
33. Administer operator actions in response to increase of primary coolant radioactivity
34. Administer operator actions in response to increase of radioactivity in the containment
35. Administer operator actions in response to increase of radioactivity in the reactor building compartments
36. Administer operator actions in response to increase of radioactivity in the vent stack flow
37. Administer operator actions in response to accident with fuel during refuelling evolutions
38. Administer operator actions in response to uncontrolled movement of the control rod bank out of the core
39. Administer operator actions in response to spontaneous drop of the control rod bank
40. Administer operator actions in response to instant throwing of the control rod out of the core
41. Administer operator actions in response to uncontrolled spray in the pressurizer
42. Administer operator actions during reactor cooldown room
43. Administer operator actions in response to loss of natural circulation in the primary circuit
44. Administer operator actions in response to spent fuel cooling system malfunction
45. Administer operator actions in response to earthquake
46. Administer operator actions when starting reactor coolant pump in addition to operated ones
47. Administer operator actions in response to emergency cooling system heat exchanger flow loss
48. Administer operator actions in response to unit blackout
49. Order to startup emergency diesel generator if it fails to start automatically
50. Monitor shift activities in response to disconnecting generator from the power grid
51. Administer operator actions in response to high/low frequency in the power distribution system
52. Administer operator actions in response to high/low voltage in the power distribution system
53. Monitor shift activities in response to power loss on 6kV bus
54. Monitor shift activities in response to power loss on 0.4 kV bus
55. Monitor shift activities in response to uninterrupted power supply system failure
56. Monitor through subordinates unit transformer cooling system operation
57. Monitor through subordinates current duct (24 kV) cooling system operation
58. Monitor shift activities in response to stator cooling system integrity loss or isolation resistance of cooling water decrease
59 Monitor shift activities in response to generator excitation loss
60 Monitor shift activities in response to electrical system annunciator actuation
61. Control generator output voltage
62 Administer shift activities to switch 6 and 0.4 kV buses from main to backup power source
63 Administer shift activities to switch from main excitation controller to the backup one
64 Monitor testing of pressurizer safety valve by real pressure increase
65. Monitor testing of steam generator safety valve by real pressure increase

66 Monitor testing of the automatic fire mitigation system
67. M<onitor testing of steam dump system and SG safety valves by manual controller from main and emergency control rooms
68. Administer activities to start up turbine
69. Monitor turbine safety system, stop valves, and control valves tests before connecting generator to the power grid
70. Synchronize generator and connect it to the grid
71. Order to increase turbine load to follow up reactor power
72. Monitor feedwater controller under all operational conditions
73 Order to use steam bypass system
74 Monitor auxiliary steam flow to external consumers
75. Monitor primary and secondary circuit cooldown
76. Monitor following the procedures by the shift personnel
77 Keep operational discipline in the control room
78. Monitor shift activities in response to condenser vacuum loss
79. Monitor shift activities in response to main feedwater controller failure
80. Monitor shift activities in response to auxiliary service water pump trip with backup fails to start
81 Order the shift to respond to poor water quality in the primary circuit
82 Order the shift to respond to poor water quality in the secondary circuit
83. Administer emergency power supply system testing
84. Administer safety system pump and valve testing
85. Monitor maintenance of instrumentation and control systems
86. Monitor emergency reactor cooling tank testings
87. Monitor safety injection pump testings
88. Check the conditions required for reactor disassembling
89 Monitor nuclear safety requirements during assembling/disassembling the reactor
90. Monitor availability of emergency control room for reactor cooldown
91 Administer power reduction
92. Monitor safety requirements when work is performed in the containment with reactor operating
93. Monitor radioactivity of compartments and equipment
94. Check availability of reactor systems
95. Monitor hydraulic testings of primary circuit
96. Monitor hydraulic testings of secondary circuit
97. Check the conditions required to heat up primary circuit
98. Order subordinates to increase reactor power
99. Monitor coincidence of the reactor parameters with safe operation limits
100. Monitor staff activities in response to turbine process controller failure
101 Monitor staff activities in response to overheating of the generator
102. Monitor staff activities in response to generator hydrogen leak
103. Monitor staff activities in response to fire of turbine oil system
104. Administer staff activities in response to fire of turbine building rood
105. Administer staff activities in response to generator fire
106. Identify safe operational conditions when specified limits are exceeded
107. Administer staff activities in response to abnormal containment parameters
108. Administer staff activities in response to fire of regular 6 kV bus
109. Monitor automatic functions in response to unit transformer
110. Order to turn power down on buses in response to fire in communications
111. Monitor staff activities when automatic fire protection is actuated
112. Monitor staff activities and automatic functions in response to fire of reactor building oil systems
113. Administer staff activities in response to fire in the control room
114. Monitor shift turnover under all conditions
115. *Administer shift activities in response to small primary leak followed by emergency core cooling* system failure

116 Administer shift activities in response to average primary leak followed by emergency core cooling system failure
117 Administer shift activities in response to major primary leak followed by emergency core cooling system failure
118. Administer shift activities in response to leak from primary to secondary circuit with steam dump valve stuck open
119. Administer shift activities in response to low pressure core cooling pipe followed by the containment isolation valve failure
120. Administer shift activities in response to major primary leak followed by vent valve (400 mm) stuck open
121 Administer shift activities in response to station blackout with diesels fail to start
122 Administer shift activities in response to steam line break followed by emergency core cooling system failure.

ANNEX C. DESIGN

C.1. SIMULATOR INSTRUCTOR TRAINING: THE SIMULATOR CENTRE KSG/GfS (GERMANY)

Qualification requirements:

- University study as mechanical or electrical engineer or physicist
- Guided instructor training (3 years)
- Examination for instructor license for specific plant
- Maintaining Competence: min. 4 weeks of training per year
- New examination when changing power plant or simulator.

Training contents (major items):

- Technical contents like shift supervisor
- Minimum of 26 weeks of control room operations
- Minimum of 28 weeks of simulator training and instructing
- Pedagogical training (8 weeks): didactics, speech, human
- Factors, learning psychology, etc.
- Training in simulation technology.

Instructor examinations:

- Examinations board:
- 2 representatives of utilities (1 from the target power plant)
- 2 representatives of KSG/GfS
- Prerequisites: Documentation of all training items (duration and success)
- -onduct of examination:
- Check of prepared course documents
- Observation of instructions in control room and class room (2 h)
- Technical hearing (1 h): Range of all technical items of the target plant.

KSG	Training Schedule for Instructors	GfS

	Initial Phase	Research Phase I	Research Phase II	Consolidation Phase	Examination Phase
Goals	- Introduction - Organisation - Definitions - Basics	- Imparting of System Operating Methods - Technical Theory	- Imparting of Plant Operating Methods	- Retraining - Consolidation - Practical Training	- Preparation for Examination
Duration	12 weeks	34 weeks	26 weeks	50 weeks	6 weeks
Contents a) Organisation	- Organisation - Regulations - Operating Manual - Naming Convention				- According to Instructor s Guideline
b) Basics		Reaktor Physics - Reaktor Technology - Thermohydraulics - Instrumentation and Control			- According to Instructor s Guideline
c) Nuclear Power Plant Technology	- Survey • Components • Systems • Entire Power Plant - Survey Operation	- Layout and Operation • Components • Systems • Entire Power Plant	- Operation of Entire Power Plant • Normal Operation • Malfunctions • Beyond Design Accidents	- All previous Training Subjects together - Analysis of Operation Experiences - Exercise Documentation - Specification	- According to Instructor's Guideline
d) Simulator Technology	- Layout of Simulator - Survey Instructor Station	- Operation of Instructor Station - Model Technology - Hardware Technology	- Model limits		- According to Instructor s Guideline
e) Didactic and Educational Theory	- Introduction of Exercise Documentation	Methods of Training (Initial Course)	- Methods of Training (Research Course)	- Definition of Training Goals - Monitoring of Training Goals - Assessment	- According to Instructor s Guideline
f) Human Factors			- Course Human Behaviour		- According to Instructor s Guideline
Ways and Media of Training	- Internal GfS Training - Self-study - Simulator Training - On-the-Job Training in the Plant (2 weeks)	- Internal GfS Training - Self-study - On-the-Job Training in the Plant (7 weeks) Initial Simulator Course I (4 weeks) - Module I - Training by Software Dept - External Training	- Internal GfS Training - Self-Study - On-the-Job Training in the Plant (7 weeks) - Initial Simulator Course II (4 weeks) - Retraining Course (2 weeks)	- Internal GfS Training - Self-study - On-the-Job Training in the Plant (12 weeks) - Preparation for the Course - Initial Simulator Course (10 weeks) - Retraining Simulator Course (10 weeks)	- Preparation for the Course - Teaching Sample

C.2. MAINTENANCE PERSONNEL TRAINING NEEDS ANALYSIS (REPUBLIC OF KOREA)

EXAMPLE OF WELDING JOB WHICH HAS SEVERAL UNIT TASKS

Field: Mechanical Maintenance Job Title: Welding Job No.: 03

No.	Unit Tasks	Number of Response	Number of Frequency						Weight Factor						Difficulty					
			1	2	3	4	5	Ave.	1	2	3	4	5	Ave.	1	2	3	4	5	Ave.
001	Fabrication	85	11	8	31	28	7	3.1	5	10	40	25	5	3.2	5	10	44	25	1	3.1
002	Welding (Non-Qualified)	89	3	22	27	24	13	3.2	3	18	51	14	3	3.0	7	7	14	53	12	2.9
003	Arc Welding (TIG, MIG)	71	9		18	21	2	2.8	-	1	18	39	13	3.6	-	3	30	32	13	4.1
004	Gas Welding	76	9	21	18	21	2	2.9	-	2	36	36	2	3.5	-	3	33	37	3	3.5
005	Arc Welding (Qualified)	85	2	21	25	36	18	3.8	2	10	35	30	8	3.4	1	8	39	32	5	3.4
006	Slug Remove	81	4	4	28	28	11	3.4	10	9	34	24	5	3.1	5	22	31	21	2	2.9
007	Heating and Stress Remove	83	5	10	45	12	4	2.9	9	3	34	38	5	3.5	0	13	41	22	7	3.3
008	Bend Test	63	9	17	22	10	0	2.5	3	0	18	36	7	3.7	2	4	29	24	4	3.4
009	Management of Welding Equipment	79	4	22	40	25	5	3.3	0	8	43	27	2	3.3	2	19	44	12	3	3.0
010	Cleaning for Welding Audit	79	13	6	29	15	1	2.6	8	5	45	24	3	3.3	4	23	35	14	3	2.9
011	Cutting Works	84	5	21	23	31	18	3.6	5	11	48	22	3	3.2	-	13	57	11	2	3.0
012	Hydraulic Pressure Tester Control	73	15	6	24	9		2.4	11	3	29	32	7	3.5	4	4	37	24	4	3.3
013	Hydraulic Pressure Testing	76	17	25	25	6		2.3	3	3	28	32	12	3.7	3	3	44	19	7	3.3

QUALIFICATION OF MAINTENANCE PERSONNEL OF THE KOREA POWER PLANT SERVICE COMPANY

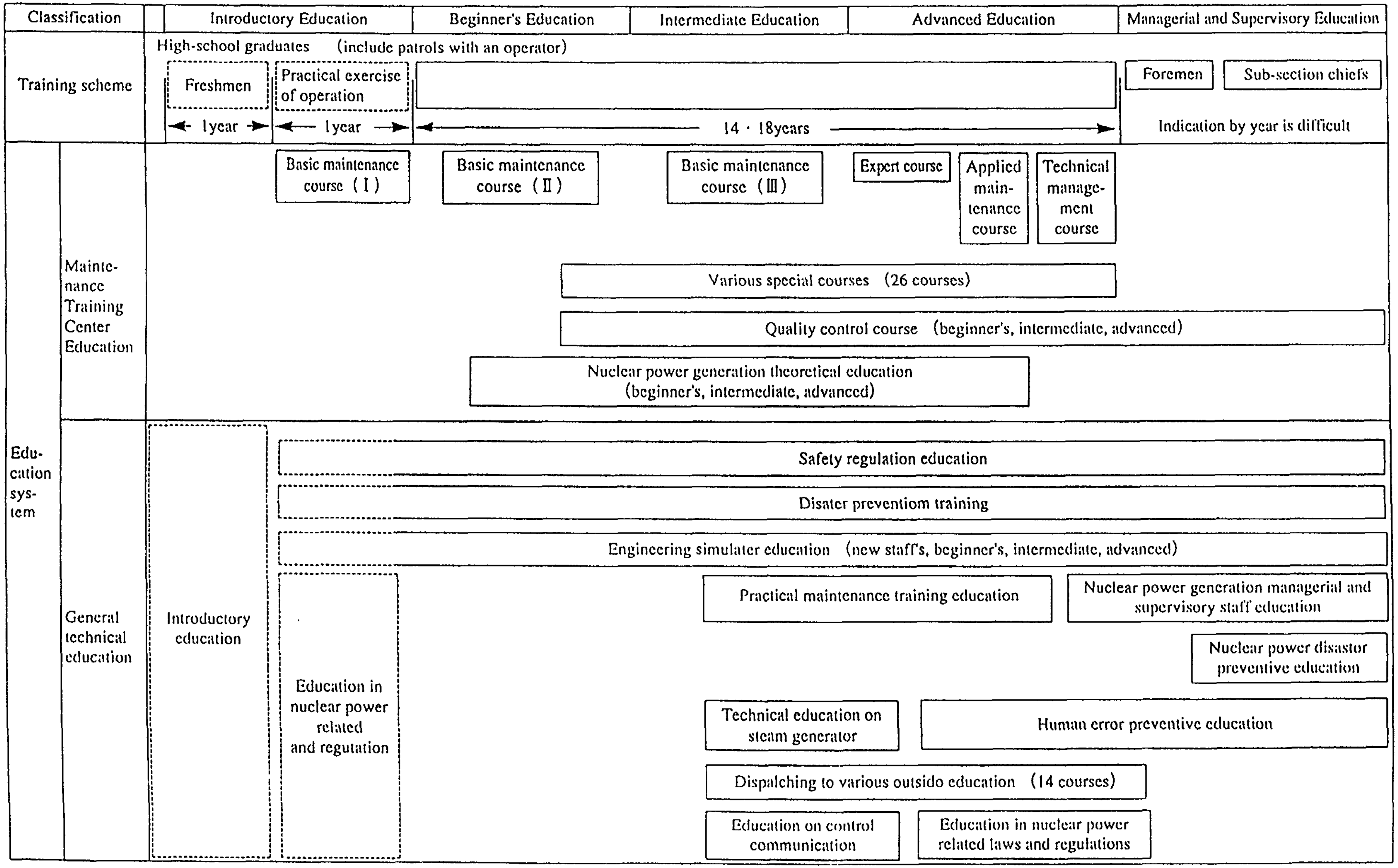
Classification	Qualification Field	Type of Qualification	Qualification Level
General qualification	Mechanics	General Mechanics	Level I
	Electrical	General Electrics	
Exclusive Qualification	Mechanics	Valve, Pump, Turbine, Reactor, Reactor Coolant Pump, Speed Governer, Diesel Engine, Vibration, Chiller, Steam Generator, Air Compressor, Post Tendom Test, Fan, Air Pre-heater, Boiler, etc (15 Types of Qualification)	Level I, II
	Electrical	Motor, Inventer, Automatic Voltage Regulator, Transformer, Breaker, Generator, Capacitor, Protective Relay, Hydraulic/Electronics Speed Governer, Electric Filter (10 Types of Qualification)	
Special Qualification	Nuclear Fuel Loading	Nuclear Fuel Loading	Level I, II
	Quality	Quality Auditing	Level I, II
		Quality Inspection	Level I, II, III
	NDT	RT, UT, PT MT ECT (5 Types of Qualification)	"
	Welding	Welding	Level I, II
	Flushing	Flushing	"
	Transmission Maintenance	Insulator Flushing, Dead line & Alive line Maintenance (3 Types of Qualification)	Level I
	Crane	Crane Operation	"
Total	11 Fields	41 Types of Qualification	

C.3. TRAINING PROGRAM OUTLINE FOR OPERATORS AND MAINTENANCE PERSONNEL (JAPAN)

LONG-TERM TRAINING SCHEDULE FOR OPERATORS

Classification		Introductory Education	Practical Exercise for Auxiliary Education	Auxiliary Operator Education	Turine Operator Education	Reactor Operator Education	Managerial and Supervisory Education
Training scheme		Freshmen	Operation trainees	Auxiliary operators	Turbine operators	Reactor operators	Foremen/Assistant shift supervisors/Shift supervisors
		← 1 year →	← 1 year →	← 3 year →	← 3 year →	← 6 · 7 year →	
Education system	Training at BTC or NTC				Shift team training course ←→		
					Initial training course ←→		
						General retraining course ←→	
						Senior retraining course ←→	
							Supervisor's retraining course ←→
	OJT	OJT in each post ←→					
	Main general technical education	Introductory education ←→					
			Educaton in nuclear power related laws and regulations ←→				
			Safety regulation education ←→				
			Simulated accident training, case study of accident, disaster prevention training ←→				
			full scope or compact simulator training ←→				
			Basic maintenance education for operators ←→				
			Nuclear power generation theoretical education, quality control education ←→				
					Human error preventive education ←→		
							Nuclear power generation disaster preventive education ←→

MAINTENANCE STAFF TRAINING SCHEME



C.4. SUPERVISORY TRAINING, BASIS AND TRAINING OBJECTIVES (ROMANIA)

OPERATING SUPERVISORY DEVELOPMENT
GOOD / BAD SUPERVISION

AREA OF CONCERN	EXPECTATION	BAD PRACTICE
1. JOB PLANNING	(a) Assign priorities according with Station requirements (b) Good understanding of planning process (c) Prioritization of work within shift (d) Coordonate job with the other groups	(a) Do not know the Station priorities and assign jos randomly (b) No ideea what Planning does (c) Resources are bad planned (d) Bottlenecks left for the next shift (e) Wait for other groups; "it's not my job"
2. JOB SUPERVISION	(e) Stop, Think, Ask questions (f) Consider contingencies (g) Provide feedback	(f) Just do the work (g) Events are coming by surprise (h) No feedback given
3. DISCIPLINE	(h) Following the procedures (i) Apply safety rules	(i) Procedures not followed (j) Safety rules not applied
4. DELEGATION OF WORK	(j) Delegate by the responsibilities	(k) The supervisor wants to be directly involved in everything
5. TEAMWORK	(k) Building team in Operating Department (l) Give the right importance to other groups involved in the Station	(l) Individualism is predominant (m) Other groups perceived just as support and they do not know anything about the Plant (n) "Kill the initiative"
6. COMMUNICATION	(m) Work Requests clearly filled (n) Completion of WR good documented (o) L4CP, OMT, etc., completed and all problems identified for the SE	(o) WR poorly written (p) WR just "complete" or "done" (q) Poor reporting on L4CP, OMTs, etc., (r) Turnover "in a glance"
7. PARTICIPATION	(p) Involvement in shift problems (q) Propose alternatives	(s) Lack of involvement (t) Accept everything as it is
8. ADMINSTRATION	(r) Keep information accesible (s) Keep good records (t) Solve current shift problems	(u) Information is lost (v) Records are bad (w) Give to somebody else to solve current shift problems
9. SAFETY CULTURE	(u) Raise UER even for your own mistakes (v) Use praise, recognition, not only punishment (w) Develop a sense of pride and ownership	(x) Hide the truth to protect himself (y) Use punishment often and no recognition (z) Negative attitude, find only the other's mistakes, no sense of ownership

COURSE OBJECTIVES DEVELOPMENT

Operating Department

ACTIONS	CONDITIONS	STANDARDS
PROMOTE SAFETY CULTURE	• in all circumstances	
• state the definition of Safety Culture	• on request • from memory	• accurately
• state the major hazard associated with reactor operation, and relate the potential for public impact to the negative results of other human activities	• on request • from memory	• accurately
• state the role and responsibilities (in regard to reactor safety) of the Licence and the Regulator	• on request • from memory	• accurately
• list the key events which led up to the Cherobyl incident and briefly describe its aftermath	• on request • from memory	• accurately
• list the main characteristics of stations with and without appropriate Safety Culture	• on request • from memory	• accurately
• carry out an assessment of Departamental practices and their contribution - or impact on - the Safety Culture at Cernavoda NPP	• at the request of the course instructor • in conjuction with other course participants • periodically, at the request of Department management	• thoroughly • honestly • within the allocated time
• identify the barriers preventing the full development of an appropriate Safety Culture in your Department, and suggest relevant solutions	• at the request of the course instructor • in conjuction with other course participants • periodically, at the request of Department management	• thoroughly • honestly • within the allocated time
• demonstrate a consistency in (thought,) word and action	• in all circumstances	• without exception
apply safety rules	☞ in all circumstances	without exception
▪ Raise UER	• in all appropriate circumstances	• consistently • accurately • with conviction
• personally support Safety Culture at Cernavoda NPP by aplying the STOP/THINK/ASK approach	• in all appropriate circumstances	• consistently • accurately • with conviction
ROLE / RESPONSIBILITIES		
• know your department position in the organization and relationship with other workgroups	• on request • form memory	• accurately
• state the primary role and major responsibilities for your position	• on request • form memory	• accurately • with confidence

• check the quality of the work plan	▪ in all appropriate circumstances	• in sufficient time to avoid negative work delays
• attend morning meetings with Expat supervisor		• daily
• briefly describe each of your major responsibilities, and show how its fullilment adds value to the work of your Department	• on request • form memory	• accurately • with conviction • within the allocated time
PLAN WORK		
briefly describe the overall planning process	on request from memory	accurately
describe in detail the work planning process for your Department	on request from memory	accurately
state the benefits of work planning to yourself, your work group, your Department and the Station	on request from memory	accurately and with conviction
Work Requests clearly filled	as required	• promptly • accurately
Document the Work Requests completed	as required	• promptly • accurately
L4 CP, OMT completed and input problems to RSE	as required	• promptly • accurately
•Turnover with relevant details	• each T/O	• accurately • in the T/O timeframe
• check the quality of the work plan	☞ in all appropriate circumstances	• in sufficient time to avoid negative work delays
• attend morning meetings with Expat supervisor		• daily
• state the benefits of work planning	• on request • from memory	• accurately and with conviction
• plan your work	• daily	• agenda agreed by the Supervisor
• solve bottlenecks	• discuss with RSE / maint.	• the problem is addressed and resolved • in sufficient time to avoid negative work delays
• establish a group strategy	• daily	
• think ahead	• as required	• in a proactive manner
ASSIGN AND MONITOR WORK		
prepare list of work assignments for the shift	☞ according with station priorities	☞ at the begining of shift
discuss work assignments with assignees	☞ when distributing the assignments ☞ at the initiative of the workers, when a concern or problem exists	☞ briefly but thoroughly

• check for feedback	• as required	• concurent with the task • postaction
• give feedback	• as required	• concurent with the task • postaction • highlight both pozitive and negative aspects
COMMUNICATE		
• listen	• when spoken to	• attentively • actively • without interrupting
• restate other's input	• when others have finished speaking	• in your own words • accurately reflecting the message presented
• give information	• on request • as circumstances require	• clearly • briefly but thourghly
• share ideas	• on request • as appropriate	• clearly • briefly but thoroughly
• ask questions	• when ideas, information or problems are not clear	• clearly • briefly • effectively
FOSTER TEAMWORK		
• use inclusive language	• in all circumstances	• consistently
• allocate assignments fairly	• when assigning work	• consistently with stated principles
• develop staff through training and coaching	• as circumstances permit • as circumstances dictate	• according with training plan • so that improvement is evident from month to month
• share responsibility and authority	• as circumstances permit	• judiciously • so that work progresses more efficiently • so that staff supervisory skill increase from quarter to quarter
• share resources	• as required	• in sufficient time to avoid work delays • so that group work progresses more efficiently
• adress presonality issues	• as required	• in sufficient time to avoid work impact • so that resolved problems do not recur
• encourage initiative and problem solving	• in all circumstances	• consistently • among all staff • so that improvement in efficiency and effectiveness are evident from quarter to quarter
• meet with other supervisors to discuss and resolve interfacing issues	• periodically	• so that improvements in cooperation are evident form quarter to quarter

C.5. LESSON PLAN (SLOVAKIA)

SESSION MANUAL

A session manual that is used in the NPP Personnel Training Centre of VÚJE should assure that the *training is delivered at the same manner all time.*

A session manual consists of:

1) Formal Review Form - it is used during formal revisions of course materials by person who is responsible for this audit
2) Session Approval Record - is used when the content of the session manual is changed
3) Review Sheet for Presenter
4) Index to Session Manual
5) Session objectives
6) Sessions notes - a part of the course participant's textbook
7) List of reference Material
8) Visual Aid Requirements and Visual Aids
9) Session Plan - it is the plan for instructor how to deliver the session
10) Overhead transparencies and slides
11) Hardcopy of overhead transparencies.

The material below illustrates the items of a session manual.

Formal Review Form

Session code: 031a01A - 14/06/01

Session title: Main Power System

Author: Viliam Kõszeghy

Check of Session Documentation:

Session Documentation	Yes	No	Comments
1. Formal Review Form			
2. Session Approval Record			
3. Review Sheet for Presenter			
4. Index to Session Manual			
5. Session Objectives			
6. Session Notes			
7. List of Reference Material			
8. List of Visual Aids			
9. Lesson Plan			
10. Visual Aids			
11. Overheads Copies			

	Name	Signature	Date
Reviewed by			
Check by			
Approve by			

Session Approval Record

Session code: 031a01A - 14/06/01

Session title: Main Power System

Author: Viliam Kõszeghy

Detail of Amendment of Review	Carried out by	Carried out on	Resulting in version	Approved by	Approved on

Review Sheet for Presenter

Session code: 031a01A - 14/06/01

Session title: Main Power System

Time Allocated: 30 minutes

Date	Tutor	Time taken	Comments

Index to Session Manual

Session code: 031a01A - 14/06/01

Session title: Main Power System

Main Power System

Learning objectives:

At the end of the session the course member will be able to:

1. ***Define two main arts of the NPP Electrical System.***
2. ***State the function of the NPP Main Power System.***
3. ***Chart the NPP Main Power System and name each part of it.***
4. ***Define the purpose of the incased conductors***

Main Power System

Here are located session notes (a part of the trainee's textbook) in the regular session manual.

List of Reference Material

1. Doc. Ing. Štefan Marko, CSc.: Power Plants,Edièné stredisko SVŠT, Bratislava,1980
2. Operational Procedure NPP V-2 T - 096
3. Operational Procedure NPP V-2 T - 097
4. Operational Procedure NPP V-2 T - 098
5. Operational Procedure NPP V-2 T - 106

Visual Aid Requirements and Visual Aids

Whiteboard

Overhead Projector

Overhead Transparencies

1. 03 1a 01A - 14/06/01/P001 Learning Objectives
2. 03 1a 01A - 14/06/01/P002 NPP Electrical System
3. 03 1a 01A - 14/06/01/P003 Main Power System
4. 03 1a 01A - 14/06/01/P004 Main Power System - detailed scheme

C.6. ENTRY LEVEL REQUIREMENTS (FINLAND)

Position	Basic Education	Work Experience Total (years)	Nuclear Field (years)
Responsible Manager and his deputy	M.Sc	10	5
Operations Manager	M.Sc, E	7, 10	3, 5
Maintenance Manager	M.Sc, E	7, 10	3, 5
Technical Manager	M.Sc	7	3
Operations Engineer	E	7	3
Safety Engineer (Operations)	E	5	3
Shift Supervisor	E, T	5, 7	3, 5
Operator	T	3	1
Field Operator	VT, -	1, 3	0 5, 1
Mechanical Maintenance Manager	E, T	5, 7	1, 3
Electrical Maintenance Manager	E, T	5, 7	1, 3
Instrumentation Maintenance Manager	E	5	1
Building Maintenance Manager	E, T	3, 5	-, 1
Work Planning Manager	E	5	3
Work Planner	T, VT	3, 5	1, 3
Work Supervisor	T, VT	3, 7	1, 3
Mechanic	VT, -	1, 3	0 5, 1
Reactor Engineer	M Sc, E	3, 5	3, 5
Fuel Engineer	M.Sc	3	1
Chemist	M.Sc, E	3, 5	1, 3
Radiochemist	M.Sc, E	3	1
Radiation Protection Manager	M.Sc, E	5	3
Radiation Protection Technician	T	3	1
Radiation Protection Assistant	T, -	1, 3	1, 3
Safety Engineer (technical support)	M.Sc, E	3, 5	3, 3
Testing Engineer	M.Sc, E	3, 3	1, 1
Operations Planning Engineer	M.Sc, E	3, 5	1, 3
Quality Assurance Manager	M.Sc	5	3
Quality Assurance Engineer	M.Sc, E	3, 5	1, 1
Quality Control Engineer	M.Sc, E	3, 5	3, 3
Planning Manager	M.Sc, E	5, 5	1, 1
Process Engineer	M Sc, E	3, 3	1, 1
Electrical Engineer	M.Sc, E	3, 3	1, 1
Instrumentation Engineer	M Sc, E	3, 3	1, 1
Reliability Engineer	M.Sc, E	3, 3	1, 1
Operational Experience Engineer	M.Sc, E	3, 3	1, 1
Training Manager	M.Sc, E	3, 5	1, 3
Instructor	E, T	3, 5	1, 3
Simulator Instructor	E, T	3, 5	3, 3
Emergency Preparedness Expert	M.Sc, E	3, 5	1, 3
Security Expert	M.Sc, E	3, 3	1, 3
Safeguards Expert	M Sc, E	3, 3	1, 3

Legend : **M.Sc** – Master of Science in Technology or equivalent academic degree
E – Engineer or equivalent technical training ; **T** – Technician or equivalent technical training
VT – Vocational training relating to the field; **-** no (specific) vocational training

ANNEX D. DEVELOPMENT

D.1. ASSESSMENT USING A BASIC PRINCIPLE SIMULATOR (UNITED KINGDOM)

Nuclear Electric plc

Technical Training Branch

Oldbury Training Centre

Departmental Instruction TT/ODI/032

Assessment of Trainee Performance
Using the Basic Principles Switching Simulator (BPSS)

Prepared by .... Date ....
C Gooch

Reviewed by .... Date ....

Approved &
Authorised for Issue: .... Date ....
Principal Oldbury Training Centre

Revision/Review Register

A review/change of this document was carried out as follows:

Date	Carried out by	Signature	Amendment & brief reason
2- 4-93	P Hanney		Initial preparation
14- 7-94	C Gooch		Amendment to add new criteria No.1

Copy No ....

Contents

Assessment of Trainee Performance Using the BPSS

1 **Purpose of Instruction**

To define the method for assessing Course Member performance during BPSS Based Training provided by Technical Training. The assessment should be used as an indicator of suitability for authorisation/nomination for HV Switching duties under Nuclear Electric Procedure SRP6 and National Grid Company Procedure SRMP6.

2 **Scope**

This Departmental Instruction applies to all assessments of Course Member performance during BPPS Based Training provided by Technical Training.

3 **Responsibilities**

The maintenance of this document is the responsibility of the OTC Principal.

4	**Procedure**	**Actions**
4.1	Form of Simulator Assessment	
4.1.1	A Course Member will be assessed by members of an assessment panel in the following areas against the criteria in Appendix A. i) Consideration of Switching Instruction ii) Pre-amble Procedure iii) Production of a switching instruction iv) Correct use of telephone technique v) Recording of switching instructions vi) Implementation of switching isolation vii) Reporting back switching operations viii) Fault reporting.	
4.1.2	The Course Member will be assessed against two exercise scenarios.	
4.2	Simulator Assessment Panel	
4.2.1	The Assessment Panel will consist of:- i) Station Shift Charge Engineer (at Stations request) ii) Simulator Tutor (BPSS) iii) Technology Team Leader or Simulator Tutor (BPSS).	
4.3	Simulator Assessment Criteria	
4.3.1	For each assessment area there are a number of criteria. See Appendix A.	

4 3 2	Each of the criteria has two categories, Satisfactory (S) and Unsatisfactory (U)	**Actions**
4 4	Recording of Simulator Assessments	
4 4 1	Each member of the assessment panel should complete and sign the simulator Assessment Record Sheet, Appendix B	Shift Charge Engineer/Simulator Tutor/Team Leader
4 4 2	Where performance in any area is unsatisfactory the reason should be given on the Simulator Assessment Record Sheet	Shift Charge Engineer/Simulator Tutor/Team Leader
4 4 3	The Simulator Exercises used for the assessments should be entered on the Simulator Assessment Record and Record Sheets - Appendix B and C	Simulator Tutor
4 4 4	The Assessment Panel should discuss the Simulator Assessment Records for a Course Member and complete the Simulator Assessment Report Appendix C, indicating the panel's opinion of whether the Course Member has demonstrated satisfactory or unsatisfactory performance in all areas	Shift Charge Engineer/Simulator Tutor/Team Leader
4 5	Report Simulator Assessments	
4 5 1	The Simulator Assessment Report Sheet Appendix C will form the basis of Technical Co-ordinator reporting Course Member Performance using the BPSS	
4 5 2	The Simulator Assessment Report Sheet for each Course Member will be endorsed by a Team Leader and sent to the Station Manager (fao Training Engineer) following a course	Team Leader
4 5 3	The Shift Charge Engineer will retain a copy of the Simulator Assessment Report Sheet for each Course Member	
4 5 4	In cases where performance in any area is unsatisfactory the Shift Charge Engineer will retain copies of the Simulator Assessment Record sheets in addition to the Simulator Assessment Report sheet for discussions with the Production Manager regarding Course Member's Performance	
4 6	Re-Training or Re-Assessment of Course Members	

		Actions
4.6.1	Technical Training will discuss and agree with Station Management any requests made by them for additional training or re-assessment of Course Members.	Course Co-ordinator
4.7	Simulator Assessment Feedback	
4.7.1	Feedback to the Course Member on his performance during Simulator Assessment will be carried out immediately following the assessment by the member(s) of the assessment panel.	
4.7.2	The Course Member should be asked to add any comment he has and to sign the Assessment Record Sheet.	Simulator Tutor
4.7.3	In cases where performance in any area is unsatisfactory a full assessment debrief will be carried out by the BPSS Tutor and/or Shift Charge Engineer.	

5 Definitions

Not applicable.

6 References

Prior to Appointment or Authorisation the following documents should be consulted:

1. Nuclear Electric Appointment of Persons SRP6
2. National Grid Company Appointment of Persons SRMP6.

7 Records

7.1	Simulator Assessment Record Sheets Appendix B Simulator Assessment Report Sheets Appendix C shall be retained by Technical Training for a period of 5 years.	Team Administrator

Simulator Performance Evaluation Guide

1 Consideration of Switching Requirement

Element	Satisfactory	Unsatisfactory
Consider purpose of switching, effect on system security and availability of Nuclear Safety related plant.		

2 Production of Switching Instruction

Element	Satisfactory	Unsatisfactory
Location of apparatus, identification, sequence of operation, Name of Control Person, legible, clear and concise		

3 Preamble Procedure

Element	Satisfactory	Unsatisfactory
Introduction to request, clear indication of requirement. Logical approach		

4 Correct Use of Telephone Terminal

Element	Satisfactory	Unsatisfactory
Use of correct terminology, voice clear and audible. Instruction given phrase by phrase. Required Authorised Person to repeat message Ask name of Authorised Person, record time and date of instruction.		

5 Recording of Switching Instruction

Element	Satisfactory	Unsatisfactory
Own name recorded. Location of apparatus, correct recording of instruction repeated back phrase by phrase. Complete message repeated back, time of switching instruction recorded		

6 Implementation of Switching Instruction

Element	Satisfactory	Unsatisfactory
Deliberate. No rushing, no delay, written instruction in hand. Pause and re-check. Check operation completed, tick off each operation, time of completion of switching. Check indication of switch/isolator before and after each operation.		

7 Report back Switching Instructions

Element	Satisfactory	Unsatisfactory
Name. Operation verified, Time of Operation, Time of confirmation		

8 Fault Reporting

Element	Satisfactory	Unsatisfactory
STOP instruction, report back to Control Person. Verify fault and log fault.		

Simulator Performance Evaluation Guide

Course ____________________ Simulator ____________________

Course Member ____________________ Designation ____________________

Assessor ____________________ Designation ____________________

		A	B
1	Consideration of Switching Requirement		
2	Production of Switching Instruction		
3	Preamble Procedure		
4	Correct use of telephone techniques		
5	Recording of Switching Instructions		
6	Implementation of Switching Instructions		
7	Report back Switching Operations		
8	Fault Reporting		
9			

Scenario	Exercise Number	Description
A		
B		

Comments

NB Comments must be made where performance is unsatisfactory.
S = Satisfactory U = Unsatisfactory

Signature of Assessor ____________________ Date____________________

Simulator Performance Evaluation Guide

Course ____________________ Simulator ____________________

Course Member ____________________ Designation ____________________

Assessors____________________ Designation ____________________

____________________ ____________________

____________________ ____________________

Date ____________________

		A	B
1	Consideration of Switching Requirement		
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9			

Scenario	Exercise Number	Description
A		
B		

Assessors Comments:

NB Comments must be made where performance is satisfactory.
S = Satisfactory U = Unsatisfactory

Course Members Comments:

Endorsed by: ____________________ Date____________________
OTC Team Leader

Omaha Public Power District
Nuclear Operations Division
Licensed Operator Training Program
CEOG Template Based Requalification Dynamic Simulator Examination

TITLE: LOCA & SBO
SSG: 08-42-13 Rev 0

Prepared by:	C.L. Rennerfeldt	**Date:**	11/21/96
Reviewed by:		**Date:**	
TRNG Supervisor:		**Date:**	
OPS Supervisor:		**Date:**	

CEOG Template Based Requalification Dynamic Simulator Examination

TITLE: LOCA & SBO
SSG: 08-42-13 Rev 0

Length: 1.00 hrs.

Date and Time of Examination: _/_/___ : _ a.m./p.m.

CREW PASS/FAIL:

EXAMINEES		~~**Individual**~~ **PASS/FAIL**
Shift Supervisor:	____________________	________
Licensed Senior Operator:	____________________	________
Licensed Operator (Primary):	____________________	________
Licensed Operator (Secondary):	____________________	________
Shift Technical Advisor:	____________________	

EVALUATORS:

Lead Instructor: ______________________________

Simulator Operator: ______________________________

Extra Evaluator #1: ______________________________

Extra Evaluator #2: ______________________________

RELATED TASKS: MTL-0006, MTL-0007, MTL-0066, MTL-0228, MTL-0360, MTL-0361, MTL-0793, MTL-0795, MTL-0796

RELATED CONTROL MANIPULATIONS: SIMA-07E, SIMA-09, SIMA-10, SIMA-11 SIMB-16, SIMB-22, SIMB-25.

EVALUATOR INFORMATION ONLY

I. SCENARIO OBJECTIVES

- Evaluate the crew's response to various related alarms and instrument failures.
- Evaluate the crew's response to a failure of the running TPCW pump.
- Evaluate the crew in applying Technical Specification requirements to an RCS leak.
- Evaluate the crew's implementation of AOP-22, "Reactor Coolant Leak", in responding to a RCS leak.
- Evaluate the crew's use of EOP-00, "Standard Post Trip Actions", and EOP-20, "Functional Recovery Procedure", in responding to an RCS LOCA and a loss of all electrical power.

II. NARRATIVE SUMMARY

1. Start with equipment listed on Turnover sheet out of service.
2. One of the PORVs begins to leak.
3. The CVCS letdown controller begins to oscillate.
4. The running TPCW pump packing beings to leak excessively.
5. An RCS leak begins that will exceed the capacity of the charging pumps.
6. Bus 1A3 will fault and DG-2's breaker will not auto close on bus 1A4.
7. HPSI fails to auto initiate on PPLS/SIAS.
8. HPSI Scenario ends when power is re-established to Bus 1A4 and the RCS is stabilized on flow.

III. REFERENCES

TS-2.
TECHNICAL SPECIFICATION - LIMITING CONDITION FOR OPERATION - RCS leakage

FCS CEOG Simulator Scenario Template Guides

EOP-00.
EMERGENCY OPERATING PROCEDURE - Standard Post Trip Actions

-203.
EMERGENCY OPERATING PROCEDURE - Functiona Recovery Procedure

AOP-22.
ABNORMAL OPERATING PROCEDURE - REACTOR COOLANT LEAK

ABNORMAL OPERATING PROCEDURE - REACTOR COOLANT LEAK

IV. SIMULATOR PREPARATION

A. Initial Condition: 80% power

B. Modifications to IC:

1. Prepare an XY Plot on ERF: RMO-57, RMO-54A, & RMO-54B.

On the ERF:

	TYPE	**XYP**
	PRESS	**DSP**
For desired group TYPE		**RMS**
	PRESS	**ENT**

2. Place RM0-64 in service.

3. Report that sample of: CST, Drip & Drain tank & Turbine Room Sump are done and there are no indications of activity.

4. Tag out VA-3B for bearing replacement.
[LOA EDS105 0,0,D]

C. Malfunction Setup:

1. Failure of HPSI pumps to start on SIAS.
[file z4201]
2. Failure of DG-2 breaker to auto close on SBO.
[file z4213]
3. Bus 1A3 fault.
[MAL EDS1C ACT,0,0,C,JRPSRXTP]
4. Loss of 161kv.
[MAL EDS11B ACT,0,0,C,JRPSRXTP]

D. All evaluators familiarize themselves with the Performance Criteria, the Critical Tasks (CTs) and Crew Evaluation Criteria, as appropriate, prior to initiating the exercise. Attachments 1 and CEOG CCE 1 will be used for rotational evaluations. Attachments 2 and CEOG CCE Brief 1 will be used for annual requalification evaluations.

V. PRE-SESSION BRIEFING

A. DYNAMIC SIMULATOR BRIEFING CHECKLIST: Review the entire checklist, Attachment CEOG Brief 1, with the crew prior to performing the first exercise. If an usually long delay occurs between exercise, the lead instructor may choose to repeat the review of Attachment CEOG Brief 1 prior to beginning subsequent exercises.

1. The crew should be assembled in the Simulator briefing area for this review of Attachment CEOG Brief 1.

B. SHIFT TURNOVER INFORMATION: Assemble the crew in the simulator and brief the entire crew as to the present status of the simulated plant.

1. Use the Turnover sheet as reference.

C. BOARD WALKDOWN AND TURNOVER: Give the SS or LSO the Turnover Sheet and instruct the crew to complete their walkdown of the control boards. Allow up to 10 minutes for the crew to complete the walkdown and sign the turnover sheet. Answer any questions the crew may have regarding equipment line-ups. **Inform the crew that no equipment should be manipulated during the walkdown, the ERF displays may be accessed, and that the annunciator checks should be completed after turnover completed.**

VI RUNNING THE SCENARIO

SIMULATOR OPERATOR ACTIONS	ANTICIPATED CREW RESPONSE
A.[SCENARIO TIME = 0:03] PCV-101-1 starts to leak **[MAL PRS5A ACT,5,0,0,0,D]**	CREW recognize the leakage through PORV and enter AOP-22.
B.[SCENARIO TIME = 0:06-08] Activate AUTO OSCILLATE on HIC-101 **[CNH CVC1 ACT,0.6,15,0,0,0,D]**	PRI operator will recognize failure of HIC-101 in auto and take manual control of RCS letdown.
C.[SCENARIO TIME = 0:12-16] RCS leak starts and increases to greater than charging pump capacity over 30 minutes. **[MAL RCS1A ACT,0.6,180,0,0,D]**	CREW recognize RCS leak, enters AOP-22; quantifies leakrate and starts a controlled shutdown SS & STA will reference T.S. on leak rate.
Raise RCS leak rate: **[MAL RCS1A ACT,4,1800,0,0,D]**	CREW will recognize the need to trip the reactor and enter EOP-00.
D [SCENARIO TIME = Leak rate exceeds charging capacity]	CREW will recognize a SBO and enter EOP-20 due to the RCS leak and SBO.
E. [SCENARIO TIME = RX Trip] Loss of onsite and offsite power, Bus 1A3 faults and DG-2 breaker fails to Auto Close	
F. [SCENARIO TIME = POST TRIP] VA-7D will not restart when power is restored. **[LOA EDS92 1,0,D]** CREW will recognize that not containment ventilation is available.G. [SCENARIO TIME = POST TRIP] HPSI fails to auto initiate.	CREW will recognize that HPSI flow has not initiated and take action to start HPSI when power is restored to bus 1A4. Inform the crew that scenario has been terminated and that they should remain in the simulator and not discuss the scenario amongst themselves until directed otherwise.

H [SCENARIO TIME = 50 00] Terminate the scenario when Bus 1A4 is powered and RCS pressure is stabilized on HPSI flow.

CEOG Attachment 1

Attachment 1 grades Individual Critical Tasks during the rotational evaluated exams. These evaluations will be conducted by Operations and Training to grade an individuals performance.

1 1 OBJ # 8411 K&A # 000-007-A1.03 **CRITICAL** MTL-0796
POSITION RESPONSIBLE LSO PRI
Given that a PORV is leaking into the PQT, the LSO will direct the PRI to isolate the PORV by closing the block valve

3 Closes the block valve and verifies that the correct valve has been closed by monitoring leakage flow and PQT parameters

2 Closes both block valves and does not take action to verify which PORV is leaking or that the leak has been stopped

1 Fail to close the block valve to isolate the leaking PORV

1 2 OBJ # 8052 K&A # 194-001-A1 10 **CRITICAL** MTL-0795
POSITION RESPONSIBLE· LSO PRI SEC
Given entry conditions for AOP-05, the crew will perform an emergency shutdown.

3 The PRI and SEC operators coordinate a steady and rapid power reduction by borating while lowering turbine steam demand, maintaining Tc on program, adjusting power distribution to control ASI, maintaining CEAs above PDIL, notifying the System Dispatch, ensuring the Shift Chemist is notified of power changes in excess of 15% in any one hour period, and not exceeding a power reduction rate of 10%/minute

2 Performs a rapid load reduction but does not properly align systems for boration, or does not properly coordinate the load reduction between the board operators in a manner such that automatic control systems can maintain PZR level, PZR pressure, or S/G levels

1 Lack of control of the plant during load reduction results in a reactor trip, or exceeds 10%/minute load reduction

1 3 OBJ # 8039 K&A # 000-009-K3.20 **CRITICAL** MTL-0795
POSITION RESPONSIBLE PRI
Given a small break LOCA increasing in severity during an Emergency Shutdown, the PRI operator recognizes the inability to maintain PZR level and take the appropriate action in accordance with AOP-22

3 Determines that RCS leakage has increased beyond the capacity of the running charging pump(s) and trip the reactor before PZR level falls below 25%

2 Needs some prompting to trip the reactor or does not trip the reactor until level is <25%

1 Fails to trip the reactor Relies on automatic systems to trip the reactor. _

1 4 OBJ. # 8327 K&A # 000-011-EA1.14 **CRITICAL** MTL-0007
POSITION RESPONSIBLE: PRI
Given an unisolated LOCA, attempt to maintain RCS pressure within the Post Accident P-T limits.

3 Does not stop or throttle HPSI flow until all conditions are met.

2 Cannot stabilize RCS P-T.

1 Stops or throttles HPSI flow due to high PZR level without meeting subcooling requirements, S/G availability, or RVLMS indication of level at top of hot leg.

1 5 OBJ. # 8071 K&A # 000-055-GEN - 12 **CRITICAL** MTL-0793
POSITION RESPONSIBLE: SEC
Given a SBO, the SEC operator will establish adequate heat removal capability.

3 Establishes feedwater via FW-10 to the S/Gs and restores level to 85% - 95% NR, establishes steaming as necessary to remove heat from the RCS without allowing Tc to reduce below its no-load value unless requested to do so to maintain subcooling.

2 Does not establish smooth control of S/G levels and steaming, but prevents inappropriate cooldown of RCS.

1 Fails to establish adequate RCS heat removal, or induces unnecessary RCS cooldown below no-load Tc value resulting in loss of RCS pressure control.

1 6 OBJ. # 8412 K&A # 000-056-EA2.03 **CRITICAL** MTL-0026
POSITION RESPONSIBLE: SEC
Given an SBO the SEC operator will take action to restore electrical power to one of the vital buses (1A3 or 1A4).

3 Restores power to one vital bus from available power source: 161kv, 345kv, or from the associated diesel.

2 Takes an inordinate amount of time to restore power to a vital bus.

1 Fails to restore power to a vital bus.

1 7 OBJ # 8413 K&A # 006-030-A1 02 **CRITICAL** MTL-0364
POSITION RESPONSIBLE LSO PRI
Given a valid PPLS initiating signal and no HPSI pump start, manually initiate HPSI flow to the RCS

3 Determines that RCS pressure has fallen below the PPLS setpoint without automatic start of HPSI pumps and manually starts the pumps to initiate flow to the RCS.

2 Fails to start HPSI flow prior to 43% level indication in RVLMS.

1 Fails to initiate HPSI flow.

1.8 OBJ. # 8011 K&A # 000-011-GEN-12 **CRITICAL** MTL-0007
POSITION RESPONSIBLE: PRI
Given a LOCA in progress, ensure ECCS systems automatically actuate when required.

3 Ensures the proper combination of Containment Spray Flow, Containment cooling units, SI flow, Emergency boration, VIAS, CIAS, and SGIS based on PZR pressure and Containment pressure conditions, and that charging flow and SI flow are maximized.

2 Fails to ensure all of the above are operating as required or does not properly interpret PZR pressure or Containment pressure indications.

1 Fails to ensure ECCS systems actuate as required.

1.9 OBJ. # 8105 K&A # 000-074-GEN-12 **CRITICAL** MTL-0007
POSITION RESPONSIBLE: SS
Given a LOCA the SS will ensure that the proper event mitigation strategy is being implemented.

3 Immediately after being released from E Plan duties, receives a complete update on plant status and ensures the crew is mitigating events in progress.

2 Fails to ensure crew is properly mitigating events in progress.

1 Provides misdirection to crew during event mitigation.

1.10 OBJ. # 8365 K&A # - - **CRITICAL** MTL-0007
POSITION RESPONSIBLE:STA
Given that an RCS leak exists which places the plant into a T.S. LCO, the STA will confirm with the SS that the appropriate actions are being implemented.

3 Performs an accurate review of T.S. 2.1.4 and confirms with the SS that all required actions have been or are being implemented as required and confirms entry into AOP-22.

2 Performs the above with minor instances of misinterpretation or fails to ensure that the required actions have been completed within T.S time limits.

1 Fails to confirm with the SS whether T.S. 2.1.4 actions have been implemented. or misdirects the crews interpretation of T.S. requirements.

1.11 OBJ. # 8391 K&A # - - **CRITICAL** MTL-0360
POSITION RESPONSIBLE: STA
During implementation of EOP-20 the STA will perform the required SFSCs using either the control boards and/or the ERFCS indications, and will report the status and reasons for the failure of Sfs to the LSO and SS approximately once every ten minutes.

3 Uses all available indications, and performs SFSCs once every ten minutes. Accurately reports SFSC info to the LSO and SS including confirmation of the reasons that specific Sfs are not met.

2 Performs SFSC and reports results to LSO and SS.

1 Fails to perform an accurate SFSC assessment or fails to report results to the LSO or the SS.

CREW CRITICAL TASKS

CRITICAL TASK #1 OBJ I.D. # 8262 K&A # 064-050-A4.02 MTL-0793

CT STANDARD The crew will restore power to vital 4160 VAC bus 1A4.

PASS or FAIL

CRITICAL TASK #2 OBJ I.D. # 8402 K&A # 000-011-GEN-12 MTL-0007

CT STANDARD The crew will recognize the failure of HPSI pumps to auto start and will take action to manually start HPSI pumps.

PASS or FAIL

CEOG SSG review sheet

1 **MES (Major Event Sequence):**

- LOCA & SBO

2. **ABNORMAL EVENTS: (1-2 required)**
   - RCS leak

3. **MALFUNCTIONS: (4-8 required)**
   - PORV start to leak.
   - CVCS letdown valve controller starts to oscillate.
   - Degraded TPCW pump due to bad packing leak.

(1-4 required after EOP entry)

- Bus 1A3 faults
- DG-2 breaker fails to Auto Close on loss of 161 kv.
- SI-2A/2B/2C fail to Auto start on SIAS signal.
- VA-7D fails to restart when power is restored.

D.3. HUMAN PERFORMANCE IMPROVEMENT COURSES (SPAIN)

D.3.1. Stress control course programme

1st day INTRODUCTION

STRESS

- History
- Definition

STRESSORS

- Stressor characteristics (Intensity/Newness)
- Stressor classification
- Learning theory

QUIZZES AND RELAXATION PRACTICES

2nd day ACTIVATION UNDER STRESS

- Yerkes-Dodson law
- Activation and individual differences

EFFECTS OF STRESS, SYMPTOMS

- Acute and chronic stress
- Short-term symptoms
- Long-term symptoms
- Stress diseases

QUIZZES AND RELAXATION PRACTICES

3rd day COPING STRATEGIES

- Life style
- Relaxation techniques
- Therapies

RELAXATION PRACTICES

CONCLUSIONS

D.3.2. Course on human factors programme

1st day INTRODUCTION

- Motivation
- General and specific objectives
- References
- Course development

CHAPTER I - LEADERSHIP AND TEAMWORK

- Leadership

* Supervision and leadership
* The Leader
* Supervision styles
* Motivation and job enrichment
* Direction and reinforcement
* Leadership strategies
* Control Room leadership

2nd day -Teamwork

* Team characteristics
* Team tasks
* Team building
* Team skills

- Roles and responsibilities
- Tests
- Videos
- Case studies
- Conclusions
- Evaluation Test I

3rd day CHAPTER 2 - COMMUNICATION

- Verbal communication

* Verbal communication fundamentals
* Verbal messages
* Communication methods
* Communication inhibitors
* Feedback mechanism

- Writing communication

- Shift turnover
- Procedures temporary changes
- Operation management
- Reports
- Guideline for writers

- Videos
- Case studies
- Communication exercises
- Simulator practices (optional)
- Conclusions
- Evaluation Test II

4th day CHAPTER III - DIAGNOSTIC

- Control room team "in-tune" with the plant

- "In-tune" with the plant
- Attention to detail
- Plant optimum performance

- Diagnostic and problems resolution

- The diagnostic logical process
- Monitoring
- Interpretation
- Intervention

- Process computer for diagnostic
- Videos
- Case studies
- Diagnostic exercises
- Simulator practices (optional)
- Conclusions
- Evaluation Test III

Simulator Final Evaluation (Optional)

D.3.3. Human error course programme

1st day- Introduction

- Human reliability
- Man-machine system and interfaces
- Human behaviour
- Case studies

- Operation errors
- "Los Rodeos" accident

2nd day- Human Error

- Human error data base
- Maintenance omissions
- Factors influencing human error (performance shaping factors) External PSF's

- Environment features

- Case studies

- External PSF's events
- TMI

3rd day - Factors influencing human errors, External PSF's (cont.)

- Tasks features
- Instructions

- Human error prevention and minimizations
- "SHERPA"
- Case studies

- External and internal PSF's events
- Chernobyl

- Conclusions

D.4. LICENSED OPERATOR REQUALIFICATION TRAINING SCHEDULE (BRAZIL)

<u>DAY 1-1</u>

<u>CLASSROOM</u>

1. Introduction to the course.

2. Discussion of the differences between the Ginna simulator and the FURNAS plant.

3. Discussion of simulator operations and procedures for the day.

   - Reactor start-up to point of adding heat
   - Plant start-up from low power to normal power
   - Boration and dilution during power operations
   - Power change greater than 10% in manual rod control
   - Manual control of steam generator water level during start-up or shutdown
   - NIS intermediate range failure
   - Loss of charging flow
   - Dropped row
   - SG pressure channel failure

<u>SIMULATOR SCENARIO DESCRIPTION</u>

- Conduct a reactor start-up from "hot" shutdown condition to the point of adding heat
- After reactor is critical and while still below P-6, introduce a failure-cleared, continue the reactor start up to the point of adding heat
- Conduct a plant start-up from low power to normal power operations
- Initiate a malfunction to a steam generator pressure channel to fail high
- Initiate a malfunction to the chemical and volume control system to cause loss of charging flow

DAY 1-2

CLASSROOM

1 Discussion of simulator operations and procedures for the day.

- Plant shutdown from power operation
- Reactor shutdown
- Boration and/or dilution during power operations
- Power change greater than 10% in manual rod control
- Manual control of steam generator water level during start-up or shutdown
- NIS intermediate range failure
- NIS power range failure
- RCP #1 seal failure
- Loss of CCW of cooling to an individual component

SIMULATOR SCENARIO DESCRIPTION

- Reinitialize from temporary IC from 1-1
- Initiate a malfunction to the component cooling system to cause a failure of component cooling flow
- Initiate a malfunction to a NIS power range channel to fail high
- Initiate a malfunction that causes a leak in the non-regenerative heat exchanger to the component cooling water system
- Initiate a RCP #1 seal leak in excess of 5 gpm to require plant shutdown
- After shutdown is started, initiate a malfunction that causes loss of IR compensating voltage on Channel 35
- Conduct a plant and reactor shutdown from power operation to hot shutdown conditions
- Cool down and initiate RHR

DAY 2-1

CLASSROOM

1 Discussion of simulator operations and procedures for the day.

- Power change greater than 10%
- Inability to move control rods
- Reactor coolant RTD failure low
- Steam generator feed flow channel fails low
- Pressurizer spray valve fails open
- Loss of turbine oil cooling

SIMULATOR SCENARIO DESCRIPTION

- Initialize at normal 100% power, EOL and commence slow power reduction
- Initiate malfunctions to auto turbine EH control to force Manual operation during power changes
- Initiate a mulfunction to cause a pressurizer spray valve to fail open
- Initiate to 100% , power, EOL
- Initiate a malfunction to the steam generator feed flow instrumentation to cause a controlling channel to fail low
- Initiate a malfunction that causes loss of turbine oil cooling causing turbine vibration to increase This requires turbine shutdown
- Initiate a malfunction that prevents rod insertion

- Initiate a malfunction which causes CW pump trips and loss of vacuum
- Initiate a malfunction to cause three rods to stick on reactor trip.

DAY 2-2

CLASSR0OM

1. Discussion of simulator operations and procedures for the day.

   - Uncontrolled rod motion
   - Stuck rod
   - Pressurizer pressure channel failure
   - Pressurizer level channel failure
   - turbine first-stage pressure channel failure
   - Steam generator level channel failure
   - Turbine trip
   - Small break LOCA inside containment

SIMULATOR SCENARIO DESCRIPTION

- Initialise at normal 100% power, EOL and initiate a power reduction
- Initiate a malfunction that causes a first-stage impulse channel to fail low
- Initiate a malfunction causes continuous rod insertion
- Initiate a rector coolant leak in excess of Tech Spec limits
- Escalate leak to cause a small break LOCA
- Initialise to 100% power, EOL
- Initiate a malfunction that causes the controlling pressurizer level channel to fail low
- Initiate a malfunction to cause a controlling steam generator level channel to fail high
- Initiate a malfunction that causes loss to both heater drain pumps
- Initiate a malfunction causing the controlling pressure channel to fail high

DAY -3-1

CLASSROOM

1 Discussion of simulator operations and procedures for the day.

   - Loss of normal RCS flow - natural circulation cooldown
   - Loss of AC power
   - Loss of all feedwater
   - Small break LOCA

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate a malfunction that causes an isolable leak from the primary system
- With the requirement to shutdown and cooldown, initiate a malfunction that causes the loss of the reactor pumps and natural circulation cooldown is required
- Initialise to 100% power, EOL
- Initiate a malfunction that causes a loss of all heat sink
- Initialise to 100% power, EOL

- Initiate a malfunction that causes a small break LOCA with the requirement to cooldown and depressurize

DAY 3-2

CLASSROOM

1 Discussion of simulator operations and procedures for the day.

- Steam generator tube rupture
- Steam leak from top of pressuriser
- Failure of reactor to trip when a protection signal is generated

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate a malfunction that causes a reactor trip and when trip occurs, reactor trip breakers do not open
- Initialise to 100% power, EOL
- Initiate a malfunction that causes LOCA from the steam space that is unisolable, carry out the point of going on RHR
- Initialise to 100% power, EOL
- Initiate a malfunction that causes a steam generator tube rupture, carry out to the point of Post-SGTR cooldown using backfill

DAY 4-1

CLASSROOM

1 Discussion of simulator operations and procedures for the day.

- Steam generator tube rupture or significant leak (determine leak rate and saturated RCS response)
- Large break LOCA
- Loss of all feedwater

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate an SGTR and initiate and malfunction that causes loss of pressure control
- Initialise to 100% power, EOL
- Initiate a large break LOCA requiring recirculation cooldown
- Initialise to 100% power, EOL
- Initiate a loss of heat sink, prevent use of the condensate pumps so that the operator must go to feed and bleed

DAY 4-2

CLASSROOM

1. Discussion of simulator operations and procedures for the day.
   - Loss of all AC
   - Feed line of steam line break inside of outside containment

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate a loss of all AC and carry out until S1 is required
- Initialise to 100% power, EOL
- Initiate a feed line break inside containment
- Initiate a steam line break in containment

DAY 5-1

CLASSROOM

1. Discussion of simulator operations and procedures for the day.

- NIS source range failure
- Letdown relief valve sticks open
- Loss of condenser vacuum
- Steam dump valve fails open
- Inadvertent S1
- Steam line break inside or outside containment

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate a malfunction to cause a slow loss of condenser vacuum. Do not allow the plant to trip
- Initiate a failure in the chemical and volume control system that causes a loss of letdown flow
- Initiate a leak in the steam system down stream of the MSIV, which requires plant shutdown
- conduct reactor shutdown from power operations
- Prior to reinstating the source range automatically, initiate a malfunction that causes both NIS source ranges to fail low
- Initialise to 100% power, EOL
- Initiate a malfunction that causes steam dumps to open to increase power approximately 5–10%
- Initiate inadvertent SI

+

DAY 5-2

CLASSROOM

1. Discussion of simulator operations and procedures for the day.
   - Steam generator tube rupture
   - Small break loca outside containment
   - Small break LOCA inside containment
   - Steam line break inside of outside containment

SIMULATOR SCENARIO DESCRIPTION

- Initialise to 100% power, EOL
- Initiate a small break LOCA with loss of S1 pumps

- Initialise to 100% power, EOL
- Initiate a malfunction that causes both steam generator to be faulted
- Initialise to 100% power, EOL
- Initiate a SGTR. When depressurizing begins, initiate a safety failed open in the same SG

DAY 6

CLASSROOM

1. Discussion of simulator operations and procedures for the day
   - Examination briefing
   - Review

SIMULATOR SCENARIO DESCRIPTION

EXAMINATION SCENARIOS

SCENARIO EVENT NO. 1

- Initial conditions 100% power, EOL
- Steam generator level channel fails high
- First-stage impulse channel fails low
- intermediate range under compensation
- RCP seal failure
- Small break LOCA

SCENARIO EVENT NO. 2

- Initial conditions 100% power, EOL
- Steam generator pressure channel fails high
- Pressurizer pressure controlling channel fails high
- Condensate pump trip
- Feedwater leak in containment
- Loss of secondary coolant in containment

SCENARIO EVENT NO. 3

- Initial conditions 100% power, EOL
- Stuck rod
- Reactor coolant rtd fails high
- Pressurizer spray valve fails open
- Loss of off-site power
- Diesel failure
- Loss of all feedwater

SCENARIO EVENT NO 4

- Initial conditions 100% power, EOL
- Pressurizer level channel fails low
- Steam generator tube leak
- Continuous rod insertion
- Steam generator feed flow controlling channel fails low
- Steam generator tube rupture

D.5. ASSESSMENT TEST, KOZLODUY NPP TRAINING CENTRE (BULGARIA): WRITTEN TEST

Trainee: ______________________________ ________________
Names Position

Evaluator: ______________________________ ________ ________ ________
Names Signature Date Results

Course :"NPP Emergency Operation "
Lesson : "Main Steam Line Break within Containment

References:

1. Instruction on accident mitigation, Units 5 and 6, Kozloduy NPP
2. Instruction on reactor operation, Units 5 and 6, Kozloduy NPP
3. Technical specification of VVER-1000 (V-320), Kozloduy NPP
4. List of protections and interlocks of Reactor Department and Turbine Department of Units 5 and 6, Kozloduy NPP
5. Rupture Interlock Drawings (YZ System), Units 5 and 6, Kozloduy NPP
6. Safety Analysis Report, Units 5 and 6, Kozloduy NPP
7. Drawings of Emergency Feedwater System TX
8. Core Neutronics Data Book (last issue), Units 5 and 6, Kozloduy NPP

Guidelines: Answer the questions by surrounding the correct answer (for the multiple choice questions), filling the requested information (for the fill in the blank questions) or giving short descriptions (for the rest of the questions). The test passing score is 35 points. You may use the above references.

1. Describe the algorithm of the interlock ($P_{SG} < 50$ kgf/cm^2 and $\Delta t_s > 75$ °C). List the systems started by the actuation of this interlock.

Answer:____

____

____

____

____

Points: 1

2. Describe the algorithm of the interlock ($P_{SG} < 5$ MPa and $P_{Check\ Valve} \leq -2$ kgf/cm^2)

Answer:____

____

____

____

____

Points: 1

3. In the event of a steam line break of one Steam Generator, the interlock is actuated by the following conditions:

a) $P_{SG} > 50$ kgf/cm^2 and $\Delta t_s < 75$ °C

b) $P_{SG} > 50$ kgf/cm^2 or $\Delta t_s < 75$ °C

c) $P_{SG} < 50$ kgf/cm^2 and $\Delta t_s > 75$ °C

d) $P_{SG} < 50$ kgf/cm^2 or $\Delta t_s > 75$ °C

Points: 1

4. List the Control Room alarms following the actuation of the interlock ($P_{SG} < 50$ kgf/cm^2 and $\Delta t_s > 75$ °C).

Answer:____

____

____

____

5. Which parameter values of the choice actuate the interlock in the event of a steam line break of one Steam Generator:

a)$P_{SG} < 50$ kgf/cm^2 or $P_{\text{Check valve}} \leq -2$ kgf/cm^2

b)$P_{SG} < 50$ kgf/cm^2 and $P_{\text{Check valve}} \leq -2$ kgf/cm^2

c)$P_{SG} > 50$ kgf/cm^2 or $P_{\text{Check valve}} \leq +2$ kgf/cm^2

d)$P_{SG} > 50$ kgf/cm^2 and $P_{\text{Check valve}} \leq +2$ kgf/cm^2

Points: 1

6. What is the number of channels forming the signal for $P_{SG} < 50$ kgf/cm^2 :

a) 2 out of 3
b) 1 out of 2
c) 2 out of 4
d) 3 out of 4

Points: 1

7. What is the number of channels forming the signal for $\Delta t_s > 75$°C:

a) 2 out of 3
b) 1 out of 2
c) 2 out of 4
d) 3 out of 4

Points: 1

8. What is the number of channels forming the signal for $P_{\text{Check valve}} \leq -2$ kgf/cm^2:

a) 2 out of 3
b) 1 out of 2
c) 2 out of 4
d) 3 out of4

Points: 1

9. What is the number of channels forming the signal for $P_{SG} < 45$ kgf/cm^2:

a) 2 out of 3
b) 1 out of 2
c) 2 out of 4
d) 3 out of 4

Points: 1

10. The signal $\Delta t_s > 75$ °C is formed by:

a) $\Delta t_s = f(P_{PRIMARY}) - f(P_{SG})$
b) $\Delta t_s = f(P_{PRIMARY} - P_{SG})$
c) $\Delta t_s = f(P_{CORE}) - f(P_{SG})$
d) $\Delta t_s = f(P_{CORE} - P_{SG})$

Points: 1

11. If the MCP is not tripped by $P_{SG} < 50$ kgf/cm2 and $P_{Check\ valve} \leq -2$ kgf/cm^2, then:

a) the reactor protection is actuated
b) the rest of the MCP are tripped
c) the electrical supply is interrupted of the section supplying the corresponding MCP
d) the system supplying the corresponding MCP passes from working to emergency supply

Points: 1

12. For each kind of accident in the left column, give the number of the corresponding symptoms from the right column that identify it. The numbers in the right column may be used once, more than once or may be not used.

a. MSLB within Containment
b. MSLB in an unisolable point
c. Main Steam Header Break

1. Containment pressure increase
2. Acute decrease of Primary pressure and Pressurizer level
3. Acute pressure decrease in one of the SG
4. Deep pressure decrease in the Main Steam Header
5. Outstripping cooldown of one of the Primary loops

Answer:

a MSLB in the Containment					
b MSLB in an unisolable point					
c Main Steam Header Break					

Points: 3

13. In the event of a significant Loop 1 steam line rupture within Containment, the interlocks ($P_{SG} < 50$ kgf/cm^2 and $\Delta t_s > 75$ °C) are actuated by I and II Engineered Safety Systems (ESS). Which of the Qiuck Acting Steam Isolation Valves (QASIV) close?

a) All four QASIV
b) All except QASIV 3
c) Only QASIV 1
d) Only QASIV 1 and 2

Points: 1

14. Which one of the following describes the philosophy of the Engineered Safety System in the event of MSLB?

a) trips MCP and continues feeding the SG
b) closes isolation valve and continues feeding the affected SG in order to cooldown the reactor
c) isolates the SG from steam and water in order to dry out the SG and to prevent the uncontrolled Primary cooldown, trips MCP of the affected loop

Points: 1

15. Which one of the following describes the conditions in the affected loop and affected SG following the automatic actuation of the protective system due to a steam line rupture? Assume all systems operate as designed

	MCP	Normal feedwater	Emergency feedwater	Steam
a)	running	trottled	trottled	isolated
b)	running	isolated	isolated	isolated
c)	tripped	trottled	trottled	isolated
d)	tripped	isolated	isolated	isolated

Points: 1

16. **Explain the way the reactivity changes at the moment of steam line rupture and why the MCP of this SG is tripped.**

Answer:____

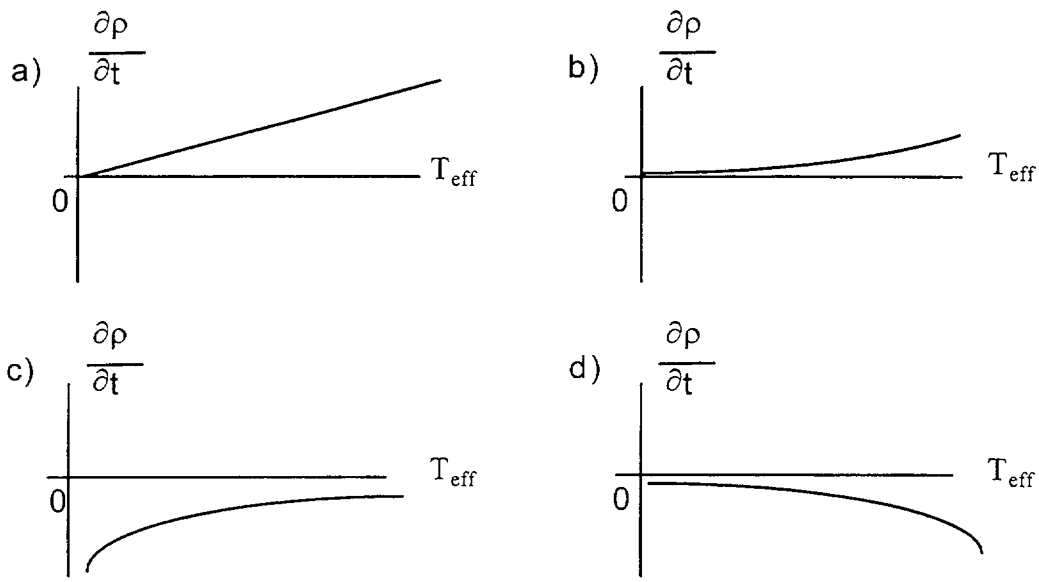
____

____

____

Points: 2

17. **Which one of the following graphs corresponds to the temperature reactivity coefficient during the reactor operation:**



Points: 1

18. **For which condition of the choice the MSLB within Containment accident is the most severe:**
    a) beginning of life, reactor stationary poisoning not reached
    b) beginning of life, reactor stationary poisoning reached
    c) end of life, reactor stationary poisoning not reached
    d) end of life, reactor stationary poisoning reached

Points: 1

19. **Three of the enclosed graphs characterize the parameters evolution during the first 30 seconds of the MSLB within Containment accident. For the parameters listed below, fill in the number of the corresponding graph.**
    a) Cold Leg temperature - graph Nr .....
    b) Containment pressure - graph Nr .....
    c) Steam Generator level - graph Nr .....

Points: 3

20. **The value of $t_{Primary}$ at which the second criticality is reached due to the rector cooldown following MSLB in an unisolable point is: .... °C.**

    Reference: point out______________________________________

Points: 1

21. In the event of the Secondary pressure decreasing due to the MSLB within Containment, N_T of the reactor is:

a) decreasing continuously
b) decreasing to a new equilibrium level
c) increasing continuously until reactor protection system actuation
d) increasing to a new equilibrium level

Points: 1

22. At which condition of the choice the reactor power change following the MSLB within Containment is the most significant:

a) beginning of life, peak of Xe (poisoned reactor)
b) beginning of life, equilibrium Xe (poisoned reactor)
c) end of life, peak of Xe (poisoned reactor)
d) end of life, equilibrium Xe (poisoned reactor)

Points: 1

23. Is it necessary to decrease the Primary pressure and why? How?

Answer:____

____

____

____

____

Points: 1

24. Which ones of the following parameters identify the affected SG:

a) $P_{PRIMARY}$ and T_{PRZR}
b) L_{PRZR} and T_{PRZR}
c) P_{SG} and L_{SG}
d) T_{SG} and T_{AV} of PRIMARY

Points: 1

25. Which one of the events listed below identifies the affected SG in the fastest and most accurate way:

a) reactor SCRAM, DG automatic loading sequence, MCP trip on the affected loop
b) reactor SCRAM, closing of Turbine stop valves, MCP trip on the affected loop
c) reactor SCRAM, DG automatic loading sequence, SG isolated from feedwater and emergency feedwater
d) reactor SCRAM, DG automatic loading sequence due to $P_{SG} < 50$ kgf/cm^2 and $\Delta t_S > 75$ °C, closing of Quick Acting Steam Isolation Valve (QASIV), and MCP trip on the affected loop

Points: 1

26. Which one of the following Secondary side interlocks does not trip the MCP of the affected SG:

a) $P_{SG} < 50$ kgf/cm^2 and $\Delta t_s > 75$°C
b) $P_{SG} < 45$ kgf/cm^2 and $\Delta t_s > 75$°C
c) $P_{SG} < 50$ kgf/cm^2 and $\Delta P_{check\ valve} \leq -2$ kgf/cm^2

Points: 1

27. Which one of the following Secondary side rupture interlocks does not isolate the affected SG from feedwater and emergency feedwater:

a) $P_{SG} < 50$ kgf/cm^2 and $\Delta t_S > 75°C$

b) $P_{SG} < 45$ kgf/cm^2 and $\Delta t_S > 75°C$

c) $P_{SG} < 50$ kgf/cm^2 and $\Delta P_{check\ valve} \leq -2$ kgf/cm^2

Points: 1

28. In the event of SG steam line rupture, which automation mode will take control over SG level controller and why?

a) SG level digital controllers
b) emergency feedwater SG level controller (TX)
c) emergency feedwater pumps (EFWP) flow limiting controller (TX)
d) ruprute interlock commands to close feedwater and emergency feedwater valves on the affected SG.

Points: 1

29. In the event of MSLB in the Containment :

a) rupture interlock $\nabla t_S < 10°C$ will be actuated
b) containment pressure interlock $P_{Containment} > 0.3$ kgf/cm^2
c) all the MCP will trip
d) a steam dump to atmosphere on the affected SG will open

Points: 1

30. What is the accident mitigation strategy in the event of Secondary side rupture upon which the Safety System interlocks are designed:

a) Primary cooldown with emergency rate after creating the cold shutdown boron concentration
b) Affected SG isolation form feedwater and emergency feedwater, and Primary cooldown by natural circulation after creating the cold shutdown boron concentration
c) Creating the cold shutdown boron concentration in the Primary in order to maintain all the SG level and cooldown by 10 °C/hr
d) Primary cooldown by 20°C/hr after creating the cold shutdown boron concentration, and affected SG isolation by closing QASIV

Points: 1

31. In the event of Containment isolation valve closure due to $P_{Containment} > 0.3$ kgf/cm^2, it is necessary to decrease the Primary pressure in order to:

a) maintain the Primary pressure;
b) provide Primary makeup;
c) maintain the reactor inventory during the cooldown;
d) create the cold shutdown boron concentration and controllable Pressurizer level (YP10B01);

Points: 1

32. In the event of Containment isolation valve closure due to $P_{Containment} > 0.3$ kgf/cm^2, in order to provide boron solution by HPSI pumps (TQ13,23,33D01), it is necessary to decrease the Primary pressure to the value of:

a) 60 kgf/cm^2

b) 70 kgf/cm^2

c) 100 kgf/cm^2

d) 120 kgf/cm^2

Points: 1

33. The repeated criticality temperature is:

a) the temperature at which the reactor becomes critical after SCRAM without boron concentration increase

b) the temperature at which the reactor becomes critical after SCRAM with most effective rod stuck, and without boron concentration increase

c) the temperature at which the reactor becomes critical after SCRAM with boron concentration increase

Points: 1

34. Will be the concentrated boron solution (CH_3BO_3=40 g/kg) supplied following complete MSLB within Containment in case of proper interlock action during affected SG evaporation. Explain Your answer.

Answer:____

Points: 1

35. Name the process system used to decrease the Primary pressure in order to supply boron solution for providing cold shutdown boron concentration

Answer:____

Points: 1

36. Name the process system of choice used to decrease the Primary pressure down to 100 kgf/cm^2 in order to supply boron solution

a) Sempell

b)YP24S01,02

c) Connecting YP10B01, YC00B01, and YB10W01 to YB40W01 through YR.

d)YR vent lines from Pressurizer to PRZR Relief Tank

Points: 1

37. The Primary pressure decrease rate:

a) depends on the number of open YR vents on PRZR and PRZR Relief Tank

b) depends on the open YR vents on PRZR and SGs

c) does not depend on the number of open YR vents

Points: 1

38. How Reactor Operator determines the cold shutdown boron concentration for primary cooldown:

a) calculates the concentration value using the core neutronics data book

b) chooses the Tech.Spec.value 12 g/l

c) determines the value by the Tech.Spec. graph

d) determines the value by the graph from the core neutronics data book, taking into account the fuel age and power level.

Points: 1

39. The cold shutdown boron concentration CH_3BO_3 is:

a) ≥12g/kg

b) C_{cr}+1g/kg

c) C_{cr}+6g/kg

d) depends on the reactor power level and is determined using the Core Neutronics Data Book

Points: 1

40. Following MSLB within Containment, it is permitted to start the Primary cooldown after:

a) creating in the Primary the boron concentration of 16 g/kg.

b) increasing the boron concentration in the Primary up to the cold shutdown one.

c) complete Pressurizer fill-up with the subsequent boron solution introduction following the PRZR level fall down.

d) introduction of 30 m^3 40 g/kg boron solution taking into account that it is impossible to perform boron sampling after Containment isolation

Points: 1

41. What is the minimal number of SG which have to be connected to feedwater (Ti or RL) for reactor cooldown:

a) one SG

b) two SG

c) three SG

d) four SG

Points: 1

42. There is a steam line break of YB10W01 within Containment. The steam line cannot be isolated from the emergency feedwater due to blocking of TX21S05 from I Safety System. What is the correct action of the Unit Shift Supervisor:

a) to order to turn of TX10D01

b) to order to close valves TX11S01,02 for the emergency feedwater

c) to order to close valves TX10S04 of the joint steam collector

d)to order to close valvesTX10S15 of the joint steam collector

Points: 1

43. There is a SG steam line break in the Containment. The steam line cannot be isolated from the emergency feedwater due to blocking of TX21S02 from II SS. What is the correct action of the Unit Shift Supervisor:

a) orders to turn off TX20D01

b) orders to close valves TX20S04 of the joint collector

c) orders to close valves TX20S05 of the joint collector

Points: 1

VGB TECHNICAL UNION OF THE
LARGE PLANT OPERATORS E.V.

VGB-Guideline

Training for the professional work in nuclear power plants

Exercise File KWM 5 MK

Responsible shift personnel

Module 1 : Basic nuclear knowledge for shift supervisors
Subjects and training objectives

Elaborated within the
VGB-Subgroup
´Nuclear training´
of the VGB-special group ´Training of plant personnel´

Second issue

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Best.-Nr. B 905 KWM 5 MK

Contents

Overview of the VGB training guidelines for the operation personnel in thermal power plants

Training scheme

Overview of the training lessons

Subjects

1. Reporting
2. Professional drawing
3. Mathematics
4. Chemistry
5. Physics - mechanics
6. Physics - hydromechanics
7. Static
8. Materials
9. Physics - thermohyraulic
10. Machine elements
11. Electric basic knowledge
12. Basis of I&C
13. Configuration, operation and environment protection of nuclear power plants
14. Basic configuration of nuclear power plants (BWR/PWR)

Training objectives

1. Reporting
2. Professional drawing
3. Mathematics
4. Chemistry
5. Physics - mechanics
6. Physics - hydromechanics
7. Static
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13. Configuration, operation and environment protection of nuclear power plants
14. Basic configuration of nuclear power plants (BWR/PWR)

Overview of the VGB-training-guidelines for the operation personnel in thermal power plants

For plant craftsmen:

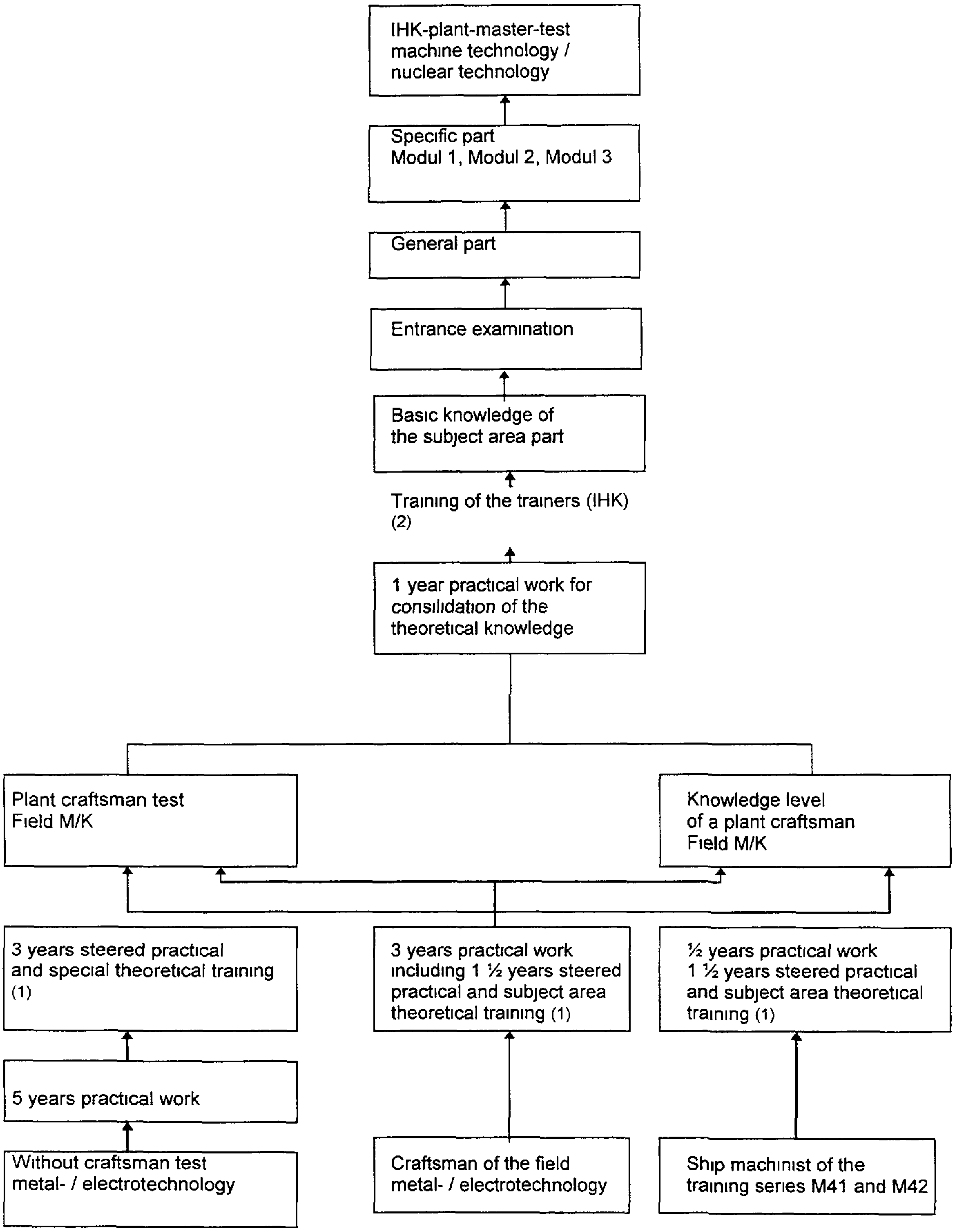
Machine technology M	Electric / I&C EL	Machine technology / Nuclear technology M/K
File KW 1 M General Prerequisites Content and scope of the training Test rules	File KW 1 EL General Prerequisites Content and scope of the training Test rules	File KW 1 MK General Prerequisites Content and scope of the training Test rules
File KW 2 M Subjects and training objectives Topics for the practical test	File KW 2 EL Subjects and training objectives Topics for the practical tests	File KW 2 MK Subjects and training objectives Areas of use

For plant masters:

Machine technology M	Electric / I&C EL	Machine technology/ Nuclear technology M/K
File KWM 1 M General Prerequisites Test rules	File KWM 1 EL General Prerequisites Test rules in Preparation	File KWM 1 MK General Prerequisites Test rules in Preparation
File KWM 2 M Preparation course Subjects and training objectives	File KWM 2 EL Preparation course Subjects and training objectives in Preparation	
File KWM 3 General part Subjects and training objectives objectives all subjects	File KWM 3 General part Subjects and training objectives all subjects	File KWM 3 Gereral part Subjects and training all subjects
File KWM 4 M Specific part incl basic knowledge objectives Subjects and training objectives	File KWM 4 EL Specific part incl basic knowledge Subjects and training objectives in Preparation	File KWM 4 MK Basic training Subjects and training
		File KWM 5 MK Modul 1 Basic nuclear knowledge Subjects and training objectives
		File KWM 6 MK Modul 2 Process technology in the nuclear power plant Modul 3 I&C and electric equipment in the nuclear power plant Subjects and training objectives

Training scheme

(IHK - chamber of industry and commerce)



(1) According VGB-training guideline

(2) This lesson is homogeneous in Gemany and can be performed in the region of the students
It is not offered by KWS

Overview of the lessons

Nr.	Subject	Abreviation	Double hours
1.	Reporting	BW	15
2.	Professional drawing	FZ	8
3.	Mathematics	MA	40
4.	Chemistry	CH	12
5.	Physics - mechanics	PM	7
6.	Physics - hydromechanics	PH	10
7.	Static	FL	10
8.	Materials	WK	12
9.	Physics - thermohyraulic	PW	15
10.	Machine elements	ME	8
11.	Electric basic knowledge	ETG	25
12.	Basis of I&C	GRL	10
13.	Configuration, operation and environment protection of nuclear power plants	ABU	10
14.	Basic configuration of nuclear power plants (BWR/PWR)	GAK	6

			188

Overview of the lessons

Subject	Abreviation	Hours
1. Basic nuclear physics	KPG	44
2. Reactor physics / heat generation	RPE	46
3. Reactor safety	RS	42
4. Radiation protection	SS	50
5. Legislative basis	GG	28
6. Worker and fire protection	AS	12
7. Practical thermohydraulic	ATH	40
8. Configuration of nuclear power plants (BWR)	AK-S	24
9. Configuration of nuclear power plants (PWR)	AK-D	24
10. Anticipated events (BWR)	AE-S	24
11. Anticipated events (PWR)	AE-D	24
12. Instrumentation	IN	10

Total number of hours		368

Module 1 : Nuclear basic knowledge for shift supervisors

Subjects of Module 1

	Subject	Symbol	Number of lessons*
1	Fundamentals in nuclear physics	FNP	22
2	Reactor physics/energy release	RPE	23
3	Reactor safety	RS	21
4	Radiation protection	RP	25
5	Basic law	BL	14
6	Work place safety and fire protection	WPS	6
7	Applied thermohydraulics	ATN	20
8	Design of nuclear power plant with BWR	DNPP - B	12
9	Design of nuclear power plant with BWR	DNPP - P	12
10	Possible expected course of events(BWR)	PECE - B	12
11	Possible expected course of events(PWR)	PECE - P	12
12	Test instrumentation	TI	5
	Total		184

Subject: **Reactor Safety** 21 lesson hours

Contents

- Risk potential of nuclear power plant
- Objective of the reactor safety
- Radioactivity release chains
- Emmision, immision
- Risk concept
- Deterministic, probabilistic, PRA
- Beyond design accidents
- Safety principles and safety levels
- Design basis accidents
- Accident analysis / Safety studies
- Design principles
- Barrier concept and desing data
- General accident groups
- Active safety features
- Reactor protection actions
- Priority of the protection signals
- Protection aim concept
- Core melt scenarios
- Hydrogen production
- Measures for handling of hydrogen releases
- Regulations for design and operation

Training objectives

Afer the end of the course, each participant must be able,

to recall the risk potential of a nuclear power plant and the general objectives of the reactor safety,

to explain the radioactivity release chains (food chain, ground point for fallout, iodine accumulation, environmental charge),

to explain the expressions ´emission´ and ´immision,

to descripe the principle of a risk concept and the sense and the purpose of a probabilistic safety analysis (PSA),

to explain the expressions deterministic and probabilistic,

to explain the expressions normal operation, incident, accident, severe accident, unforeseen and beyond design accidents,

to explain the safety levels (design, avoidance, handling of accidents, handling of unforeseen and beyond design accidents, limitation of event sequences),

to explain what are design basis accidents and what are the objectives for the accident analysis,

to explain the design features ´inherent safety, basis safety, redundancy, diversity, fail-safe-principle, spatial separation, civil protection, active and passive electrical actuation, separation, votings, single failure concept´,

Learning objectives

After the end of the course, each participant must be able,

to explain priorities of protection actions (component protection, limitations, reactor protection) and the 30 minutes concept,

to explain the barrier concept (passive safety features) and reasons for fission product transfers,

to explain the configuration and the relevant design data of the different barriers,

to explain the 2 general accident groups ´internal events´ and ´external events´,

to recall the active safety systems of the PWR and BWR and to explain the principle functions and the main design data of these equipments,

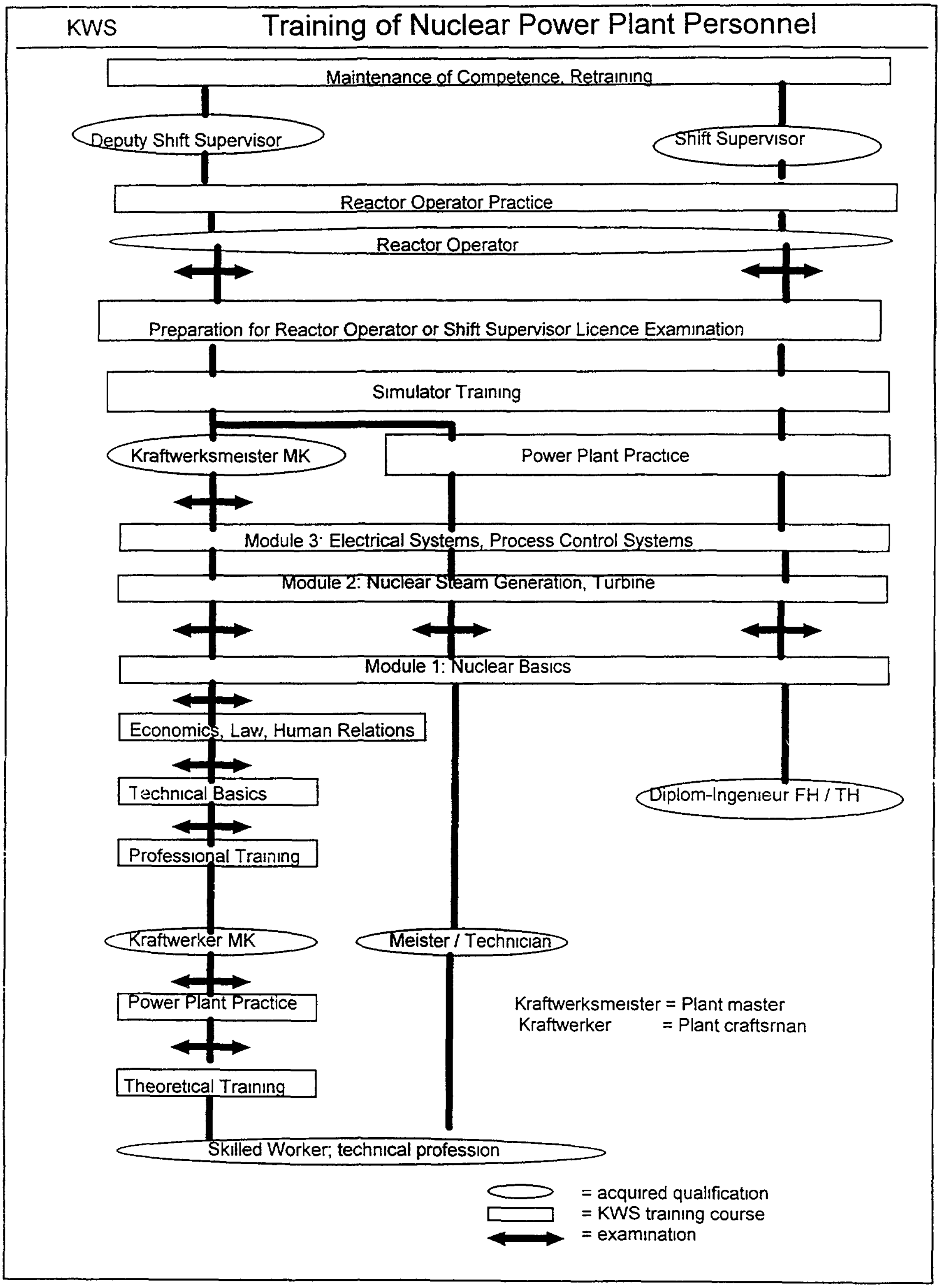
to descripe the protection aim concept (state based accident handling),

to descripe the core melt scenarios ´high pressure path´ and ´low pressure path´,

to explain the mechanisms of hydrogen production in normal operation and during accidents and to explain the equipment to control eventual hydrogen releases,

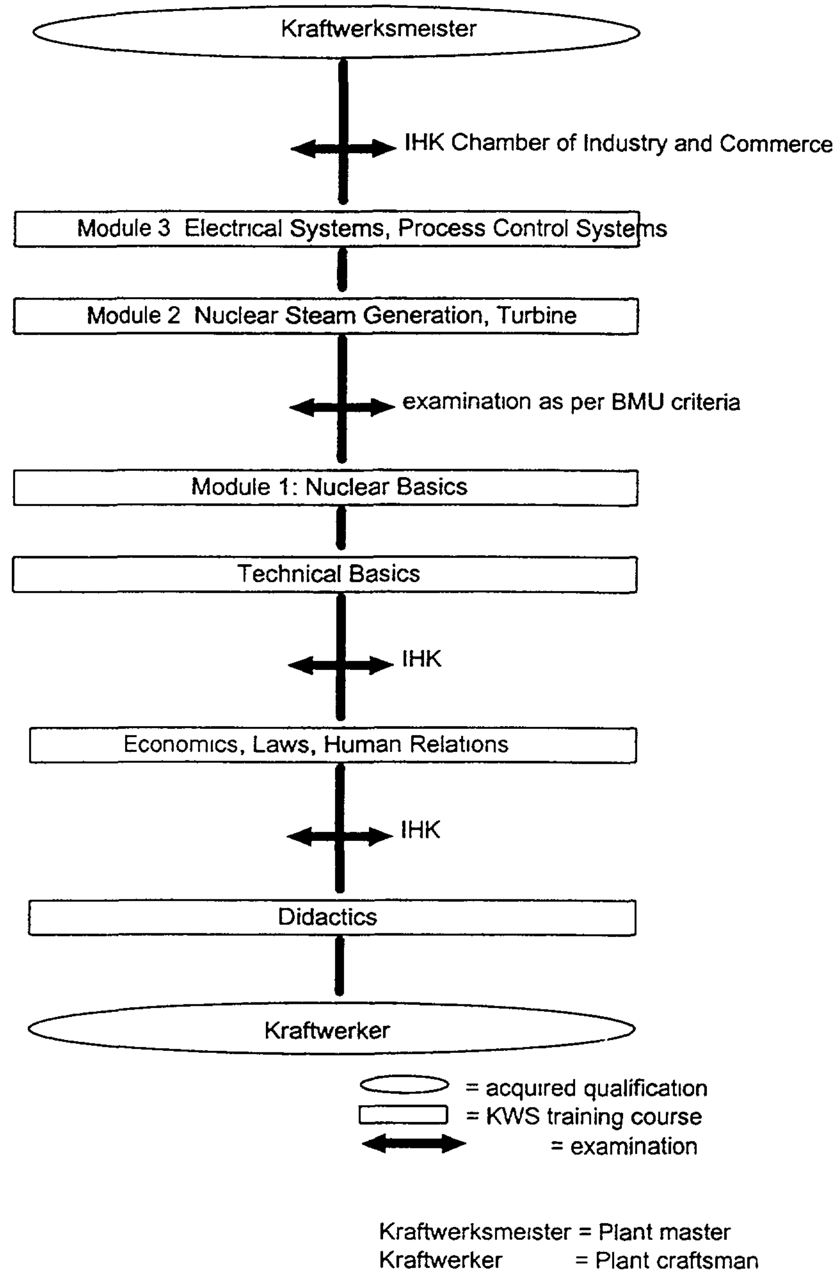
to explain the trigramme hydrogen-air-steam,

to recall regulations, on which the design and the operation of a nuclear power plant and its construction are based on.


KWS
Training of Nuclear Power Plant Personnel
Maintenance of Competence, Retraining
Deputy Shift Supervisor
Shift Supervisor
Reactor Operator Practice
Reactor Operator
Preparation for Reactor Operator or Shift Supervisor Licence Examination
Simulator Training
Kraftwerksmeister MK
Power Plant Practice
Module 3: Electrical Systems, Process Control Systems
Module 2: Nuclear Steam Generation, Turbine
Module 1: Nuclear Basics
Economics, Law, Human Relations
Technical Basics
Diplom-Ingenieur FH / TH
Professional Training
Kraftwerker MK
Meister / Technician
Power Plant Practice
Kraftwerksmeister = Plant master
Kraftwerker = Plant craftsman
Theoretical Training
Skilled Worker; technical profession
= acquired qualification
= KWS training course
= examination

KWS

Kraftwerksmeister Training
Mechanical Engineering / Nuclear Engineering



ANNEX E. EVALUATION

E.1. FOUR STEP EVALUATION METHOD (FEEDBACK SHEETS FOR STEPS 2, 3 AND 4)(ROMANIA)

ASSESSMENT METHOD FOR *Learning STEP 2*

This stage of evaluation has to be given to all the students before and after the course

Entry level assessment

From the list of objectives

1. Take each objective:

Ex.1 Supervisors to plan work one day ahead

Question to ask:

e.g. *How am I doing this now?*

2. These assessments has to be as much objective as possible, so :

A. Take each student
B. Have himself to assess **his** *current planning capabilities (ex.1)* On a scale 1 - 5

After training is finished

A. Take each student
B. Have himself to assess **his** *current planning capabilities (ex.1)* On a scale 1 - 5

What you should end up with *(for each training objective)* :

Supervisor	Current (before training)	After training	Improvement	Comments
John D.	3	4	+1	
Smith J.	2	4	+2	
xxxxx	2	2	O	

ASSESSMENT METHOD FOR *Behavior STEP 3*

This stage of evaluation has to be given to all the students supervisors before and (between 3 and 6 months) after the course

Entry level assessment

From the list of objectives

1. Take each objective:

Ex.1 Supervisors to plan work one day ahead

Question to ask:

e.g. *How many are doing this now?*

2. These assessments has to be as much objective as possible, so :

A. Take each student
B. Have his boss assess *current planning capabilities (ex.1)*
On a scale 1 - 5

After training is finished (3 to 6 months)

A. Take each student
B. Have his boss (should be the same who did the initial assessment) assess *current planning capabilities (ex.1)*
On a scale 1 - 5

What you should end up with *(for each training objective)* :

Supervisor	Current (before training)	After training	Improvement	Comments
John D.	3	4	+1	
Smith J.	2	4	+2	
xxxxx	2	2	O	

ASSESSMENT METHOD FOR *Results STEP 4*

At this stage of evaluation this form has to be given to all the students line supervisors (at least two level above in the orgchart) (between 3 and 6 months) after the course and **after** results from step 3 were analyzed.

1. Write the objective:

2. Can be implemented (verified) ?:	___Yes Write solution in box 7	_____No Continue in box 3

3. Which is the constraint ?:					
__People	__Money	__Time	__Education	__Policy	__ Procedures
__Tools	__Skills	__ Materials	__Other *(explain)*		

4. Can you do something to change the constraint ?: *If yes write down how:*	___Yes Continue in box 5	_____No Continue in box 6

5. The ideal characteristic can be implemented (verified) now ?:	___Yes Write solution in box 7	_____No Continue in box 6

6. Alternative solutions*(list at least two) to minimize the problem:*

7. Write the final solution to resolve the problem:

E.2. EVALUATION OF FIELD TRAINING FOR NUCLEAR OPERATIONS PERSONNEL (CANADA)

1.0. INTRODUCTION

The training and qualification of operating, maintenance, technical and management station staff is an important component of the safe operation of the nuclear generating station. Within a utility, this training includes general training, equipment principles, and systems training which are taught in a structured classroom environment by the Nuclear Training Departments. In addition to this classroom training, the trainee's line organization provides on-the-job training (OJT) to ensure the individual has the specific knowledge and skills to effectively perform tasks to the required performance standards.

The Atomic Energy Control Board (AECB) has monitored and evaluated the classroom training provided to the utility staff by their respective training departments. However, there has been little involvement and review of the utility's on-the-job training program. As a result, the AECB initiated a review of the on-the-job training program for the utility plant personnel. The initial project focused on the field operators at one station. Based upon the pilot project, the evaluation process was revised. This project used the revised process to assess field operator on-the-job training at another station.

The assessment process used in this project included the following steps:

(1) Review corporate policies and procedures to compare with the utility standards and industry guidelines. These include job performance standards and on-the-job training standards and guidelines.

(2) Review station and training department policies and procedures to compare with corporate standards and industry guidelines.

(3) Field observations of job tasks by qualified operators for comparison with station requirements and industry guidelines and practices.

(4) Field observations of the implementation of the on-the-job training program for comparison with station and corporate requirements, and industry guidelines and practices. Between 70 and 100 person-hours of field observations should be performed to identify performances strengths and weaknesses.

(5) Interviews with station and training personnel, including trainees, qualified workers, supervisors, on-the-job trainers, on-the-job assessors, line management, training specialists, and training management. These interviews help identify performance strengths and weaknesses, as well as the significance, extent and causes of each observed weakness.

(6) Follow-up review of station documentation. This includes training records, training lesson plans, evaluation guidelines, and event reports. Such reviews assist in identifying performance weaknesses, and their significance and extent.

(7) Identify program and implementation strengths and weaknesses.

1.1. Project Objectives

The overall objective of this project is to determine whether on-the-job training for field operators at the station is consistent with a systematic approach to training as defined by the International Atomic Energy Agency (IAEA) and other organizations which are recognized internationally in nuclear energy such as the Instituted for Nuclear Power Operations (INPO), and the World Association of Nuclear Operators (WANO).

Specific objectives of the project are:

(1) To evaluate the process used by the utility to determine on-the-job training requirements.

(2) To evaluate the effectiveness (quality and consistency) of the station's on-the-job training for field operators.

(3) To provide a process by which AECB staff can evaluate the effectiveness of a plant's on-the-job training program.

1.2 On-the-Job Training Evaluation

An initial pilot to evaluate the effectiveness of field operator on-the-job training was performed in 1994 at a station. The lessons learned from this assessment were used to improve the assessment procedure. This procedure was used for this project. This project was done for field operators at another station.

The following tasks were performed to meet the project objectives:

(1) Revised on the On-The-Job Training Assessment Procedure.

(2) Reviewed industry standards to identify requirements for the development and implementation of an effective on-the-job training program.

(3) Implemented the procedure to evaluate the effectiveness of the station's field operator on-the-job training program. This evaluation included the review of appropriate documentation of both stations, field observations and interview of station and training personnel.

(4) Identify the results of the evaluation with conclusions.

(5) Incorporate lessons learned from this evaluation in the On-the-Job Evaluation Procedure.

1.3 Evaluation Team

The evaluation was performed by a three-person core team. The combined experience of the assessment team included:

(1) More than 60 person-years of experience in the nuclear industry.

(2) More than 40 person-years of experience in CANDU and US Pressurized Water Reactor (PWR) nuclear power plant operations.

(3) Development of Field Operator on-the-job training programs at several nuclear power plants. These training programs are accredited by the National Academy for Nuclear Training of the Institute of Nuclear Power Operations (INPO) in the United States.

(4) Recognized expertise in the evaluation of accredited Field Operator on-the-job training programs.

(5) Performed more than 80 performance-based evaluations of nuclear power plants.

In addition to the core team, one member of the AECB staff and two members from the Training Department participated in the evaluation. Their participation was valuable to the effectiveness of the assessment, and their observations and interviews are included in the report. However, analysis, conclusions, and recommendations remain the responsibility of the core team.

1.4 The Role of On-The-Job Training

The safe and reliable operation of a nuclear power plant required the successful integration of plant and system design, programs and procedures, and qualified personnel. This integration is summarized in Figure 1, and is consistent with INPO's guidelines for safe and reliable operation of nuclear power plants

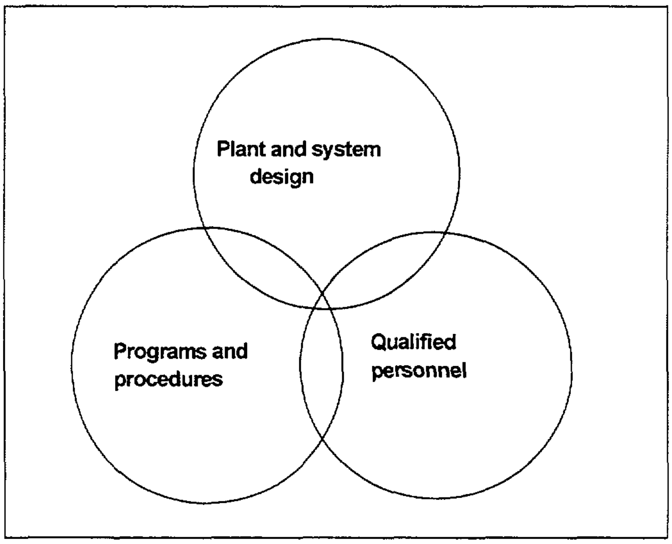


Figure 1. Elements of Safe and Reliable Operation

Of these three components, operations personnel and management have the capability to influence and improve programs and qualified personnel. Programs include operating procedures, preventive and corrective maintenance programs, testing procedures and processes, and administrative procedures and processes to ensure control and effective implementation of programs. Qualified personnel includes selection, training, and evaluation that performance meets established performance standards. On-the-job training is important element to obtain and manage qualified personnel.

2. EVALUATION METHODOLOGY FOR ON-THE-JOB TRAINING

The developed procedure to evaluate the effectiveness of on-the-job training involves a review of appropriate corporate and station policies and procedures to understand training and field performance standards and expectations, followed by a performance-based evaluation of field performance and training implementation. The performance-based evaluation permits a review of actual performance for the identification of strengths and weaknesses, along with the significance and extent of each. Figure 2 summarizes the evaluation methodology. This methodology includes the following steps:

(1) Review corporate policies and procedures for a comparison with the utility standards and industry guidelines. These include job requirements, and on-the-job training standards and guidelines.

(2) Review station and training department policies and procedures for a comparison with corporate standards and industry guidelines.

(3) Observe job tasks performed by qualified operators for comparison with station requirements and industry guidelines and practices.

(4) Observe the implementation of the on-the-job training for comparison with station and corporate requirements, and industry guidelines and practices.

(5) Interview station and training personnel, including trainees, qualified workers, supervisors, on-the-job trainers, on-the-job assessors, line management, training specialists, and training management. These interviews help identify performance strengths and weaknesses, as well as the significance, extent and causes of each observed weakness.

(6) Review additional station documentation. This includes training records, training lesson plans, evaluation guidelines, and event reports. Such reviews assist in identifying performance weaknesses, and their significance and extent.

(7) Identify program and implementation strengths and weaknesses.

Between 70 and 100 person-hours of field observations should be performed to identify performances strengths and weaknesses. A good cross-section of individuals should be interviewed to ensure that the facts obtained are representative. For field operators, at least fifty individuals should be interviewed.

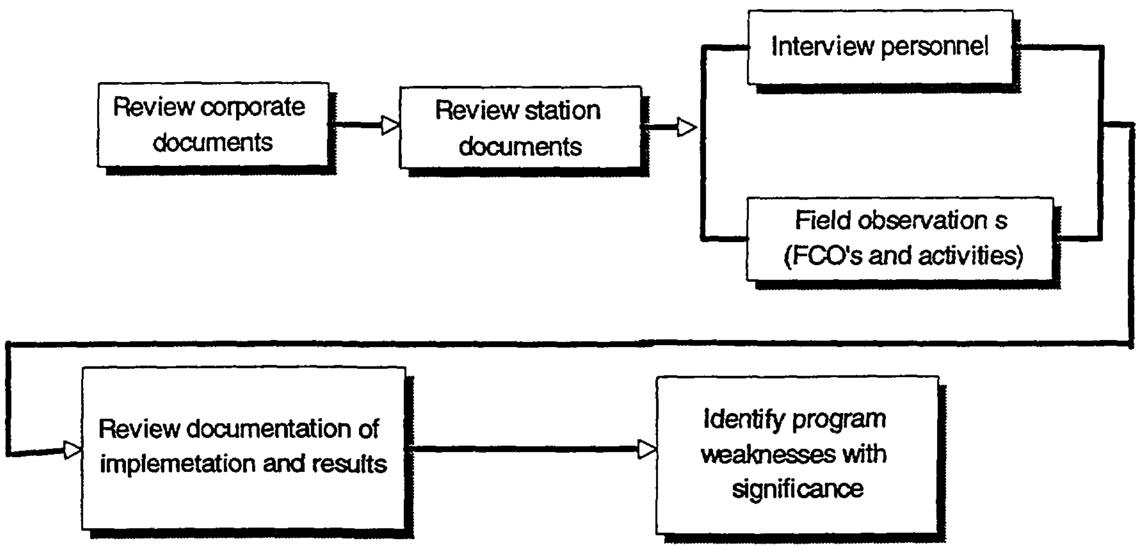


Figure 2. Evaluation Methodology

INSTRUCTOR EVALUATION - CLASSROOM

Instructor: ______________________ Date: ______________
Evaluator: ______________________ Lesson Length: __________
Lesson Title: ______________________ Evaluation Length: ________
Training Program: ______________________ Number of Trainees: ________

Directions: Check Yes, No, N/O (Not Observed), or N/A (Not Applicable)

I. **Advance Preparation** - Determine if the instructor demonstrated adequate preparation for the training session.

	YES	NO	N/O	N/A
a. Training area was set up for effective instruction prior to training (e.g., lighting, seating, supplies)?	☐	☐	☐	☐
b. Training materials were gathered and checked for accuracy, completeness, and legibility?	☐	☐	☐	☐
c. Administrative materials (e.g., attendance sheets) were available?	☐	☐	☐	☐
d. Training aids and materials (e.g., tests, handouts, transparencies) were organized for effective and efficient use?	☐	☐	☐	☐
e. Audio/visual equipment was set up and operational?	☐	☐	☐	☐

2. **Format of the Training Material** - Determine if the instructor demonstrated ability to follow the lesson:

	YES	NO	N/O	N/A
a. An overview of the session was presented as part of the introduction?	☐	☐	☐	☐
b. Training content was presented according to the lesson plan?	☐	☐	☐	☐
c. Instructor/trainee activities were implemented according to the plan?	☐	☐	☐	☐
d. The instructor demonstrated the ability to make the instruction meaningful for the trainees?	☐	☐	☐	☐
e. Training objectives were presented at the beginning of the class?	☐	☐	☐	☐
f. Objectives were reinforced during the training?	☐	☐	☐	☐
g. Examples and analogies were used to apply the content to practical situations?	☐	☐	☐	☐

Determine if the instructor demonstrated the ability to focus trainee attention on the training content:

	YES	NO	N/O	N/A
h. The trainees were provided with an appropriate purpose for the training?	❑	❑	❑	❑
i. Interest in the topic was increased through the use of reinforcement?	❑	❑	❑	❑
j. The relationship of the present session to previous training was identified?	❑	❑	❑	❑
k. The on-the-job significance of the training was emphasized?	❑	❑	❑	❑

Determine if the instructor demonstrated the ability to present the content and instructor/trainee activities in an organized, logical sequence:

	YES	NO	N/O	N/A
l. One teaching point/objective flowed to the next?	❑	❑	❑	❑
m. Trainees could follow the presentation without confusion?	❑	❑	❑	❑
n. "Nice to know" information was minimized?	❑	❑	❑	❑
o. Meaningful relationships between concepts and skills were clear?	❑	❑	❑	❑
p. Topics had natural beginning and ending points?	❑	❑	❑	❑

3. **Technical Material Review** (for use when evaluation is performed by a SME) - Determine if the instructor demonstrated appropriate technical competence to present the subject matter:

	YES	NO	N/O	N/A
a. Content knowledge was accurate and current?	❑	❑	❑	❑
b. Knowledge was of appropriate depth?	❑	❑	❑	❑
c. Knowledge could be applied to the job as appropriate?	❑	❑	❑	❑

4. **Applied Instructional Theory** - Determine if the instructor demonstrated the ability to involve trainees actively in the learning process (as opposed to constant lecture or watching a demonstration):

	YES	NO	N/O	N/A
a. Active trainee participation was encouraged?	❑	❑	❑	❑
b. Checks for understanding were made through questioning, performance, review quizzes, etc?	❑	❑	❑	❑
c. Training was monitored/adjusted to trainee needs?	❑	❑	❑	❑

d. Allowances were made for "slower" and "faster" learners?	❑	❑	❑	❑
e. Behavior and trainee responses were elicited?	❑	❑	❑	❑
f: Frequent and appropriate trainee responses were elicited?	❑	❑	❑	❑
g. Opportunity to ask subject-matter questions was encouraged?	❑	❑	❑	❑
h. Trainees were given an opportunity to practice more than once (if needed)?	❑	❑	❑	❑
i. "Hands-on" practice was provided where possible?	❑	❑	❑	❑
j. "Hands-on" practice emphasized critical steps and skills?	❑	❑	❑	❑

Determine if the instructor summarized key points, information, and task steps before progressing to the next objective:

	YES	NO	N/O	N/A
k. The amount of information presented was appropriate for the trainees?	❑	❑	❑	❑
l. Instructor summarized objective and ensured understanding before moving to next point?	❑	❑	❑	❑

Additional Comments: ____

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Strengths: ____

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Areas for Improvement: ____

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Evaluator Signature: ________________________ Date ____________

Review the results of this evaluation within two working days of the session with the instructor:

Instructor Signature: __________________________ Date ____________

Route original to the instructor's personnel file; Copy to the Training Manager.

INSTRUCTOR EVALUATION - LABORATORY

Instructor: ______________________ Date: ______________
Evaluator: ______________________ Lesson Length: __________
Lesson Title: ______________________ Evaluation Length: ________
Training Program: ______________________ Number of Trainees: ________

Directions: Check Yes, No, N/O (Not Observed), or N/A (Not Applicable)

I. General Instructional Techniques.

	YES	NO	N/O	N/A
a. Objectives for the laboratory were discussed prior to performance?	❑	❑	❑	❑
b. Instructor followed the lab guide (content and time)?	❑	❑	❑	❑
c. Instructor activity assisted trainees during the lab session?	❑	❑	❑	❑
d. Instructor identified and corrected trainee knowledge and skill weaknesses?	❑	❑	❑	❑
e. Instructor used trainee responses and other situations as opportunities to teach and reinforce concepts?	❑	❑	❑	❑
f. Instructor exhibited interest and enthusiasm for the session?	❑	❑	❑	❑
g. Instructor listened to trainees and responded to their questions and needs?	❑	❑	❑	❑
h. Instructor adjusted the pace to the level of trainee's knowledge and ability?	❑	❑	❑	❑
i. Instructor movements and gestures were appropriate (not distracting)?	❑	❑	❑	❑
j. Instructor maintained vocal variety (not monotone)?	❑	❑	❑	❑
k. Instructor avoided using distracting vocal mannerisms ("and-uh", "you know", "OK?")?	❑	❑	❑	❑
l. The instructor summarized activities at the end of the session?	❑	❑	❑	❑
m. Instructor solicited and answered unresolved trainee questions at the end of the session?	❑	❑	❑	❑

2. Knowledge of Subject Matter (only to be answered by an SME).

	YES	NO	N/O	N/A
a. Instructor explained technical information clearly and concisely?	❑	❑	❑	❑
b. Instructor pointed out differences that may exist between the lab and actual	❑	❑	❑	❑

facility procedures and equipment?

c. Instructor asked questions that required the trainees to:				
(1) Think through causes and effects of steps?	❑	❑	❑	❑
(2) Think through plant conditions, activities, causes, and responses?	❑	❑	❑	❑
(3) Integrate knowledge (theory, systems, procedures, tech specs, etc.)?	❑	❑	❑	❑
d. Instructor's feedback to trainees (timing, frequency, nature) was appropriate for the stage of the session?	❑	❑	❑	❑
e. The instructor effectively incorporated the theory of facility operations and industry operating experiences into the laboratory training?	❑	❑	❑	❑
f. Enough time was spent on the exercises?	❑	❑	❑	❑

3. **Technical Material Review** (for use when evaluation is performed by a SME) - Determine if the instructor demonstrated appropriate technical competence to present the subject matter:

	YES	NO	N/O	N/A
a. Content knowledge was accurate and current?	❑	❑	❑	❑
b. Knowledge was of appropriate depth?	❑	❑	❑	❑
c. Knowledge could be applied to the job as appropriate?	❑	❑	❑	❑

Additional Comments: ______________________________

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Strengths: ______________________________

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Areas for Improvement: ______________________________

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Evaluator Signature: ______________________ Date __________

Review the results of this evaluation within two working days of the session with the instructor:

Instructor Signature: ______________________ Date __________

Route original to the instructor's personnel file; Copy to the Training Manager.

INSTRUCTOR EVALUATION - SIMULATOR

Instructor: ____________________ Date: ____________

Evaluator: ____________________ Lesson Length: ________

Lesson Title: ____________________ Evaluation Length: ______

Training Program: ________________ Number of Trainees: _____

Directions: Check Yes, No, N/O (Not Observed), or N/A (Not Applicable)

I. Introduction

	YES	NO	N/O	N/A
a. Instructor maintains a professional demeanor?	❑	❑	❑	❑
b. Organized and prepared simulator and materials?	❑	❑	❑	❑
c. A briefing was held on initial conditions, status of the plant, and special instructions?	❑	❑	❑	❑
d. Gave overview of simulator exercise and objectives?	❑	❑	❑	❑
e. Provided time for board walkdown and questions?	❑	❑	❑	❑
f. Participant roles were assigned?	❑	❑	❑	❑

2. Lesson

	YES	NO	N/O	N/A
a. Ideas were put in context and tied to previously learned skills?	❑	❑	❑	❑
b. Instructor used effective questioning skills?	❑	❑	❑	❑
c. Instructor recognized and encouraged participant questions?	❑	❑	❑	❑
d. Instructor posed valid follow-up questions?	❑	❑	❑	❑
e. Training activities promoted control room realism?	❑	❑	❑	❑
f. Instructor clarified standards of performance and addressed deviations?	❑	❑	❑	❑
g. Required participants to use procedures?	❑	❑	❑	❑
h. Instructor recognized and encouraged correct performance?	❑	❑	❑	❑

3. **Use of Simulator (To be evaluated by Supervision of License Training Only)**

	YES	NO	N/O	N/A
a. Instructor initiated malfunctions properly?	❑	❑	❑	❑
b. Instructor operated the console correctly?	❑	❑	❑	❑
c. Simulator training time was used effectively?	❑	❑	❑	❑
d. Instructor utilized the simulator's capabilities effectively to ensure training realism?	❑	❑	❑	❑

4. **Summary/Post Exercise Critique**

	YES	NO	N/O	N/A
a. Instructor conducted critique of performance?	❑	❑	❑	❑
b. Instructor summarized performance and key points?	❑	❑	❑	❑
c. Instructor reviewed objectives and clarified questions?	❑	❑	❑	❑
d. Instructor discussed problems encountered and recommended solutions?	❑	❑	❑	❑
e. Instructor discussed teamwork skills and communication?	❑	❑	❑	❑
f. Instructor discussed safety functions and emergency classifications?	❑	❑	❑	❑
g. Instructor addressed conflict resolution problems?	❑	❑	❑	❑
h. Instructor discussed the importance of leadership?	❑	❑	❑	❑
i. Instructor addressed role and responsibility problems?	❑	❑	❑	❑
j. Instructor discussed attitudes and attitude problems?	❑	❑	❑	❑
k. Summary included a tie to corresponding lessons, courses or other training?	❑	❑	❑	❑
l. Instructor completed documentation of simulator exercise?	❑	❑	❑	❑

Additional Comments: ____

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Strengths: ____

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Areas for Improvement: ____

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Evaluator Signature: ______________________ Date __________

Review the results of this evaluation within two working days of the session with the instructor:

Instructor Signature: ______________________ Date __________

Route original to the instructor's personnel file; Copy to the Training Manager.

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