



UPGRADING NPP PERSONNEL

COMPETENCE AND TRAINING

THROUGH THE SYSTEMATIC APPROACH TO TRAINING

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**UPGRADING NPP PERSONNEL COMPETENCE AND TRAINING
THROUGH THE SYSTEMATIC APPROACH TO TRAINING**

The objective of this presentation is to provide a comprehensive overview of SAT as accepted international best practice for the training and qualification of NPP personnel, the Systematic Approach to Training or SAT, to enable an understanding of SAT advantages, experience and methodology. Specific issues to be addressed include:

- **SAT AS THE ACCEPTED INTERNATIONAL BEST PRACTICE FOR ACHIEVING AND MAINTAINING THE QUALIFICATIONS AND COMPETENCE OF NPP PERSONNEL**
- **SAT ADVANTAGES WITH REGARD TO TRAINING AND EVALUATION**
- **SAT EVOLUTION FROM TRADITIONAL OR CONVENTIONAL APPROACHES**
- **REASONS WHY SAT HAS BEEN INTRODUCED IN VARIOUS COUNTRIES AND NPPS**

- **REQUIREMENTS FOR INTRODUCING SAT, INCLUDING THE APPROPRIATE FORMATION OF THE SAT PROJECT GROUP, AND TRAINING ON SAT FOR MANAGEMENT AND SUPERVISORY PERSONNEL AND TRAINEES**

- **SAT APPLICATION FOCUSSES ON SPECIFIC TRAINING NEEDS AND PRIORITIES AND BUILDS UPON EXISTING TRAINING CAPABILITIES**

- **EXPERIENCE GAINED FROM THE APPLICATION OF SAT INCLUDING PROBLEMS ENCOUNTERED, SOLUTIONS DEVELOPED AND LESSONS LEARNED**

- **RESULTS OF THE IAEA WORLD SURVEY ON NPP PERSONNEL TRAINING**

**FACTORS INFLUENCING THE
EVOLUTION OF THE TRAINING PROCESS**

- **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 country/ training 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...)**
- **Training delivery techniques used**

EVOLUTION OF SAT PHASES

ANALYSIS

Analysis will ultimately aim to give, as regards both technical and human-factor-related competencies, a complete definition of all knowledge required, how to apply this knowledge (skills) and the individual's approach (attitude) when applying the knowledge to perform competently the tasks of the job.

DESIGN

Design will evolve to the point where individuals actively participate in defining their learning needs, for both individual and team work; training objectives will relate not only to required knowledge but will relate also to needed skills and attitudes; a wide range of training settings and tools are available and designed to suit the method that will be used to train for the required competency.

DEVELOPMENT

Training materials will have to support not only training for knowledge but also for skills and attitudes, be prepared by trained individuals with active involvement of supervisors and/or job incumbents and relate closely to the training objectives. They will have valid and reliable test items and support the wide range of training settings and techniques available.

EVOLUTION OF SAT PHASES

IMPLEMENTATION

Instructors possessing both plant knowledge and instructional skills provide training for knowledge, skills and attitudes, and assess achievement of training objectives, with feedback to the trainee and into the training process. This culminates in training being delivered to the individual or team using the techniques and settings most suitable for the specific type of training (knowledge, skills, attitudes), with continuous assessment carried out and feedback to the trainee(s) and training process.

EVALUATION

Evaluation will aim to encompass the continuous evaluating of the complete training program, using inputs of the trainees, instructors, supervisors and management, and results of trainee assessments. Feedback will be used to improve not only job performance but also the NPP technical and economic performance.

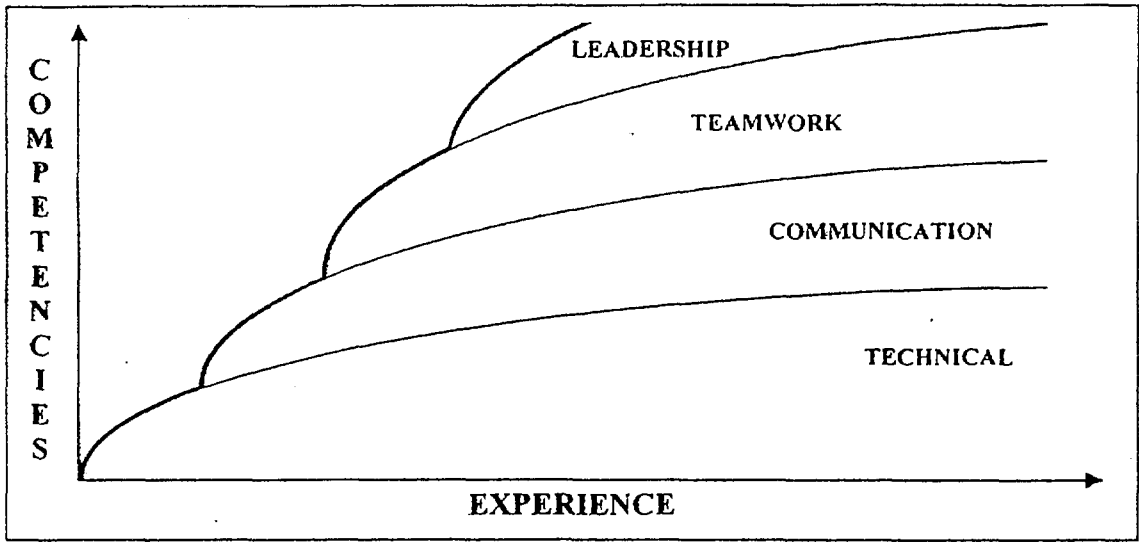


FIG.1. Competencies versus experience

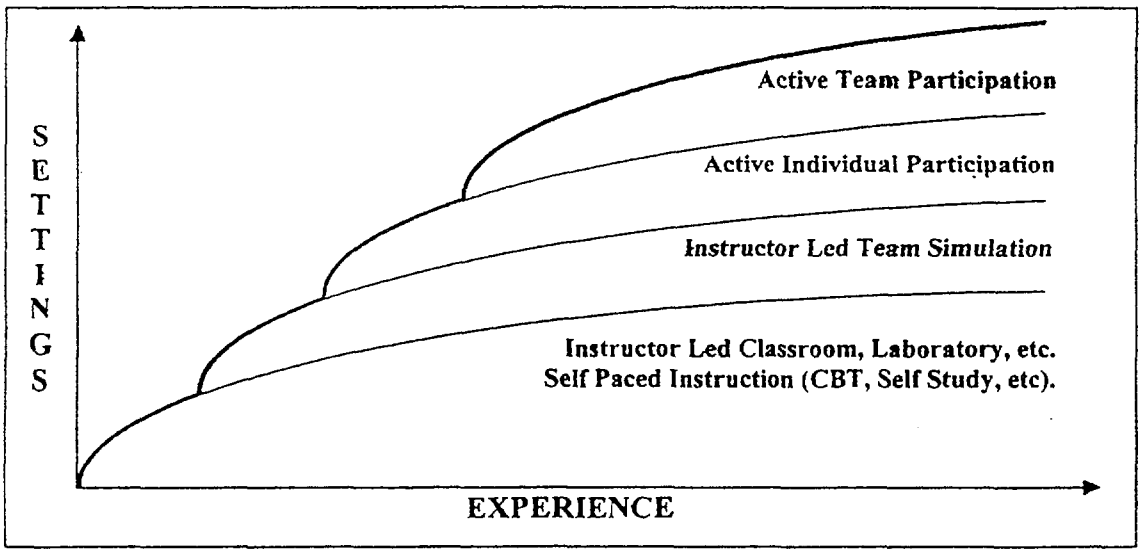


FIG. 2. Settings versus experience

MAIN REASONS FOR USING SAT

The reasons for using SAT vary from country to country and among NPPs. The main reasons 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 OF 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 cause
- Helps an operating organization to provide assurance to the regulatory authority that the nuclear power plant training programs provides the required competencies.

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

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



SAT METHODOLOGY OVERVIEW

What is SAT?

- **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 these competencies, and subsequent evaluation of this training.**

SAT-based training emphasizes:

- **Technical knowledge and skills as well as human factors or human performance knowledge, skills and attitudes, in order to achieve the required levels of competence and professionalism.**

SAT can and should be adapted for each country and NPP.

- **SAT is to be adapted and is adaptable to suit the specific requirements, conditions and experience of each NPP, utilizing and building upon existing capabilities.**

INPUTS FROM SOURCES EXTERNAL TO THE SAT PROCESS

- Need for updating/improving NPP personnel training
- Procedures for analysis phase
- Plant documents
- Description of existing training programmes
- External documents
- Regulatory requirements
- Procedures for design phase
- Procedures for development phase
- Procedures for implementation phase
- Qualified instructors
- Adequate training facilities
- TRAINEES**
- Procedures for evaluation phase including evaluation objectives and criteria
- Plant operating experience data and performance indicators
- Inputs from supervisors and job incumbents
- Plant modification data
- Plant procedure changes

SAT PHASES

- ANALYSIS** of jobs and training needs
- DESIGN** of training programmes
- DEVELOPMENT** of training material
- IMPLEMENTATION** of training
- EVALUATION** of training effectiveness

INPUTS/OUTPUTS INTERNAL TO THE SAT PROCESS

- Training needs
- List of job-related tasks/activities for which formal training is needed
- List of KSAs/competencies for job performance
- Training objectives
- Training plan
- Lesson plans
- Instructor materials
- Trainee materials
- COMPETENT PERSONNEL**
- Training records
- Data for training evaluation
- Needed improvements in training programmes
- Needed improvements in SAT phases
- Needed plant improvements

FEEDBACK

W
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Overview of the SAT Process including Inputs and Outputs.

EXPERIENCE GAINED IN SAT APPLICATION

Overall, the experience gained leads to the following conclusions:

- **Utility management should effectively direct and adequately support plant training activities**
- **Trainers (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 program content**
 - prepare supporting training materials**
 - maintain the training program.**
- **Training program content should provide the trainee with the knowledge, skills and attitudes needed to perform functions associated with the position for which training is being conducted.**
- **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 programs, as appropriate.**

- **In introducing or applying SAT, a project approach is advisable with defined achievable goals which can demonstrate real results/success of SAT training to all those involved in training as well as to management.**

- **SAT should build on existing training capabilities where possible.**

- **In carrying out the IAEA World Survey of NPP Personnel Training, it was found from the data of the individual country reports that, while most countries apply some form of SAT, few apply the full SAT process, i.e., all five phases of SAT, the most commonly omitted phase being analysis.**

SYSTEMATIC APPROACH TO TRAINING

- **IAEA GUIDEBOOK ON NUCLEAR POWER PLANT PERSONNEL TRAINING AND ITS EVALUATION (TECHNICAL REPORTS SERIES 380, PUBLISHED IN 1996) STRONGLY RECOMMENDS SAT TO ACHIEVE THE QUALIFICATION AND COMPETENCE OF NPP PERSONNEL.**
- **THE SAT PROCESS INVOLVES ANALYSIS, DESIGN, DEVELOPMENT, IMPLEMENTATION AND EVALUATION/FEEDBACK AND IS THE MOST WIDELY USED METHODOLOGY FOR UPGRADING NPP PERSONNEL TRAINING.**
- **BROADER INTEGRATED APPROACH TO TRAINING AND RETRAINING TO PROVIDE THE REQUIRED QUALIFICATIONS AND COMPETENCE, INVOLVING NOT ONLY TECHNICAL KNOWLEDGE AND SKILLS BUT ALSO COMPETENCE RELATED TO MOTIVATION, RESPONSIBILITY, COOPERATION, LEADERSHIP, TEAMWORK, AND A GENERAL QUESTIONING AND ALERT ATTITUDE.**
- **SAT INVOLVES JOB-SPECIFIC, PERFORMANCE-BASED TRAINING, INCORPORATING OBJECTIVE PERFORMANCE INDICATORS.**
- **JOB-RELATED AND JOB-SPECIFIC TRAINING SEEKS TO DEVELOP AN INTEGRATION OF THE MANAGERIAL, TECHNICAL AND METHODOLOGICAL KNOWLEDGE, SKILLS AND ATTITUDES NEEDED TO SUPPORT HIGH OPERATIONAL AND SAFETY PERFORMANCE.**
- **SAT IS A MANAGEMENT TOOL FOR ACHIEVING QUALITY IN TRAINING AND PERSONNEL PERFORMANCE, AND THUS FOR SAFETY AND QUALITY CULTURE**
- **PLANT MANAGEMENT ARE RESPONSIBLE FOR THE COMPETENCE OF NPP PERSONNEL.**

- **MANAGEMENT HAS AN IMPORTANT ROLE AND RESPONSIBILITIES. IT MUST BE INVOLVED IN THE TRAINING PROCESS AND APPROVE THE TRAINING PROGRAM. MANAGEMENT MUST PREPARE THE JOB SPECIFICATIONS FOR WHICH TRAINING IS TO BE GIVEN IN ORDER TO ACHIEVE COMPETENCE.**
- **SAT BENEFITS ARE FULLY ACHIEVED ONLY IF IT IS IMPLEMENTED COMPREHENSIVELY AND CONSISTENTLY. COMMITMENT AT ALL LEVELS OF PLANT ORGANIZATION AND THE ALLOCATION OF ADEQUATE RESOURCES.**
- **SAT IS FAR MORE THAN ANALYSIS, AND SHOULD NOT BE IDENTIFIED WITH JOB ANALYSIS + TASK ANALYSIS (JTA). OTHER METHODS OF ANALYSIS CAN BE EQUALLY EFFECTIVE AND HAVE BEEN SHOWN TO BE MORE EFFICIENT.**
- **SAT EVALUATION AND FEEDBACK OCCURS DURING ALL PHASES OF THE TRAINING PROCESS. THERE MUST BE A MECHANISM FOR REGULAR FEEDBACK OF THE RESULTS OF EVALUATION INTO THE TRAINING PROCESS. FEEDBACK FROM PLANT CHANGES AND HUMAN-FACTOR-RELATED ROOT CAUSES OF EVENTS, ON A WORLDWIDE BASIS, MUST BE INCORPORATED INTO TRAINING PROGRAMS.**
- **SAT CAN AND SHOULD BE ADAPTED TO THE LOCAL TRAINING NEEDS, CONDITIONS AND PRIORITIES.**
- **SAT CAN AND SHOULD USE AND BUILD ON EXISTING TRAINING CAPABILITIES**
- **WHILE THE WAYS AND MEANS TO ACHIEVE THE COMPETENCE AND QUALIFICATION OF NPP PERSONNEL, WHICH INCLUDES OPERATIONS, MAINTENANCE, MANAGEMENT, AND TECHNICAL SUPPORT PERSONNEL, MAY VARY DEPENDING ON THE NEEDS/CONDITIONS OF THE TRAINING IN A GIVEN COUNTRY OR NPP,**
THE FINAL LEVEL OF QUALIFICATION AND COMPETENCE TO PERFORM A GIVEN JOB MUST BE THE SAME, REGARDLESS OF COUNTRY OR NPP (ASSUMING THE JOB INVOLVES THE SAME TASKS)

SAT--BROAD INTEGRATED AND SYSTEMATIC APPROACH TO TRAINING

- **TO ACHIEVE AND ENHANCE SAFETY AND RELIABILITY OF NPP OPERATION, EXPERIENCE HAS SHOWN THAT SAT SHOULD COVER A BROAD INTEGRATED APPROACH TO TRAINING, WHICH EMPHASIZES NOT ONLY TECHNICAL KNOWLEDGE AND SKILLS BUT ALSO HUMAN PERFORMANCE KNOWLEDGE AND SKILLS.**

- **SPECIFICALLY, SAT SHOULD BE BROADENED TO INCLUDE:**
 - **HIGHER COGNITIVE SKILLS (e.g., DIAGNOSTIC ABILITIES)**
 - **TEAM TRAINING AND TEAMWORK**
 - **COMMUNICATION SKILLS**
 - **HUMAN FACTORS (e.g., MAN-MAN INTERFACE, SOCIO-TECHNICAL SYSTEMS)**
 - **PEDAGOGICAL SKILLS (e.g., FOR ON-THE-JOB TRAINING)**
 - **QUESTIONING ATTITUDE**
 - **ALERTNESS**
 - **MANAGEMENT AND SUPERVISORY COMPETENCIES**
 - **ORGANIZATION**
 - **MOTIVATION**
 - **RESPONSIBILITY**

- **A BROAD INTEGRATED TO INITIAL TRAINING AND CONTINUING TRAINING SHOULD STRIVE FOR EXCELLENCE AND RESPONSIBILITY NOT ONLY THROUGH TECHNICAL COMPETENCE BUT ALSO THROUGH THE DEVELOPMENT OF THOSE HUMAN PERFORMANCE SKILLS AND ATTITUDES WHICH ENHANCE THE FUNCTIONING OF ALL STAFF AS INDIVIDUALS AND AS TEAM MEMBERS. 1**

THE SYSTEMATIC APPROACH TO TRAINING

Definition of SAT

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

SAT consists of five interrelated phases:

- ANALYSIS:** The Analysis phase comprises the identification of training needs and of the competencies required to perform a particular job.
- DESIGN:** In the Design phase, competencies are converted into training objectives. These objectives are organized into a training plan.
- DEVELOPMENT:** The ~~Implementation~~ ^{Development} phase comprises preparation of all training materials so that the training objectives can be achieved.
- IMPLEMENTATION:** In the ~~Development~~ ^{Implementation} phase, training is conducted by using the training materials developed.
- EVALUATION:** During the Evaluation phase, all aspects of training programs are evaluated on the basis of the data collected during each of the other phases. This is followed by suitable feedback leading to training program and plant improvements.

EXPERIENCE GAINED IN SAT ANALYSIS

- Job-Task Analysis (JTA) and Job Competence 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 analyzed.
- The best way to start is with a pilot project addressing a few high priority job position.
- 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.
- The IAEA World Survey data show that while SAT is applied in nearly all training organizations, the full SAT process, namely all five phases are applied in only some countries, the phase most often omitted being analysis.

EXPERIENCE GAINED IN THE DESIGN AND DEVELOPMENT PHASES

- **Ensure appropriate establishment of entry level requirements when defining training objectives.**
- **Training objectives can sometimes be derived directly from the tasks.**
- **Training programs 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.**
- **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.**

EXPERIENCE GAINED IN IMPLEMENTATION OF SAT

- **TRAINING MUST BE PROVIDED BY STAFF WHO HAVE THE TECHNICAL AND INSTRUCTIONAL KNOWLEDGE AND SKILLS, AS WELL AS THE APPROPRIATE ATTITUDES**

- **ON-THE-JOB TRAINERS AND ASSESSORS SHOULD BE SUITABLY TRAINED AND QUALIFIED, INCLUDING REGULAR RETRAINING/REFRESHING OF KNOWLEDGE AND SKILLS**

- **TEST ITEMS SHOULD BE VALIDATED USING PEER REVIEW OR ASSESSMENT VALIDATION PANELS**

- **ACCURATE REPRESENTATION OF THE OPERATING CHARACTERISTICS OF PLANT COMPONENTS AND SYSTEMS MUST BE ENSURED**

EXPERIENCE GAINED IN THE EVALUATION PHASE

- **Feedback from evaluation results from trainees, instructors and supervisors should be used to improve training programs, job performance and plant performance.**
- **Training materials used must be up to date and consistent with plant configuration, if training is to meet needs.**
- **If possible, modify generic training material and training material developed for other plants to the specific conditions and characteristics of the trainees' plant.**
- **Require that plant personnel review and approve training material prior to implementation.**
- **Feedback from trainee assessments must be used to modify future assessments.**
- **Evaluation of training must be based on defined objectives and criteria or equivalent requirements.**
- **Adequate resources should be allocated to the revision and updating of training programs and materials.**
- **The use of feedback forms to be filled in by the trainees upon completion of a training activity is tending to decrease. However, 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.**
- **Analyze changes and feedback (e.g., regulatory changes, changes in job scope, results of evaluations and inspections, changes in plant procedures, changes in plant systems and equipment, changes in industry guidance and associated training materials) to identify the need for modifications to the initial and continuing training programs.**

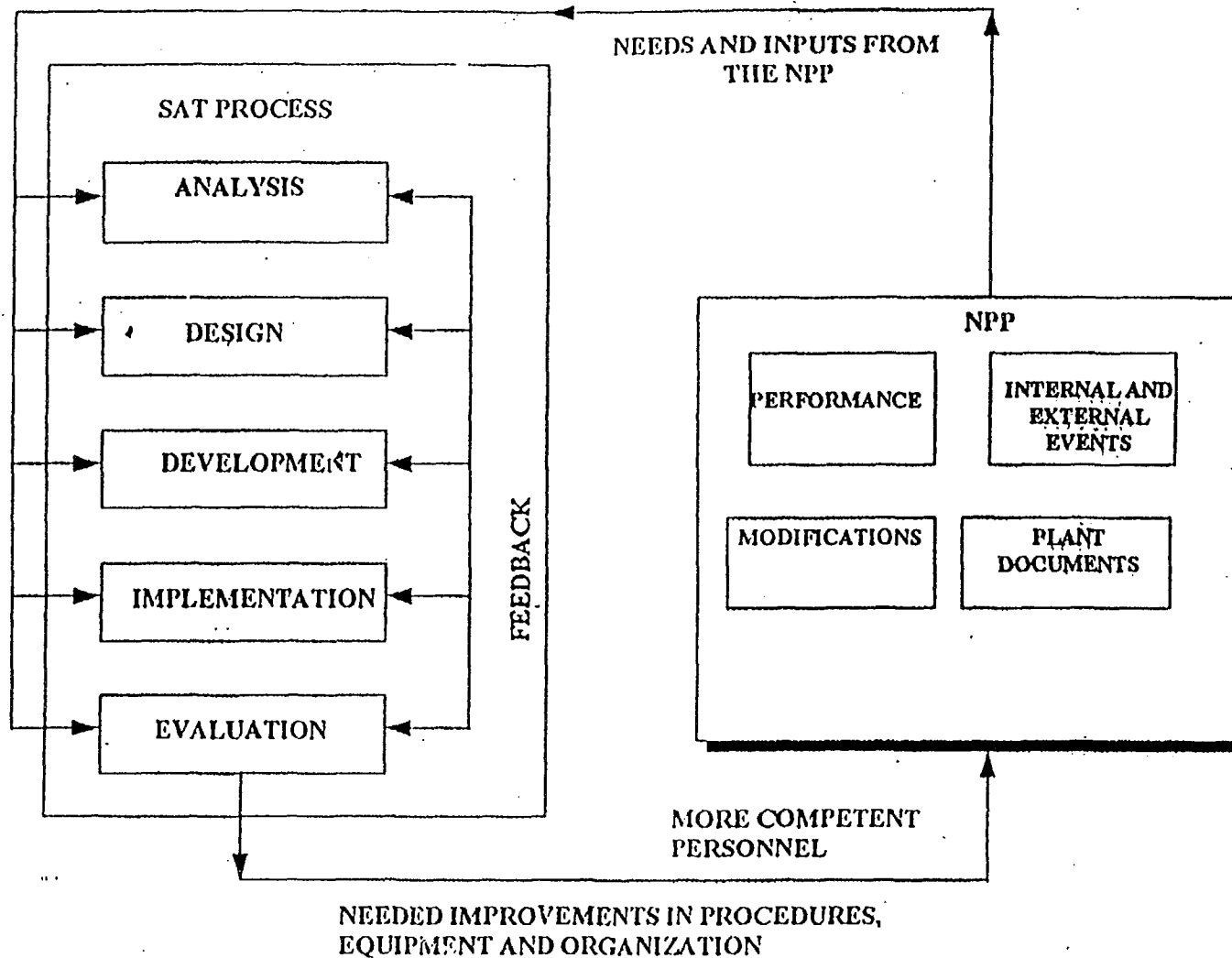
IAEA WORLD SURVEY

AIMS

- **Provide world-wide overview of all aspects of NPP personnel training**
- **Foster international and regional cooperation**
- **Mechanism for exchange of experiences and practices**
- **Identify and encourage adaptation of effective training practices**
- **Provide information from 23 countries on**
 - **National system and organization of training**
 - **Job positions for which SAT is used**
 - **Training programs for the key operations, maintenance, instructor and technical support jobs**
 - **Role of management and regulatory body**
 - **Training facilities**
 - **Recommended training practices**
 - **Availability of training to personnel from organizations outside of the country**
 - **Contact points in each of 129 training organizations (NPP Training Departments or Training Centers) which responded to Survey**

Member States Responding to the Survey

Country	Number of NPPs with training facilities providing information	Number of Training Centers providing information	Availability of Training to External Personnel
Brazil	1		Yes
Bulgaria	1		Yes
Canada	1	2	Yes
China, People's Republic of		2	Yes
Czech Republic	2	1	Yes
Finland	2		Yes
France		4	Yes
Germany	12	4	Yes
Hungary	1		Yes
Japan	10	2	
Kazakstan, Republic of	1		No
Korea, Republic of		3	Yes
Lithuania	1		Yes
Mexico	1		
Romania	1		Yes
Russia	8	2	Yes
Slovak Republic	2	1	No
Slovenia	1	1	
Spain	4	1	Yes
Sweden	6	1	Yes
Switzerland	4		No
Ukraine	5		Yes
United Kingdom	14	5	Yes
United States of America	24		Yes



96

Relationship between the SAT Process and the NPP