

# PRINCIPLES OF TRAINING SYSTEM DEVELOPMENT

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SECTION 1

INTRODUCTION



## 1. INTRODUCTION

This manual provides guidance on applying the systems approach to training in the nuclear power industry. It is designed for use by training managers, training supervisors, and training staff at nuclear power plants and training centers. The manual illustrates an application of accepted principles for establishing and maintaining training and qualification systems based on job performance. Its success depends on effective management of the activities described. INPO accreditation criteria are consistent with these principles. This manual may be used to complement accreditation efforts and guide training program improvements.

This manual was developed by adapting recognized instructional systems development processes to the demands of nuclear power plant training. The training system development (TSD) approach presented in this manual illustrates the types of processes and activities necessary for performance-based training. TSD is one method of improving the overall quality and effectiveness of nuclear power plant training. Other instructional system processes also can produce performance-based training. Although this manual presents TSD activities in a five-phase sequence, concepts and actions described in each phase can be applied individually to existing training systems, and/or some activities can be performed in a sequence different from that presented.

INPO solicits suggestions for improving the Principles of TSD Manual as member utilities gain experience in its use.

### 1.1 Why is a Systematic Approach Needed?

The complexity of nuclear power plants demands the highest level of employee competence. Required levels of employee performance can be achieved when training develops skills and knowledges needed for safe, effective job performance.

The success of the systematic approach in meeting complex training requirements has been demonstrated by extensive use in the aerospace, health, and defense industries. It has gained acceptance in each of

these fields by improved training effectiveness, accountability, and control. It offers similar benefits to the commercial nuclear power industry.

An effective, performance-based training and qualification system includes activities to accomplish the following:

- o identify what training should be provided for each position (based on analysis of job performance requirements and initial qualifications of trainees)
- o design and develop training programs with explicit learning objectives and appropriate content
- o conduct training as designed
- o ensure that trainees master the learning objectives before they begin working in their assigned positions
- o evaluate training effectiveness and use these results to maintain and improve training

The training process has an input and an output: people. Training must be designed to accommodate expected input, and it must be evaluated by the quality of output. The training system should be adjusted to meet needs of the personnel selected to participate and be modified, as necessary, to produce the on-the-job performance required for safe, reliable plant operation.

A well-managed, performance-based training system has the following advantages over other systems:

- o It permits effective management control. Because measurable objectives are established and performance is evaluated and documented regularly, those responsible for training can measure and correct performance.

- o It is fully accountable. It includes training in skills and knowledges required to perform the job properly, as determined through systematic analysis.
- o It supports teamwork. By describing how performance based training operates, it provides a framework for more effectively using the talents of plant and training personnel.
- o It provides continual feedback. Training effectiveness is monitored systematically, and results are used to improve program design and implementation.
- o It is cost-effective. Only elements required for proper job performance are included; resources can be allocated properly and justified.

## 1.2 What is TSD?

TSD is one method for developing performance-based training for meeting nuclear plant job requirements. The TSD process includes five phases: analysis, design, development, implementation, and evaluation. The overall system relies on feedback for monitoring performance and adapting to changing conditions and requirements. Each phase within the system uses feedback to identify and correct problems. The TSD phases, activities, and their outputs are illustrated in the TSD Supplement. (Reference: TSD Supplement, pp. 1-1-2 to 1-1-4)

The analysis phase begins with a determination of the training needed for specified job positions. These needs are then analyzed using job and task analysis. Information is gathered from appropriate position documentation, plant procedures, and experienced employees to define and select tasks and attitudes required for proper job performance. The key to task selection is identification of tasks that are difficult and important to perform. Selected tasks and attitudes are analyzed to determine the skills and knowledges necessary for successful

job performance. Training requirements identified during the analysis phase are used in design and development processes to ensure that required content is included in the training programs.

During the **design** phase, measures of job performance are developed. Learning objectives are developed to define competencies that trainees are expected to master during training. Training settings and sequences are determined, and tests are developed. Design activities conclude by identifying trainee entry-level skills and knowledges and preparing a training plan. Outputs of the design phase become specifications for the development phase.

During **development**, instructor and trainee learning activities are defined. Suitable media, methods, materials, and lesson plans or training guides are selected or produced, as required. The resulting program is reviewed for technical accuracy, tried out on a group of trainees, and revised as necessary. A performance-based training program results from completing this phase.

The training plan is activated during **implementation**. Instructors are trained, trainees are selected, and training is conducted. Trainees are required to demonstrate mastery of learning objectives, and instructor performance is evaluated. Effective implementation produces employees capable of performing their jobs.

**Evaluation** is used to measure, control, and improve the training program. This is accomplished by monitoring job performance and reviewing reports from independent parties. Plant modifications, procedure changes, industry events, and regulatory developments are monitored to identify any training implications. The evaluation phase provides feedback that is used to improve, refine, and maintain the training program.

### 1.3 Who Should Use This Manual?

Implementing a TSD process has two fundamental requirements: management commitment and qualified training personnel. Training

managers and supervisors should have a working knowledge of activities described in this manual and adhere to the principles of performance-based training.

Once a decision is made to establish performance-based training, perhaps the most important action is to ensure that personnel developing and conducting training are qualified. The instructional staff should be trained in TSD principles and techniques required to do their jobs effectively. Additional training beyond that provided in this manual will be necessary for personnel who do not possess knowledge in performance-based training.

#### 1.4 How Do You Use This Manual?

Each utility's training process should be appropriate for its organizational structure and its specific manpower and training situation. Therefore, appropriate application of this manual will depend on the status of a utility's training system. The concepts described in this manual should be adapted to meet that utility's needs and should be used to revise procedures for training-related activities. If most activities described in this manual already are in place, then it can be used to reinforce and refine present practices.

In most instances, a utility will have established training programs, and the TSD process should be used to identify and complete program adjustments and improvements that build on existing materials. The evaluation phase would be the typical starting point for determining where corrective actions are appropriate. The following examples represent situations in which the training manager must decide how to apply the TSD process:

- o System modifications or new equipment are installed in the plant. Notification to the training department of plant equipment changes should be part of a feedback network that supports the TSD evaluation activities. The plant equipment changes suggest that the scope or content of a job(s) has been altered, and a needs analysis would be in order. The likely TSD process



entry point for making necessary training program changes would be "Conduct Needs Analysis" in the analysis phase.

- o Job analysis and task analysis results are available as a basis for reviewing and revising existing classroom lesson plans. This suggests that a comparison of existing learning objectives and lesson plans to the applicable job and task analysis information would be in order (an evaluation activity). The likely TSD process entry point for making necessary training program changes would be "Prepare Learning Objectives" in the design phase.
- o A Self-Evaluation Report for INPO Accreditation is being prepared. This suggests an internal evaluation is in progress, and the results would identify recommended changes to existing training programs. The likely TSD process entry point for determining corrective actions would be "Monitor Indicators" in the evaluation phase.

In those instances in which a utility does not have an established training program, the TSD process should be performed in the general sequence presented. However, existing sources of information, such as training materials from similar plants, job and task analysis results, and program outlines, would be valuable inputs to facilitate implementation of the TSD activities.

This manual can be used as a guide to establish or improve an existing training system, but it does not include detailed procedures for carrying out each activity. Detailed information is contained in references listed in the TSD Supplement. A TSD glossary is also provided. (Reference: TSD Supplement, pp. 7-1-3 to 7-1-10)

INPO training publications also provide supplementary guidance that can be useful throughout the TSD process. INPO accreditation criteria, for example, focus on specific aspects of TSD that are required for accreditation of training programs. During the analysis phase of



TSD, INPO's job and task analysis manuals can assist utilities in obtaining industrywide job and task analysis data and adapting that data to plant-specific requirements. The various INPO training and qualification guidelines can be helpful for establishing training program content during the design and development phases of TSD. Finally, INPO's Simulator Training Guideline (INPO 82-005) and the INPO Good Practice on development and implementation of on-the-job training programs (TQ-501) provide guidance for developing and implementing training programs in those training settings.

When used in a comprehensive manner, it provides one method for achieving excellence in nuclear power training programs. Some utilities will make tradeoffs or streamline the TSD process during initial implementation due to existing resource constraints. However, any adjustments made to the TSD process should be reviewed to ensure that a systematic process remains and that no degradation in performance-based training occurs. As the availability of resources increases, utilities that have made adjustments should strive to achieve excellence in their training programs, using TSD or a similar process.



SECTION 2

ANALYSIS

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## 2. ANALYSIS

The analysis phase of the TSD process applies logic to define a requirement or problem, identify probable causes and possible solutions, and select the solution that best fits the needs of the organization. When training is selected as part of the solution, analysis creates data that serves as the foundation for systematic development of performance-based training programs.

There are three major analysis activities: (Reference: TSD Supplement, p. 2-1-3)

- o conduct needs analysis to identify potential requirements for new, additional, or improved training
- o conduct job analysis to identify tasks required for job performance
- o conduct task analysis to define elements and skills and knowledges needed by employees for task performance

During needs analysis, human resource requirements and performance deficiencies are identified and analyzed. Evaluation phase activities described in Section 6 identify potential needs for changes or additions to existing training, based on problems or changes in job requirements. The evaluation process determines the specific TSD phase or activity that should be applied to accomplish the change or addition. In some cases, formal needs analysis will be necessary to determine if training changes or additions are appropriate. After a need is identified and training development approved, a work plan is developed to control the training development activities.

Job analysis defines tasks that comprise job performance through review of existing data or through comprehensive analysis of data acquired from employees. After review and selection of tasks for training, task analysis is conducted. This process identifies task elements and skills and knowledges needed by employees to perform tasks under specified conditions and in accordance with established standards. A review process is employed to ensure accuracy and consistency in task analysis data.

Finally, common skills and knowledges are placed in groups to reduce redundancy and permit a more efficient approach to subsequent program development.

This manual describes a method for using job and task analysis data to design and develop training programs. This data also can be used to validate or improve existing training programs. It should be recognized, however, that job and task analysis data has application beyond training. This data can provide information for equipment design (i.e., human factoring) and a multitude of human resource processes. These include job design, job performance aid and procedure development, personnel selection, and personnel manning determinations.

## 2.1 Conduct Needs Analysis

Needs analysis is the systematic process of identifying human resource requirements and performance deficiencies, analyzing alternative solutions, and identifying solutions that will satisfy the requirement or eliminate the deficiency. Needs analysis ensures that management initiatives, in addition to training, are considered for satisfying performance requirements and deficiencies.

The following procedures are performed when conducting needs analysis: (Reference: TSD Supplement, p. 2-2-3)

- o perform fact finding
- o assess needs
- o submit training development recommendation
- o develop work plan

In performing needs analysis, data on human resource and performance requirements is collected to determine needs that can be satisfied best through training. These data are collected from relevant functional departments (i.e., operations, maintenance, engineering, personnel, etc.), and others who are aware of requirements that may affect job performance. When identified and approved, training development is planned and scheduled using a work plan.



### 2.1.1 Perform Fact Finding

Successful performance-based training programs are built on a firm foundation. During fact finding, an information base is developed that will be assessed to determine needs best satisfied through training. Interviews are conducted, background research is reviewed, and documentation on past and present problems and future plans that may affect training are studied. Circumstances generally having training implications include the following:

- o Performance-based training programs do not exist for key plant positions.
  - Training is not being conducted on tasks that impact plant safety or reliability when performed improperly.
  - Training is not being conducted on tasks difficult to learn on the job.
  
- o There are shortages of qualified personnel (at hire and for advancement).
  
- o Major changes in job scope have occurred.
  
- o Changes in regulatory requirements exist.
  
- o Plant modifications (existing and planned) are not being incorporated into training.
  
- o There is evidence of job performance deficiencies.

### 2.1.2 Assess Needs

After the information base is established, an assessment is conducted to determine training needs. This is necessary because a variety of problems can be attributed incorrectly to a lack of training; they are solved best through other management initiatives.

The absence of performance-based training programs for key positions or for important or difficult tasks generally indicates a training need. Change in regulatory requirements and plant modifications require assessment for any impact on training. Human resource problems that involve shortages of qualified personnel or a major change in job scope also may point to a training need, but should be assessed to determine alternatives to training that may be more cost-effective.

Job performance deficiencies require thorough assessment. The following factors should be considered to determine those deficiencies best solved through training and those that should be solved through other management initiatives. (Additional information on evaluating job performance deficiencies is provided in Section 6.)

#### Training

- o Is the deficiency due to a lack of skill or knowledge?
- o Were past employees able to perform the task successfully?
- o Is the task critical to safe job performance?

#### Other Management Initiatives

- o Can the manner in which the task is performed be improved?
- o Is correct task performance being discouraged?
- o Is incorrect task performance being rewarded?
- o Are there policy, equipment, physical, or emotional barriers to performing the task correctly?
- o Can the deficiency be corrected by an initiative other than training?

Training needs identified by the above analysis should be placed in order of priority for each position affected. The priority should be consistent with established training goals

and objectives. It also should consider any significant constraint in resources that cannot be overcome and that would preclude a commitment to training.

#### 2.1.3 Submit Training Development Recommendation

After training development needs are placed in order of priority by position, they should be submitted for management approval. A Training Development Recommendation form may be used to document the training need and the review/approval process. The Training Development Recommendation form defines the training need and is initiated to obtain functional and training management approval for subsequent program development. It includes three parts. Part 1 requires that the initiator answer several questions. In parts 2 and 3, functional and training management review the recommendation and decide if the proposed development or change is justified. TSD Supplement 2-2-4 illustrates this procedure. (Reference: TSD Supplement, pp. 2-2-4 and 2-2-8)

#### 2.1.4 Develop Work Plan

Having received approval for training program development, effort shifts to developing the plan, schedule, and budget needed to ensure controlled development. TSD planning is the process of defining goals and relating them to individual activities necessary for project achievement. It also includes scheduling each activity, identifying critical outputs or milestones, and estimating development costs for project activities.

Developing a work plan is facilitated by using a planning worksheet. The work plan clarifies requirements, enhances project communication, coordinates actions of personnel, raises the visibility of the development effort, and provides accountability for the development process. It is a dynamic tool that defines constraints and identifies and schedules activities.

Training development activities should be scheduled using a planning worksheet. Within each major development phase, activity requirements are listed sequentially. Across the top of this worksheet, a time line, or calendar, is depicted. Important events are identified when they are scheduled and actually occur. This time/activity scheduling is suitable for TSD planning efforts. (Reference: TSD Supplement, pp. 2-2-11 and 2-2-12)

## 2.2 Conduct Job Analysis

The needs analysis process identifies a need for training and produces a work plan and schedule for development. During job analysis, job incumbents and their supervisors share their knowledge and experience with training system development personnel to develop a detailed list of tasks required to perform a particular job, duty area, or task. Job analysis produces a list of valid tasks and performance indicators for analysis that are to be included in initial and continuing training. Evaluation may identify a few tasks that are missing from the training program. The scope of this job analysis would be much smaller than the initial job analysis effort.

The following procedures are performed when conducting job analysis: (Reference: TSD Supplement, p. 2-3-3)

- o review and select existing job data
- o identify work attitudes
- o analyze the job
- o select tasks and performance indicators for analysis
- o identify tasks and performance indicators for initial and continuing training

### 2.2.1 Review and Select Existing Job Data

Existing job analysis data should be considered before resources are committed to a full-scale job analysis project. Job procedures and manuals can provide relevant job information that can be used to construct or modify a list of tasks and performance indicators for the job under review.

A job description and criteria used to select tasks and performance indicators for analysis should be used to guide the selection of existing job data. The search should include the reader's own utility and the following:

- o plants in the same configuration and regional training group
  
- o government agencies that use the systems approach and job analysis for development of training. (Reference: TSD Supplement, p. 4-3-11 and 4-3-12)
  
- o job analysis data that INPO has compiled on several nuclear power plant positions

Existing job analysis data should be reviewed and revised to be plant-specific. A panel of subject matter experts and training personnel should review task statements for clarity, completeness, conciseness, and consistency to ensure that an accurate, plant-specific task list is produced. (Reference: TSD Supplement, p. 2-3-7)

A job survey using the completed task list may be required. If a large percentage of the tasks were modified during the review, a survey of employees is advisable. However, if the review concluded the task list was highly accurate, the job survey may not be necessary.

#### 2.2.2 Identify Work Attitudes

Employees are expected to exhibit other work behaviors not addressed by a task statement. In addition to exhibiting certain skills and knowing certain facts, employees need to develop proper work attitudes. These attitude statements must be defined if associated behaviors are to be developed in training. This analysis is the process of describing indicators that collectively define the attitude. This process



takes an attitude, such as safety awareness, and defines essential, tangible indicators of that attitude.

Appropriate areas for analysis include plant operational safety, industrial safety, plant security, and fitness for duty.

### 2.2.3 Analyze Job

A job analysis should be conducted when job data does not exist or is incomplete. Job analysis activities are outlined in a data collection plan. The contents of this plan focus on resources, schedule, and activities required for collection and analysis of job data.

Data collection can involve three methods: interviewing workers, conducting consensus meetings using panels of experts, and conducting surveys using questionnaires. Each of these methods has guidelines to ensure that reliable and valid data is collected. (Reference: TSD Supplement, pp. 2-3-11 to 2-3-16)

After methods are selected, the data collection process begins. This process requires selecting job analysts, developing data collection forms, validating those forms, making administrative arrangements, collecting data, and then consolidating data for analysis. Additional information on job analysis products is also provided in INPO's Job and Task Analysis Users Manual (INPO 83-033). (Reference: TSD Supplement, 2-3-19 to 2-3-22)

When analyzing attitudes, the process begins when the intended outcome of the attitude is stated. This written description must state the product, not the process by which to achieve the attitude. For example, "exhibits safety awareness in the plant" is an outcome, but "develop an appreciation for the importance of safety" is a process. The statement is further



refined by determining the performance indicators that represent the characteristics of the attitude. These statements should be phrased as a positive behavior. "Reports potential safety hazards" or "observes safety signs" are appropriate indicators for the attitude of "exhibits safety awareness in the plant." To develop a list of performance indicators, ask supervisors these questions:

- o How would successful achievement of the attitude be demonstrated?
- o What would a person who has achieved the attitude do or say to indicate competency?
- o What activities comprise the successful achievement of the attitude?
- o How would trainees be separated into satisfactory or unsatisfactory performers?

Once the list of performance indicators is compiled, review it to eliminate redundancy, clarify abstractions, or omit unnecessary items. The list of indicators should be reviewed by management to ensure that the indicators fully represent the attitude. Once approved, the indicators can be analyzed.

After collection, job analysis data should be summarized and reviewed to determine the validity of the list of tasks. A typical summarizing technique involves ranking tasks based on the percentage of job incumbents who indicate they perform the task. The list of tasks in order of percentage performing is submitted to a panel of experts and training personnel for review. The panel then decides which tasks are to be included and which should be removed from the task list.

#### 2.2.4 Select Tasks and Performance Indicators for Analysis

Although all valid tasks for the job under review are identified during data collection, not all tasks should be selected for analysis and training. Some tasks require classroom training, while others should be learned on the job.

Tasks that are difficult to learn and important (critical) should be selected. Selection decisions should be made by a panel of experts and training personnel and can be aided by using quantitative information obtained during data collection. (Reference: TSD Supplement, p. 2-3-25)

If performance indicators have been identified, a panel of supervisors should review the list to ensure they are appropriate for further analysis.

#### 2.2.5 Identify Tasks and Performance Indicators for Initial and Continuing Training

Selected tasks should be identified further for initial or continuing training (or both). Considerations in this determination include the following:

- o Initial training--develop the skills and knowledges necessary for effective job performance.
- o Continuing training--improve job-related skills and knowledges by the following:
  - reviewing skills and knowledges included in initial training
  - providing more in-depth training in skills and knowledges included in initial training
  - providing training in tasks that are important, difficult, and infrequently performed
  - providing training on tasks and performance indicators for which job performance has been less than satisfactory
  - addressing changes in systems, equipment, or procedures that affect job performance
  - disseminating information on industry operating experiences that affect job performance

### 2.3 Conduct Task Analysis

Tasks and performance indicators selected for training should be analyzed using a task analysis approach. Task analysis is the process of dividing a unit of work (task) into manageable steps (elements). It also identifies task standards and conditions and the skills and knowledges required by employees to perform each task. Results of task analysis produce the data base from which job performance measures and training program learning objectives are developed or verified. INPO's Task Analysis Procedure (INPO 83-009) provides additional information.

Task analysis is used to identify obvious skills and knowledges for a particular task that is proceduralized. However, additional, complex skills and knowledges may be needed when procedures are nonexistent or incomplete for a particular task. For example, a thorough understanding of the ability to solve problems and take corrective actions must be developed so that a worker can transfer learned skills and knowledges to new situations. The task analysis process is limited by a finite set of resources that preclude the analysis of every potential task condition; however, careful monitoring and inclusion of plant feedback, operating experiences, and plant modifications into a training program will help ensure a practical, thorough understanding of the problem-solving process.

The following procedures are performed when conducting task analysis:

(Reference: TSD Supplement, p. 2-4-3)

- o prepare for task analysis
- o perform procedural task analysis
- o perform paradigm task analysis
- o perform attitude analysis
- o check task analysis for quality
- o group common skills and knowledges

### 2.3.1 Prepare for Task Analysis

Appropriate forms should be developed for use during data collection. The forms should allow for ease of collection and logical sequencing. A sample data collection form is provided in Appendix A of INPO's Task Analysis Procedure (INPO 83-009). Following are examples of questions to consider when developing data collection forms:

- o Do the forms contain clear directions?
- o Do the forms provide for collection of all data needed for training program design?
- o Have interested persons been given an opportunity to request data and review the forms?
- o Does the form include information on standards, cues, conditions, elements, skills and knowledges, references, related tasks, task output, human interfaces, personnel safety considerations, and consequences of inadequate performance? (Reference: TSD Supplement, pp. 2-4-7 to 2-4-9)

Tasks determined to be normal or routine during job analysis are analyzed using a procedural task analysis process. Abnormal, emergency, or troubleshooting tasks are analyzed using a branching or paradigm technique. Performance indicators are analyzed using a simplified attitude analysis process.

### 2.3.2 Perform Procedural Task Analysis

Procedural task analysis identifies inputs and outputs of the task, as well as sequential steps of task performance. This task analysis approach is used when a task is linear in nature (i.e., step-by-step sequence) and performed under normal or routine conditions. During procedural task analysis, tasks are analyzed to identify their elements (action steps), sequence, and other performance-related data.

INPO's Task Analysis Procedure (INPO 83-009) provides detailed guidance and should be referenced when conducting procedural task analysis.

### 2.3.3 Perform Paradigm Task Analysis

Many jobs have some tasks that are not sequential and involve decisions. These more complex tasks necessitate a different analysis approach. Paradigm task analysis should be used for analyzing tasks that are abnormal, emergency tasks, or tasks that involve multiple conditions (i.e. troubleshooting). During paradigm task analysis, stimulus-response patterns are defined. Analyzing a task to the paradigm level offers the following advantages:

- o Performance problems involving branching (decision points) and proper sequence are identified.
- o Task cues are identified readily.
- o Employee responses are stated explicitly.

Paradigming a task with decision points is a skill refined through practice. For more information on paradigm task analysis, review INPO's Task Analysis Procedure (INPO 83-009).

### 2.3.4 Perform Attitude Analysis

After the performance indicators are defined for each attitude, they must be analyzed once for each job. Performance indicators are similar to task elements and are analyzed in the same fashion. For example, the performance indicator "observes safety signs" requires the knowledge to interpret radiation symbols, sign colors, and abbreviated safety messages. Discussions concerning the conditions and standards for each indicator require the assistance of an expert who possesses the attitude being defined or else someone who recognizes the attitude when it is demonstrated. The analysis is complete when the following question can be answered affirmatively: If someone demonstrated each of these performances, have they achieved the attitude?



Once each indicator is analyzed, it should be reviewed by management personnel for approval prior to incorporating these newly-derived skills and knowledges into the training program.

#### 2.3.5 Check Task Analysis for Quality

A systematic review and revision process should be established to correct errors that may have occurred during task analysis. The use of quality control measures can prevent future training problems caused by inaccurate or incomplete task elements and skills and knowledges.

Effective quality control of task analysis data requires the use of established criteria during the analysis process. The criteria applied during quality control checks should be the same as those used during task analysis. A sample checklist for quality control of task analysis data is contained in Appendix C of INPO's Task Analysis Procedure (INPO 83-009).

During quality control of task data, criteria are applied, results interpreted, and revisions determined. Quality control is an iterative process that involves independent review. This requires that the individual performing the review be knowledgeable of technical content and quality control procedures and be someone other than the person who performed the task analysis. The quality of task analysis data is improved by using a procedure such as the following:

- o task analysis team completes task analysis data collection
- o task analysis team reviews own work
- o task analysis supervisor spot-checks analysis team's work
- o QC team reviews total task analysis data
- o QC team supervisor spot-checks QC team's work
- o task analysis manager performs sampling review of completed tasks
- o final task analysis product transmitted to end users



### 2.3.6 Group Common Skills and Knowledges

Performing analysis on tasks and attitudes produces some repetition in the skill and knowledge statements. A large collection of tasks and attitudes for a given job classification can increase the magnitude of this redundancy. A means of indexing or grouping common skills and knowledges can be used to reduce redundancy and provide a more organized and efficient approach to training program development.

Some skills and knowledges are integral to and should remain associated with a given task during training. Others can be removed, grouped with other common skills and knowledges, and taught independently without incurring any loss of intent or emphasis. It is with these skills and knowledges that benefit can be derived from grouping.

Grouping requires that categories appropriate to skills and knowledges being reviewed be established. While these specific categories may vary according to job classification, once defined, they should be used uniformly to classify skills and knowledges. For example, during the PWR control room operator task analysis, INPO established an index of skills and knowledges using the following areas (see INPO's Job and Task Analysis Users Manual (INPO 83-033) for further details):

- o System--information pertaining to a system or major component location, interrelationship, indications, controls, alarms, or power supplies (e.g., purpose of letdown valve).
  
- o Component--information pertaining to characteristics, function, construction, or operation of a specific piece of equipment (e.g., construction of the letdown flow control valve).

- o Academic--information pertaining to facts, definitions, principles, rules, or theories (e.g., conversion of flow in pounds mass per hour to gallons per minute).

Skills and knowledges then were assigned to the above areas, using an outline of topics. (Reference: TSD Supplement, p. 2-4-13)

Within the topics, additional selectivity can be applied by using subtopics when clustering common skills and knowledges for training design purposes. For example, pump skills and knowledges could include subtopics such as type, function, characteristics, and operation. The residual heat removal system could include subtopics such as procedures, valves, pumps, and heat exchangers. Academic skills and knowledges that address mathematics could include basic concepts, scientific notation, dimensional analysis, algebra, geometry, and trigonometry.

Establishment of areas, topics, and subtopics should be based on specific job classification requirements and utility training needs. Skills and knowledges should be grouped for training program efficiency (i.e., removing redundancy and combining common skills and knowledges). Removing skills and knowledges and teaching them independently from the task also should be considered.

#### 2.4 Summary

Needs analysis identifies human resource requirements and performance deficiencies requiring training. Then, training development projects are planned and scheduled. Job analysis is conducted to define the requirements further by identifying tasks that comprise job performance. Since all these tasks are identified during job analysis, a review process is employed to select important and difficult-to-learn tasks for further analysis and training. Task analysis is conducted

on the tasks selected to identify task conditions, standards, elements, and skills and knowledges required to perform the task satisfactorily. Attitude analysis is conducted to determine the performance indicators needed for demonstrating proper work attitudes. Resulting data then is reviewed to ensure that an accurate data base is available for subsequent training development activities. In the final analysis activity, common skills and knowledges are placed in groups to reduce redundancy and provide a more organized and efficient approach to program development.

## 2.5 Key Considerations

The following key considerations should be emphasized when performing and evaluating activities of the analysis process:

- o A systematic process involving both training personnel and plant personnel is used to analyze human resource requirements, performance deficiencies, and training needs.
- o Alternative solutions to performance problems, including training and other management initiatives, are considered thoroughly before committing resources.
- o Work plans are used to guide analysis activities and enhance teamwork.
- o Job performance requirements are identified through review of existing job data and/or surveys of workers and are confirmed by subject matter experts.
- o Clear standards and uniform methods are used to collect, analyze, and review job and task data.
- o A panel of subject matter experts is used to assist training personnel when selecting tasks for analysis and training.
- o Tasks are identified for initial and/or continuing training.

- o Task analysis data collection forms include all data required for training development.
- o Task analysis is conducted with experienced workers who identify task performance data and required skills and knowledges.
- o Procedural task analysis is used when a task is performed under routine plant conditions.
- o Paradigm task analysis is used when a task involves decision points and is performed during troubleshooting, abnormal, or emergency plant conditions.
- o Attitude analysis is used when performance indicators of employee attitudes are identified.
- o Identified skills and knowledges are grouped for efficient program design.

Additional references on training system analysis are provided.  
(Reference: TSD Supplement, p. 2-5-3)

SECTION 3

DESIGN

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### 3. DESIGN

During analysis, the basis for performance-based training is established through analysis of selected tasks to determine skills and knowledges needed for job performance. Design activities use this information to produce specifications for developing, implementing, and evaluating the training program. To provide an effective program, design specifications should be developed systematically and be traceable to job and task performance requirements. These specifications should define acceptable performance and permit diagnosis of problems that may occur when the program is implemented.

Not all design activities must be performed in the sequence described in this section. Each design activity can be applied separately, depending on the status of an existing program. Operational training programs should be evaluated (Section 6, Evaluation) to identify deficiencies and determine where improvements are needed. Feedback from existing training programs can be obtained from internal (e.g., supervisory experience) and external (e.g., NRC audit) sources. Appropriate activities of the Design Section then can be used to achieve those improvements.

There are eight major design activities: (Reference: TSD Supplement, pp. 3-1-3 and 3-1-4)

- o develop job performance measures (JPM)
- o determine appropriate training settings
- o prepare learning objectives
- o develop test items
- o describe expected trainee entry-level skills and knowledges
- o organize learning objectives
- o construct tests
- o develop training plan

During design, job performance measures are developed to measure task performance in the job environment. Training settings are selected to provide the appropriate environment in which learning can occur.

Terminal objectives are derived from tasks to establish the direction of the training program. Enabling objectives are then developed from grouped task elements and skills and knowledges to describe the performance necessary for trainees to achieve mastery of the terminal objectives. Next, test items are prepared to measure trainee mastery of learning objectives during and after training.

Subsequent design activities refine specifications and provide the framework for developing the training program. These activities identify expected trainee entry-level skills and knowledges using entry-level test results. Then, learning objectives are organized. In the final activity of the design phase, the training plan is developed to plan and administer the training program and to ensure availability of trainees, instructors, course material, support services, facilities, and equipment.

### 3.1 Develop Job Performance Measures

During job and task analysis, tasks were selected for training, and the supporting elements, conditions, and standards necessary for adequate on-the-job performance were defined. The first step in the design phase is to develop job performance measures, which are performance tests prepared at the task level. Job performance measures are used as follows:

- o to measure adequacy of a plant employee's performance of a task on the job (ensures consistency in performance evaluations) or during training (such as simulator training)
  
- o to provide the basis for development of a terminal objective, which is a training goal expressed in terms of measurable trainee performance

Job performance measures are derived from tasks and task elements. They define the cue that prompts or signals an employee to perform a specific task, identify conditions under which actions occur, and establish standards that measure performance adequacy. It is not always feasible to duplicate all aspects of a task in a job performance measure. For this reason, the procedure for developing a job

performance measure involves determining ways in which it must be different from the task and then constructing a job performance measure that is the best approximation of that task.

The following procedures are performed when developing job performance measures: (Reference: TSD Supplement, p. 3-2-3)

- o determine testing limitations
- o determine elements of a task to be tested
- o determine conditions and standards
- o determine scoring procedures
- o pilot test and revise the job performance measure

After testing requirements are determined and conditions and standards are developed, the job performance measure is constructed. This work sheet should be referred to in the following sections as each aspect of the job performance measure is discussed. (Reference: TSD Supplement, pp. 3-2-7 and 3-2-8)

#### 3.1.1 Determine Testing Limitations

The first step in developing a job performance measure is to review the task to determine potential testing constraints. Constraints include availability of time, work force, equipment, and resources. If performance of an entire task would require more time than is reasonable for testing, the job performance measure should be developed using a sample of critical task elements. Work force availability also can impose constraints on task performance. These constraints occur when more than one plant employee is required for task performance. A job performance measure should include representation from the job classifications involved in performance of the task. Each position, however, should be scored separately.

Situations occur when equipment or facilities will not be available to support employee testing. If it is determined

that testing of selected tasks would impose unreasonable demands on facilities or equipment, then test those tasks using simulation.

Cost is another important factor affecting job performance measures. The cost of test administration must be kept within reasonable limits. Many infrequently performed tasks cannot be performed for training or testing purposes in the job environment. In these situations, if a job performance measure is needed, simulation is a recommended alternative.

The following evaluation should be conducted when determining the need for simulation in performance measurement:

o Downtime

What effect does measuring performance of a task have on the readiness and efficiency of the plant system or equipment?

o Damage or danger

What are potential dangers to plant personnel or damage to plant equipment if performance measurement of a task is done?

o Cost

What is the cost of using plant personnel, equipment, and materials for measuring task performance?

### 3.1.2 Determine the Elements of A Task to be Tested

When constraints make duplication of the task in the job performance measure unrealistic, task elements should be examined. Elements that include important decision points are predictors of successful performance of the entire task. If they can be tested realistically, they should be included in the job performance measure.

### 3.1.3 Determine Conditions and Standards

After testing constraints and simulation requirements have been determined, job performance measure development moves to

identification of conditions and standards needed for task performance. Although the ideal is to duplicate cues, conditions, and standards of the actual task, some compromise may be necessary. For tasks with multiple conditions and branching decisions, multiple job performance measures may be written.

Conditions are prerequisite requirements that exist for task performance. They define plant conditions and include information and resources available to the employee during task performance. If constraints prevent using all conditions identified during task analysis, a sample should be used that best assesses the ability of the employee to perform the task under actual conditions.

Job performance measures include standards of measurement (quantitative or qualitative) that are applied consistently in evaluation of task performance. Standards may relate to the process or product of performance or a combination of both. Process standards are step-by-step procedures that must be followed, usually without deviation. Other standards may prescribe output (the product of performance) and criteria for judging acceptability of the performance.

Task and element standards should be transferred directly from task analysis data to the job performance measure whenever possible. However, limitations in the testing environment may require less than total adherence to the job standard in performance measurement. Other factors that could contribute to adjustment of the standard in the job performance measure include the following:

- o The job standard for fully competent performance exceeds the minimum required for successful task performance.



- o The job standard for fully competent performance requires achievement of a final product of performance and adherence to a noncritical, step-by-step process (i.e., steps could be omitted or not followed in sequence, but the final product of performance required would be achieved).

#### 3.1.4 Develop Scoring Procedures

After the job performance measure is constructed and documented, scoring procedures are developed. A detailed, step-by-step description of required performance provides an effective scoring procedure for some tasks. Action steps or elements required in the job performance measure usually are prepared in checklist form, and the employee is required to follow each step without deviation. For other tasks, the product of performance (i.e., a tangible result) must be measured. In developing a scoring procedure for this type of job performance measure, scorable characteristics must be defined to distinguish clearly between satisfactory and unsatisfactory performance.

Scoring procedures used during measurement of task performance should be reliable and unbiased. Reliability means that evaluation of task performance will not vary over time (assuming the individual remains the same) and that different scorers using the same performance measure will evaluate the employee the same way in any given testing situation. Unbiased scoring procedures ensure that evaluations are not influenced by inappropriate factors. Reliable and unbiased scoring procedures should include clear, measurable standards for evaluating task performance and the use of trained evaluators skilled in administering job performance measures.

#### 3.1.5 Pilot Test and Revise Job Performance Measures

A validated job performance measure is one that has been pilot tested and found to be an accurate predictor of task performance.

that is, the employees who pass the job performance measure are those who perform the task well on the job.

Collection and analysis of pilot test data should ensure that all parts of the job performance measure are valid. Guidelines for pilot testing a job performance measure are as follows:

- o ensure the job performance measure work sheet is complete
- o arrange all resources required for administering the job performance measure
- o provide instructions to the scorer
- o select examinees from job incumbents
- o assign an observer for recording information on job performance measure deficiencies
- o revise the job performance measure based on observed deficiencies

### 3.2 Determine Training Setting

After job performance measures are developed, training settings are determined. The setting is the environment in which training is conducted and learning occurs. Training settings include the following:

(Reference: TSD Supplement, p. 3-3-3)

- o classroom
- o laboratory and workshop
- o formal on-the-job training (OJT)
- o simulator
- o self-study

Settings are selected early in training systems development, as they affect development of learning objective conditions and standards. Tasks, elements, and their skills and knowledges should be reviewed to determine settings suitable for most training to occur. The review also should identify alternate setting(s), as constraints may dictate compromise, particularly when the impact of primary selections may have adverse impact on utility facilities and resources. These constraints may include any of the following factors:

- o Constraints of the training setting (e.g., equipment scheduling) would significantly delay the completion of training.
- o Training in one setting is more expensive than in another. (An analysis should be conducted based upon short- and long-term cost considerations.)
- o Excessive use of formal OJT may disrupt essential plant operations.

These constraints affect the degree of fidelity to which tasks, elements, skills, and knowledges can be trained. Decisions concerning the training setting can be facilitated by organizing tasks into three categories:

- o tasks requiring complete replication
- o tasks requiring partial replication
- o skills and knowledges required to be grouped and taught independent of individual tasks

The first category requires that a task be completely simulated by a full-scope simulator or within the actual job environment. Tasks falling into this category have the highest level of fidelity and are the most important to the job.

The second category requires that selected critical elements be replicated by using a part-task simulator, laboratory, or workshop setting.

The third category requires a classroom or self-study setting to prepare trainees for mastering skills and knowledges necessary for subsequent task performance.

### 3.2.1 Select Classroom Training

The classroom is the setting in which group training is led by an instructor. Classroom training includes lectures, demonstrations, and discussions with active trainee participation.

Training that meets the following conditions can be considered for classroom training:

- o Large quantities of information will be presented during training.
- o A large group of trainees will be scheduled for training at a given time.
- o Other training settings are not suitable or available.

### 3.2.2 Select Laboratory/Workshop Training

During laboratory and workshop training, multiple job conditions (i.e., environment, system, equipment, etc.) of task performance are simulated to varying degrees of fidelity. Laboratories and workshops permit application of course material by the trainees in a hands-on environment. They are particularly effective when used to train basic skills that support task performance.

Training that meets the following conditions can be considered for laboratory/workshop instruction:

- o Tasks, elements, and skills require hands-on practice to achieve mastery.
- o Job conditions can be simulated in the laboratory/workshop.

### 3.2.3 Select Formal OJT

Formal OJT is designed to qualify plant employees in job performance through training conducted by qualified personnel in the actual work environment. Formal OJT provides hands-on experience and allows the trainee to make a positive contribution to the mission of the plant while being trained. INPO's good practice Development and Implementation of On-the-Job Training Programs (TQ-501) provides additional details on this type of training setting and program.

Training that meets the following conditions can be considered for formal OJT:

- o Assignment of trainees can be made in small groups and spread over a sufficiently long period of time.
- o There are no critical resource constraints in the plant, and multiple training conditions can be provided in the job environment.
- o Qualified personnel are available to conduct and manage formal OJT.

#### 3.2.4 Select Simulator Training

Simulators provide a real-time, realistic setting for training without affecting plant operations. IEPG guideline 52-005, Simulator Training, recommends use of simulator training for normal, abnormal, and emergency operating procedures. This recommendation applies specifically to the positions of control room operator, senior control room operator, shift supervisor, and shift technical advisor. In addition to the above, training that meets the following conditions can be considered for simulator training:

- o High fidelity (i.e., closeness to the task) is required for trainees to achieve mastery.
- o Problem diagnosis under stressful situations is an integral part of performance.
- o Teamwork is an important part of task performance.

#### 3.2.5 Select Self-Study Training

In self-study instruction, all training conditions are either provided in training materials or made available in the plant when needed by the trainee. Self-study frequently is used with training conducted in other training settings. Although a full-time instructor is not needed in self-study instruction, guidance and assistance by qualified plant personnel are necessary. Self-study instruction should include frequent tests administered by a qualified individual for evaluating and providing feedback on the trainee's progress.



Training that meets the following conditions can be considered for self-study:

- o Training for the task does not require close supervision. Unsupervised training is not likely to result in injury to plant employees or damage to plant equipment. In addition, immediate feedback from a supervisor is not required for the trainee to achieve mastery.
  
- o All conditions can either be provided in the training materials or made available in the plant when needed by the trainee. Tasks that require special facilities, conditions, or equipment not readily available in the plant should be considered for another training setting.
  
- o The task does not require extended periods for the trainee to achieve mastery. Tasks that are "very difficult" or "extremely difficult" suggest lengthy training durations and are more suited to settings that provide supervision and immediate feedback.

### 3.3 Prepare Learning Objectives

Once training settings are determined, tasks selected for training and their analyzed elements and skills and knowledges become the basis for developing learning objectives. Learning objectives describe what is to be learned in terms of measurable trainee performance. They serve as a connecting link between performing a task on the job and learning how to perform it in the training environment. Learning objectives also define the content of the training program. A properly prepared learning objective consists of the following:

- o a statement of behavior (action) the trainee must exhibit
- o the conditions under which the action will take place
- o the standards of satisfactory performance

There are two levels of learning objectives: terminal and enabling. After the terminal objectives are developed at the task level, a learning analysis is conducted. This process identifies the enabling

learning objectives (training steps) that are needed to support achievement of the terminal objective. Enabling objectives are derived from grouped task elements and skills and knowledges using a design strategy.

When developing enabling objectives, preliminary estimates should be made about the entry-level skills and knowledges possessed by the trainees. This determination guides the preparation of enabling objectives to a level appropriate to those entry-level skills and knowledges. Trainee entry-level skills and knowledges are determined more accurately later, and enabling objectives are reviewed to determine the need for any adjustment.

The following procedures are performed when developing learning objectives: (Reference: TSD Supplement, p. 3-4-3)

- o establish design strategy
- o determine the action statement for trainee performance
- o specify conditions of trainee performance
- o describe standards for evaluating trainee performance

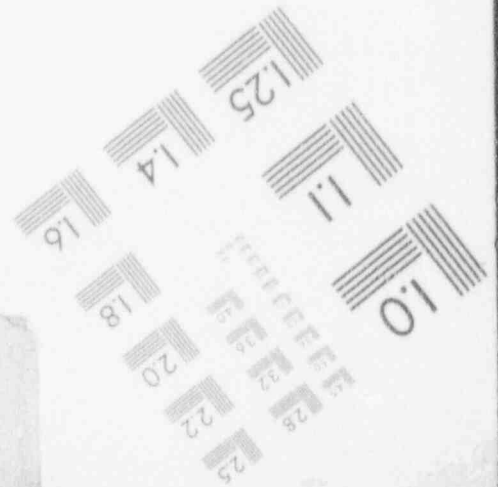
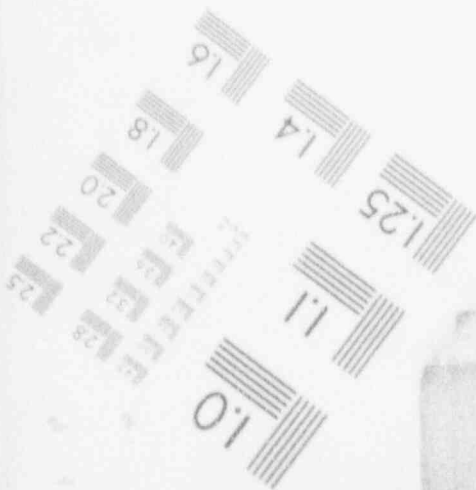
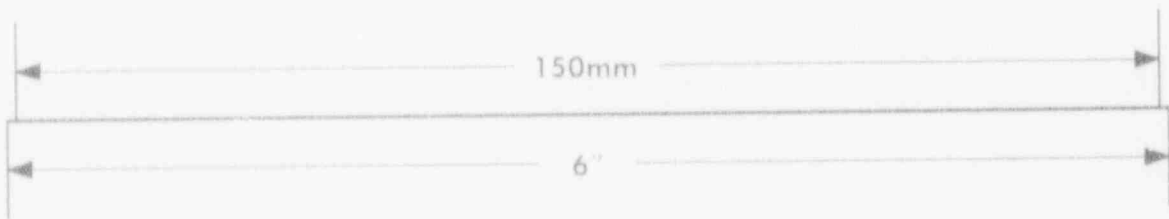
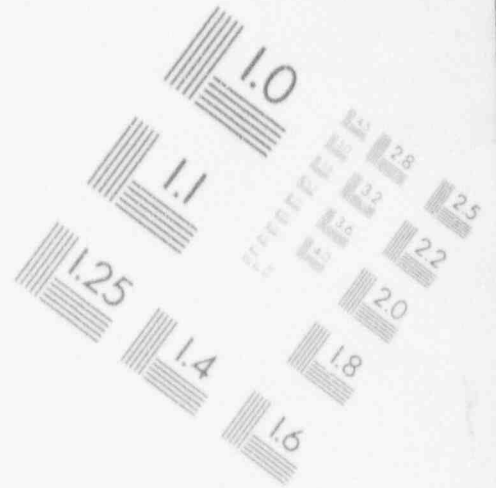
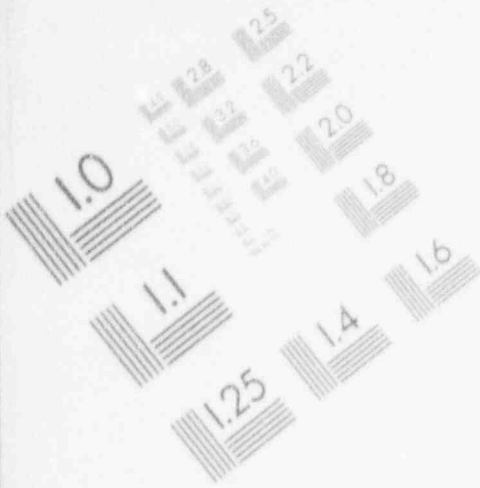
### 3.3.1 Establish Design Strategy

When task analysis is performed (Section 2.3), a significant amount of performance-based data (i.e., task elements and skills and knowledges) is produced for a given job classification. Effective use of this data requires that a design strategy be developed and applied when developing learning objectives for a training program. (Reference: TSD Supplement, p. 3-4-7)

The design strategy should ensure that basic relationships exist between tasks and terminal objectives and between grouped elements, skills and knowledges, and enabling objectives. It should provide a process for sorting elements and skills and knowledges by training setting (Section 3.2) and then by a topical outline that reflects the desired structure of training. The topical outline should be based on the

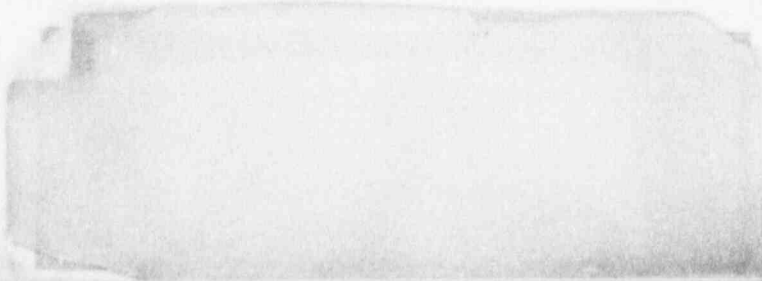
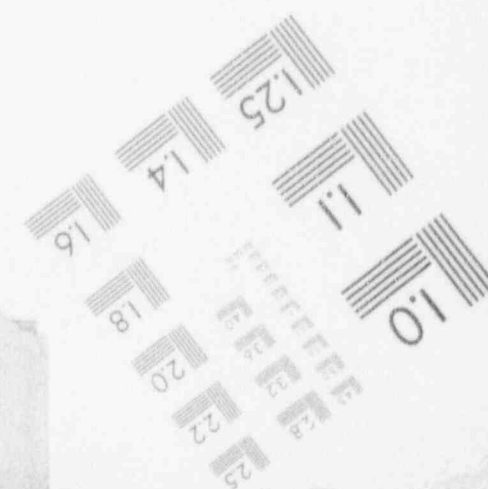
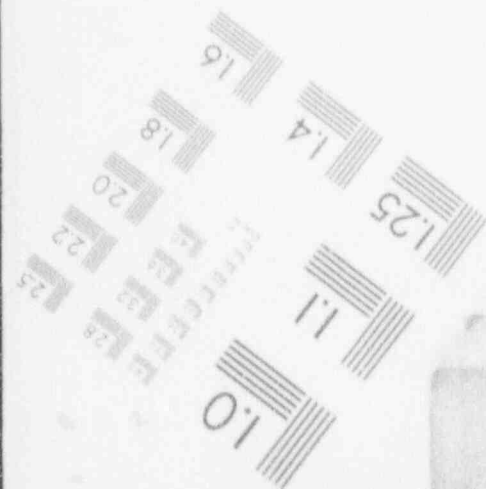
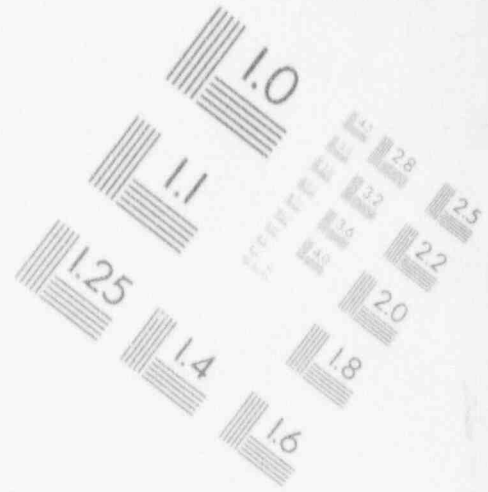
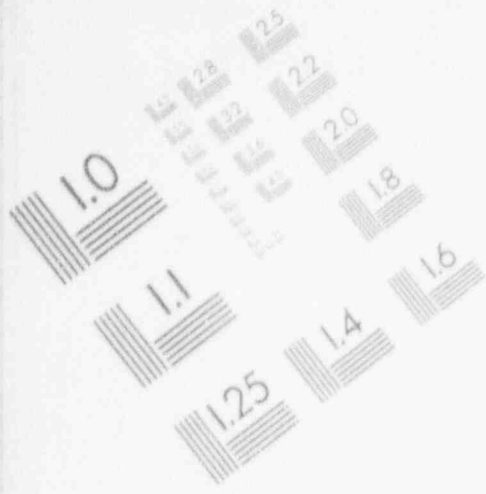
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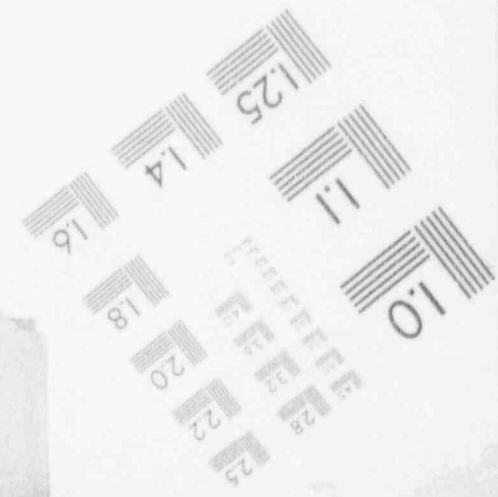
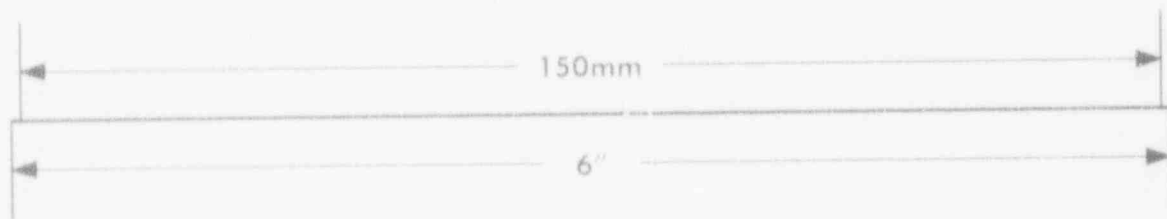
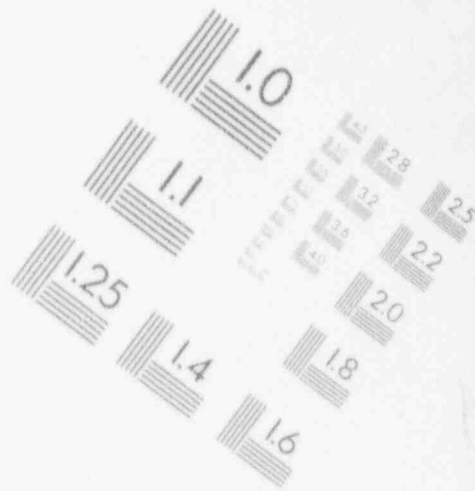
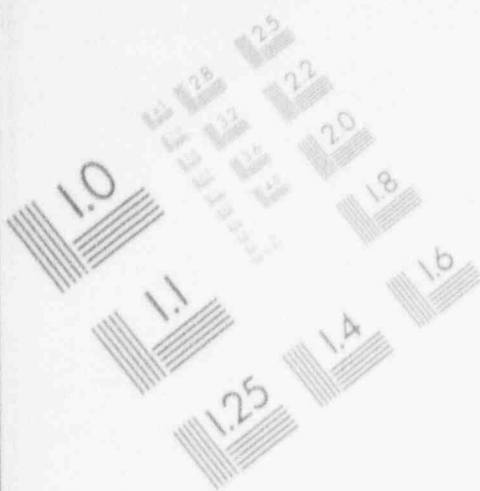
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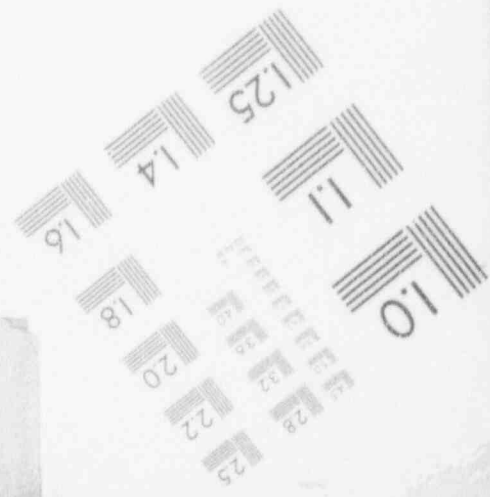
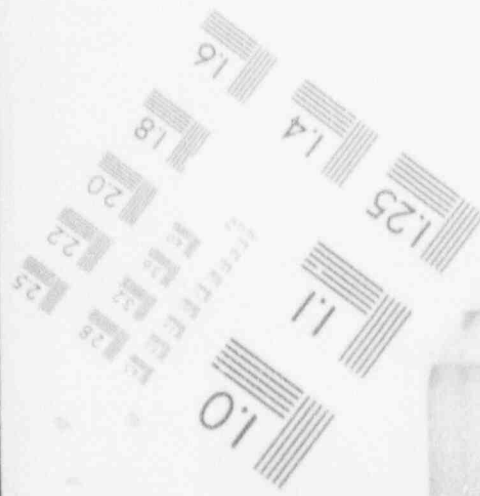
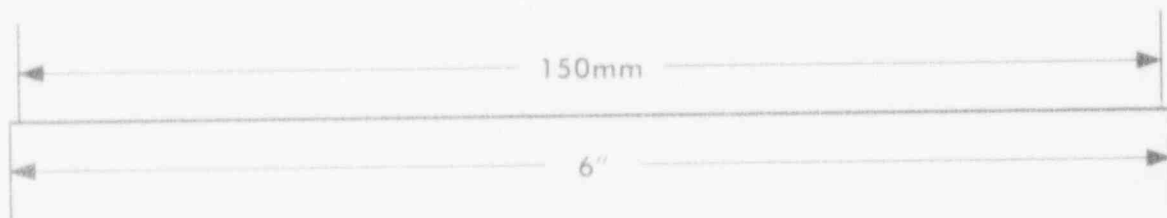
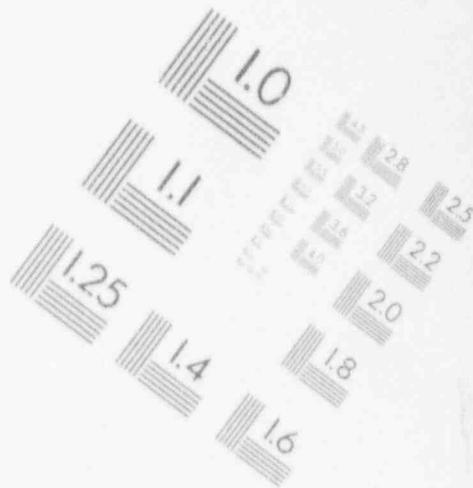
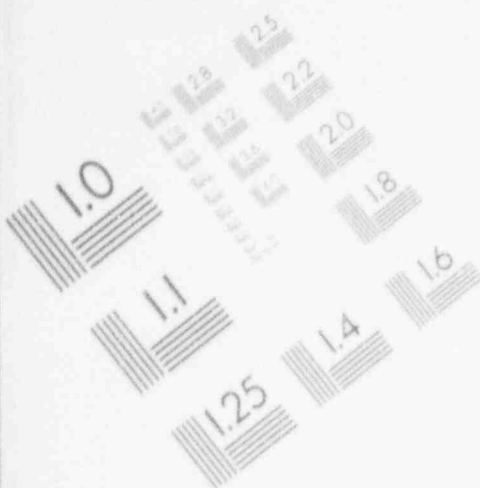
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## IMAGE EVALUATION TEST TARGET (MT-3)



uniqueness of the job classification and plant-specific training requirements. Training topics recommended for each job classification in the INPO training and qualification guidelines can be useful in developing the topical outline.

Although the sorting of skills and knowledges is generally within a job classification, there are skills and knowledges that are applicable to more than one job classification. These common skills and knowledges could be grouped and subsequently trained within mixed job classifications.

### 3.3.2 Determine Action Statement

The first step in developing a learning objective is to determine the action statement. The action statement consists of an action verb and direct object that clearly define what the trainee is required to do. The action verb should identify trainee behavior that is observable and measurable. For example, in the action statement "start the secondary equipment closed cycle cooling system," the action verb (start) and direct object (secondary equipment closed cycle cooling system) are identified clearly as a terminal performance for a simulator or OJT setting.

An action statement for a classroom enabling objective might be "state the purpose of the secondary equipment closed cycle cooling system." The action verb (state) and direct object (purpose of secondary equipment closed cooling system) are expressed similarly.

Skill and knowledge verbs range from simple to complex. Skill refers to physical or manipulative activity. Knowledge pertains to recall, comprehension, or application of information. Other action verbs with definitions can be found in the INPO guideline Emergency Operating Procedures Writing Guideline (INPO 82-017) and the INPO Task Analysis Procedure (INPO 83-009). (Reference: TSD Supplement, p. 3-4-11)

### 3.3.3 Determine Conditions

A properly developed learning objective should state clearly the conditions that will exist at the time of trainee performance. Conditions of performance define the plant situation, environmental aspects, and resources available to aid trainee performance. Typical conditions include the following:

- o plant operating mode
- o safety considerations or hazards
- o equipment and equipment status
- o tools and materials to be used
- o references (diagrams, plant procedures, vendor manuals, textbooks, etc.) available
- o environmental conditions
- o problem situations or contingencies (abnormal or emergency)

Conditions are derived from various job conditions identified during task analysis. When developing learning objective conditions, adjustments may be necessary to reflect the degree of fidelity (to multiple job conditions) that can be achieved in the training setting. For example, job conditions can be simulated with high fidelity during formal OJT and simulator training because they mirror the actual job conditions. When classroom or self-study are used, the learning objective conditions are limited by the constraints of the classroom or self-study environment. (Reference: TSD Supplement, p. 3-4-15)

### 3.3.4 Identify Standards

A well-prepared learning objective includes a standard for evaluating trainee performance. The trainee's action should result in an output, and the required quantity or quality of that output is the standard of performance.

Standards can include step-by-step processes that do not permit deviation. Others may prescribe the product of performance and the factors for judging that product.

Standards are derived from job standards identified during task analysis. Similar to the development process for conditions (Section 3.3.2), learning objective standards also should be adjusted to reflect fidelity (to job standards) that can be achieved in the training setting. (Reference: TSD Supplement, p. 3-4-19)

### 3.4 Develop Test Items

After job performance measures are developed, they may be used to test the terminal learning objectives or measure subsequent on the job performance. However, additional test items are needed to measure trainee mastery of the enabling learning objectives during training. During test item development, learning objectives are examined to determine skills and knowledges that should be evaluated in the test. Using this process, test items are developed to be consistent with the action statement, conditions, and standards of the learning objectives. When developed, test items are placed in a test bank and used later (Sections 3.5 and 3.7) to develop entry-level tests, pretests, progress tests, and post-tests for the training program.

The following procedures are performed when developing test items:  
(Reference: TSD Supplement, p. 3-5-3)

- o determine test item format
- o determine number of test items to be developed
- o develop test items for skill and knowledge learning objectives

#### 3.4.1 Determine Test Item Format

Test items are developed from the learning objectives to measure trainee skills (skill test items) or the recall and/or application of information (knowledge test items). Test item formats that are preferred in a performance-based system

include performance, completion/short answer, alternate choice, multiple choice, matching, and drawing/labeling. (Other test item formats may have application in specific situations.)

Selection of test item formats is guided by action verbs of the learning objectives. Action verbs suggest a test format more appropriate for use in testing than others. Skill action verbs suggest a performance test format, and knowledge action verbs suggest one or more of the written formats. For example, "start" and "shut down" are skill action verbs that suggest a performance test format. The completion/short-answer format is appropriate for many knowledge action verbs, including "recall," "identify," and "list." However, action verbs such as "discriminate" and "select" should be tested using alternate choice or multiple choice formats. Learning objectives that require the trainee to "classify" or "relate" should be tested in the matching format because of the condition and response nature of the action verb. (Reference: TSD Supplement, pp. 3-5-7 to 3-5-9)

#### 3.4.2 Determine the Number of Test Items

The appropriate number of test items for each learning objective depends on a number of factors. Although at least one test item must be developed for each learning objective, certain considerations justify development of more than one test item for a given learning objective. For example, tasks used to develop the learning objectives that were rated at or near the maximum scale of importance and/or difficulty would suggest a larger number of test items than those tasks rated nearer the minimum of the scales.

#### 3.4.3 Develop Skill and Knowledge Test Items

After format is selected and the number of items determined, test items should be developed. They are derived from the



learning objectives and should reflect the behavior or action required of the trainee and conditions and standards of performance.

Test items should be clear, grammatically correct, unambiguous, well-constructed, and free of clues as to the correct answer. They should be written at a reading level appropriate for trainees. (Reference: TSD Supplement, pp. 3-5-13 to 3-5-15)

### 3.5 Describe Expected Entry-Level Skills and Knowledges

After test items are developed, an entry-level test is developed and administered to a representative group of trainees. Test results are used to confirm that trainees can be expected to possess skills and knowledges considered prerequisite to entering the training program. Results are also used to confirm that learning objectives are prepared at a level consistent with expected entry-level skills and knowledges. This process helps ensure that training conserves time and resources by avoiding unnecessary training, yet starts at a level that will permit trainees to complete training successfully.

The following procedures are performed when determining expected trainee entry-level skills and knowledges: (Reference: TSD Supplement, p. 3-6-3)

- o Develop and administer the entry-level test to a group of trainees representative of potential trainees.
- o Assess entry-level test results, determine trainee entry-level skills and knowledges, and revise learning objectives and test items based on these skills and knowledges.

#### 3.5.1 Develop and Administer Entry-Level Test

The purpose of the entry-level test is to determine trainee entry-level skills and knowledges. This test determines if the level of skills and knowledges in the enabling objectives and supporting test items is appropriate. The entry-level test should be composed of test items that measure skills and

knowledges considered prerequisite to the training program being developed. It then should be administered to a group of trainees representative of expected future trainees.

### 3.5.2 Analyze Entry-Level Test Results

Entry-level test results should provide an indication of skills and knowledges already mastered by trainees and those in which trainees are deficient. The assessment begins by comparing trainee performance on the entry-level test to training standards established during development of test items.

If test results indicate trainees do not possess the prerequisites, the learning analysis of learning objectives should be extended to lower levels of skills and knowledges. New learning objectives with supporting test items should be developed to cover this gap in skills and knowledges. New test items should be administered to the trainee sampling and the results analyzed. This process is continued until the trainees' level of skills and knowledges and those in the learning objectives and test items are compatible. The level to which the learning analysis is taken must be determined by considering training cost, training availability, and alternative personnel actions.

If entry-level test results indicate that some learning objectives on which test items were based already have been mastered by the trainees, those learning objectives and test items should be eliminated from the training program (or reserved for refresher training). This helps ensure that only new learning will be provided in the training program and that time and resources will be conserved.

### 3.6 Organize Learning Objectives

This section describes the process of organizing and sequencing learning objectives to develop an outline of the training program.

Effective sequencing ensures training is provided in the shortest period of time and assistance is provided to trainees in making the transition from one level of skill or body of knowledge to another.

This process involves constructing a course map or hierarchy for new programs or reviewing training sequences for existing programs.

The following procedures are performed when organizing learning objectives: (Reference: TSD Supplement, p. 3-7-3)

- o determine the level of learning objectives
- o sequence learning objectives based on dependent, supportive, common factor, or independent relationships

#### 3.6.1 Determine the Level of Learning Objectives

The next step is to determine the appropriate level for the learning objectives. The levels of learning help define an efficient learning sequence within each training setting. Knowledge is the process of storing, recalling, and/or applying bodies of information. Knowledge can involve simple recall of information, comprehension of principles and concepts, or application of information to solve a problem. Skill involves some physical or manipulative activity that is directly observable. Learning objectives and their levels of learning have application when developing test items and learning activities.

#### 3.6.2 Sequence Learning Objectives

Learning objectives should be sequenced within each training setting, based on relationships that exist among them. These relationships include dependent, supportive, common factor, and independent. Proper sequencing of learning objectives provides for the maximum transfer of learning from one topic to the next. When sequencing of learning objectives is uncertain, subject matter experts should be consulted. (Reference: TSD Supplement, p. 3-7-7)

### 3.7 Construct Tests

The test item bank compiled during test item development is used to prepare tests to be used during training. When administered, tests will discriminate between those trainees who have mastered learning objectives and those who have not. Tests used during training include pretests, progress tests and post-tests.

A pretest is used to confirm individual trainee qualifications for entering the training program. It also is used to identify remedial training requirements and may be used to accelerate or exempt a trainee from all or portions of training. For these reasons, the pretest should sample key learning objectives of the course.

A progress test is used to measure trainee progress during training. The outline for a progress test should cover only those learning objectives that have been addressed during a particular segment of training.

The post-test evaluates trainees' successful completion of the training program. It should be course-comprehensive and of detail sufficient to discriminate clearly between trainees who have and have not mastered the learning objectives.

The following procedures are performed when constructing tests:

(Reference: TSD Supplement, p. 3-8-3)

- o develop test specification
- o prepare tests
- o set training standards

#### 3.7.1 Develop Test Specification

The test specification defines the scope and emphasis of the oral or written test to be developed. It identifies which learning objectives in each content area are to receive what amount of emphasis in the test. The purpose of the test specification is to ensure that the test samples the essential

content areas. To assist in this process, a table of specifications is developed. This table identifies the major content areas and level of the learning objectives. Each cell within the table indicates the number (or percentage) of test items needed to test the content area. The number of test items for each test is determined by the amount, difficulty, and importance of the learning objectives to be tested. The content areas are determined by the scope of the lesson, unit, or course objectives. A table of specifications may be developed for pretests, post-tests, and progress tests. (Reference: TSD Supplement, p. 3-8-7)

Performance tests are constructed to measure trainee mastery of the learning objectives that have actual or simulated job conditions. Although job performance measures are the most complete and realistic measure of job performance, alternative, less realistic performance tests may be necessary due to the constraints of the training setting. Performance tests measure learning objectives that are based on key elements or skills that support a task or several related tasks. For example, performance tests could measure learning objectives that sample executing technical procedures, performing management skills, or responding to new conditions under pressure.

The most common performance tests include work sample tests, identification tests, or supervisor, peer, or self-ratings. These are usually evaluated with a product or process checklist or rating scale via observation. Although individual performance is usually assessed, multiple or team performance can be measured when the learning objectives are based on tasks that require more than one individual to perform them in the job environment.



### 3.7.2 Prepare Tests

Pretests, progress tests, and post-tests should be prepared using items in the test bank and the appropriate test specification.

The specific test item should be varied periodically to preclude compromise of test content. Using equivalent test items allows the scope and difficulty of the test to remain constant and trainee performance and program effectiveness to be evaluated over time.

### 3.7.3 Set Training Standards

After tests are prepared, training standards (i.e., pass/fail) should be established. A training standard is set and used to discriminate between satisfactory and unsatisfactory trainee performance.

When the trainee is on the job, the performance standard should be the job standard. During training, these standards may be different from job standards. Established training standards should be guided by the desired trainee proficiency level after specified periods of training. The training standards should specify one of the following:

- o "go, no-go" score on performance tests
- o percentage score that prescribes pass-fail on a written test

## 3.8 Develop Training Plan

Learning objectives and test items are sequenced to form the preliminary course outline. These specifications are used to develop a training plan for future program development and implementation.

The training plan addresses organizing, planning, and administering the training program. It provides guidance for integrating resources--trainees, instructors, support services, facilities, and equipment. Due to interaction of these training program components, the plan

should be flexible and provide for coordination of effort from all units responsible for training. (Reference: TSD Supplement, pp. 3-9-3 to 3-9-11)

### 3.9 Summary

Activities of the design phase produce job performance measures from tasks selected for training. They are used to measure adequacy of a plant employee's performance. Training settings are selected to provide the appropriate environment for learning to occur. Development of learning objectives establishes goals of the training program expressed in terms of measurable trainee performance. Using the tasks, task elements, and skills and knowledges, learning objectives were developed to provide training steps needed for the trainee to achieve mastery. Test items are derived from the learning objectives to measure trainee mastery of the learning objective in the training program. Subsequent design activities identify expected entry-level skills and knowledges, using entry-level test results.

Learning objectives were organized based on dependent, independent, supportive, and common factor relationships within a designated training setting. The training plan was developed in the final activity of the design phase to establish the organization, resources, and administrative guidelines for administering the training program.

### 3.10 Key Considerations

The following are key considerations that should be emphasized when performing and evaluating activities of the design process:

- o Job performance measures contain job-related data for measuring task performance.
  
- o Selection of training settings considers instructional, resource, and logistical constraints.
  
- o Learning objectives are used to identify training content and satisfactory trainee performance.

- o Learning objectives identify observable and measurable trainee action/behavior.
- o Test items are appropriate for the learning objectives.
- o Learning objectives are compatible with expected entry-level skills and knowledge of trainees.
- o Learning objectives are sequenced to assist trainees in making the transition from one skill or knowledge level to another.
- o Pretests are developed to determine trainees' entry qualifications and to identify remedial training and exemption/acceleration requirements.
- o Progress tests are developed to evaluate trainee performance and determine the need for additional assistance.
- o Post-tests are developed to measure trainees' satisfactory completion of training.
- o Training standards for evaluating trainee test performance are established.
- o The training plan specifies organizational, personnel, resource, and facility requirements and establishes the course curriculum outline.

Additional references on training system design are provided.  
(Reference: TSD Supplement, pp. 3-10-3 to 3-10-5)

SECTION 4

DEVELOPMENT

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#### 4. DEVELOPMENT

The design phase creates the specifications for developing, implementing, and evaluating a training program. Job performance measures are developed to measure plant employee's job performance. Training settings are selected to provide the appropriate training environment for learning to occur. Learning objectives are developed to establish measurable goals of the training program. Test items are derived from the learning objectives to measure trainee mastery of the learning objective in the training program. In the final design activities, learning objectives are sequenced, and the training plan is prepared. These program specifications are used in the development phase to develop the training program and materials. Training materials are prepared to guide the instructor(s) and trainees during training. The development process is structured to achieve training effectiveness and efficiency.

Development is the third phase in the five-phase TSD model presented in this manual. Development activities should be followed in the sequence indicated, with the starting point determined by the status of an existing program. However, some activities such as developing training materials and selecting training methods can be performed in parallel.

There are five major development activities: (Reference: TSD Supplement, p. 4-1-3)

- o specify learning activities
- o develop training materials
- o select training methods
- o develop lesson plans
- o conduct training program tryout

During development, the training setting, the learning objectives, and the training plan are used to determine instructor and trainee activities and to select and/or develop supporting materials for the training program. Techniques are presented for the collection, review, and selection of existing course material. Guidelines for the systematic development of new materials also are provided. Training methods for enhancing and lesson plans for guiding the learning process also are presented. The

final development activity deals with reviewing, testing, evaluating, and revising the training materials.

#### 4.1 Specify Learning Activities

In the first development activity, the sequential structure of training is established. Effective learning occurs when training is structured and sequenced based on certain principles of the learning process. An effective learning process consists of the following nine training events:

- o gaining and maintaining attention and motivating the trainee
- o informing the trainee of the learning objectives
- o eliciting recall of prerequisite knowledge
- o presenting the training material
- o providing learning guidance
- o eliciting mastery of the learning objectives
- o providing performance feedback
- o evaluating trainee performance
- o enhancing retention and transfer of training material

For any learning objective (or group of learning objectives), the trainees progress through nine events in the learning process from entry level to mastery. The objective of each event is used to determine the instructor and trainee activities appropriate for that stage of learning.

These nine training events are one strategy for determining instructor and trainee activities. It is recognized that a variety of strategies exist that can be used with equal effectiveness.

For each training event, there are guidelines on how instructor and trainee activities should be developed using the learning objectives. Although the nine training events are common to all types of training, the development guidelines are different when applied to skill and knowledge learning objectives. Learning activities are determined by applying the development guidelines to the learning

objectives. They reflect the unique activities that should occur at each stage of learning (i.e., training event).

Although learning activities may be derived for each training event of each learning objective, the development guidelines can be applied to a series of learning objectives to produce learning activities that will occur once rather than several times during training. More efficient training is achieved using this approach. This applies particularly to the development guidelines for the first and second training events.

The derivation of learning activities for a given learning objective reflects the following process: (Reference: TSD Supplement, pp. 4-2-5 to 4-2-18)

- o identify the training event
- o classify the learning objective as skill or knowledge
- o identify the appropriate skill or knowledge development guidelines for the training event
- o analyze the learning objective using the development guidelines
- o develop the learning activity to reflect the unique aspects of the learning objective that conforms to the development guidelines

#### 4.2 Develop Training Materials

Prior activities led to the identification of expected trainee entry-level skills and knowledges and the development of learning objectives, the training plan, and learning activities. This information will be used to evaluate and select from existing course materials and to develop new materials for use in the training program. When selecting or developing materials, the method of instruction is influenced by the type of materials. The characteristics of various training methods are discussed in Section 4.3.

Training materials should support the learning objectives and emphasize job-related information and situations. The materials should be consistent with the learning activities and be adequate in terms

of training appropriateness and effectiveness. Training materials refer to training equipment, audiovisual media, and printed material. Examples of training materials include: models, simulators, transparencies, procedures, and texts.

The following procedures are performed when developing training materials: (Reference: TSD Supplement, p. 4-3-3)

- o specify use of audiovisual media
- o review and select from existing materials
- o modify existing materials
- o develop new materials

#### 4.2.1 Specify Use of Audiovisual Media

The use of audiovisual media provides an effective way of packaging and presenting course information to the trainees. Many training events involve the use of step-by-step procedures on plant equipment, while others consist of oral presentations by the instructor to the trainees. Although training frequently is presented in one of these ways, the use of audiovisual media in presenting course material can help maintain trainee interest and motivation and improve training efficiency and effectiveness.

Media used in the nuclear power industry include simulation, computer-aided instruction, film/videotape, sound slide/film strip, audio recorder, slide/film strip without sound, and transparencies. The application of each of these media is determined by the training setting selected and the audiovisual characteristics of the learning activities.

During the design phase, training settings (classroom, laboratory/workshop, formal OJT, simulator, and self-study) are selected to provide the most effective environment for learning. The training setting helps determine audiovisual media selection since some media are effective in certain training settings and not in others.

The characteristics of a learning activity may suggest that a medium with certain audiovisual capabilities will be more effective in displaying or transmitting the desired information to the trainees. These characteristics include the following:

- o Visual - The learning activity has pictorial or alphanumeric characteristics that are best learned through visual display of those characteristics.
- o Visual Movement - Physical movement in the learning activity is best learned through demonstration of that movement.
- o Exact Scale - The learning activity requires knowledge of the exact form and dimensions of an object that is best learned through an exact scale representation of the object.
- o Audio - The learning activity has sound characteristics that are best learned through demonstration of those characteristics.

The process involves analysis of each learning activity to determine which of the above characteristics should be reflected in the audiovisual capabilities of the medium. It should be recognized that the four characteristics are not independent, and combinations of characteristics (e.g., audiovisual) may be needed to display or transmit the information effectively. (Reference: TSD Supplement, p. 4-3-7)

The media selected based on training setting and learning activity characteristics should be evaluated in terms of



cost and practicality of use in the training program. Factors to be considered in this evaluation include the following:

- o The projected life-cycle costs of the selected media are lower than other equally useful media.
- o Budgetary resources are available, particularly if the media require a substantial capital investment.
- o The media are appropriate for the number of trainees who will be trained at a given time.
- o The media are appropriate for training that is subject to frequent change or is conducted infrequently.
- o The media are compatible with existing programs.
- o The lead time required to produce the media corresponds with the planned implementation date of the training program.

#### 4.2.2 Review and Select from Existing Materials

Developing effective training materials requires creativity and is both costly and time-consuming. For this reason, the usefulness of existing material should be considered before resources are committed to developing new material. By adopting or modifying existing material, training costs can be reduced.

A primary source of existing materials is current plant training programs and ones that have been conducted in the past. It also is desirable to survey other utilities with plants of similar design or in the same regional training group. NUCLEAR NETWORK offers an effective survey medium, and its use for determining course external materials being used in the industry is encouraged. Additional sources of existing training materials are available. (Reference: TSD Supplement, pp. 4-3-11 and 4-3-12)

Existing course materials should be collected and reviewed to determine if they meet in whole or in part the needs of



the training program. The review and selection process consists of evaluating promising course materials to determine their compatibility with expected trainee entry-level skills and knowledge, learning objectives, learning activities, and the training plan of the program under development. The goal is to identify existing materials that can be used with or without some modification.

A matrix of the criteria can be used to review existing training material. The evaluation of each item of existing material moves sequentially from appropriateness to expected trainee entry-level skills and knowledges to compatibility with the training plan. Clarifications and suggested applications are provided for each criterion. (Reference: TSD Supplement, p. 4-3-15)

The review and analysis of existing course material will identify materials to be rejected, materials to be accepted without revision, and materials to be revised. The materials that are suitable without revision should be incorporated into the development process and tried out (as described later in this section). Materials needing revision should be modified as described in the following section.

#### 4.2.3 Modifying Existing Material

Modifying existing training materials can minimize development time and conserve resources. The modification process can involve two approaches: (1) the revision of existing training materials that are free of copyright restrictions, or (2) the preparation of supplementary materials for training materials that are under copyright restrictions. Modification should be considered when existing materials are incomplete or minor changes are needed. This could include the following:

- o additional information needed to meet the requirements of the learning objectives and learning activities
- o minor modifications to plant systems, equipment, and/or procedures that require an update or change
- o minor changes in regulations that require an update or change
- o industry operating and maintenance experiences necessitate a minor update or change

Existing materials should be modified using the following guidelines:

- o The style and reading level of the modification should be consistent with the existing materials.
- o Modifications should be inserted into existing material where needed.
- o Some redundancy may be necessary to provide continuity between the modification and the existing materials.

#### 4.2.4 Develop New Materials

Training materials should be consistent and adequate in supporting the learning objectives. The materials should reflect the learning activities to ensure that the trainees progress through training in an organized and efficient manner.

Training materials should be developed using adequacy guidelines that are intended to promote learning. These guidelines include formatting that will ensure ease in trainee use. For example, charts, graphs, tables, and other illustrations that are effective in emphasizing key points should be located on a separate page and in close proximity to the related information in the material.

The reading level of training materials should be consistent with the expected entry-level skills and knowledges of the trainees. The materials should not be confusing, vague, or

too wordy. Essential information should be located in the materials, and the trainees should not be referred to other places for that information.

It is often desirable to include more than one representation of key or complex information in the materials. Relating the information in a job context is an effective way. This should include a description of the job environment, how the information will be applied on the job, and the reasons why it is important for the trainee to learn the information.

Another way to promote learning of key or complex information is the use of practice exercises. Practice exercises provide application of course material at the end of training segments. They should be based on the learning objectives, be similar to the tests, and include the opportunity for the trainees to make errors. The feedback from practice exercises should show clearly why the trainee is wrong and how the mistake can be avoided in the future.

#### 4.3 Select Training Methods

Training methods are techniques or strategies employed to enhance the learning process. They include lecture, demonstration/practice, discussion, oral questioning, role playing, walk-through, and self-pacing.

Training methods should be selected for the learning activities that are appropriate for the training setting. Although discussion and oral questioning have general application in all training settings, other methods are more effective in certain training settings. For example, lecture generally is considered more appropriate for the classroom. Demonstration/practice applies primarily to formal OJT, laboratory/workshop, and simulator training, although it can be used in the classroom. Role playing is particularly effective during

simulator drills and exercises that involve team training. Walk-throughs serve to enhance training that is conducted in training settings where the job environment is simulated. Self-pacing is a method generally reserved for self-study. (Reference: TSD Supplement, pp. 4-4-3 to 4-4-5)

#### 4.4 Develop Lesson Plans

Lesson plans are an expansion of the curriculum outline. Used by the instructor as a primary training tool to guide the learning process, lesson plans are the culmination of previous design and development activities. They identify the learning objectives, learning activities, training equipment, and training materials needed for training and provide guidance for their use. Lesson plans are not considered training materials, but rather the controlling document for utilizing training materials.

The effective use of lesson plans ensures consistency in the delivery of training from instructor to instructor and from class to class. For this reason, they should be organized and formatted to enhance learning. To ensure performance-based training, each lesson plan should reference the specific task title(s) it supports. Although there are common features, lesson plans should be prepared to reflect the unique characteristics of each training setting. These characteristics and the associated lesson plans are addressed in the following sections. Existing lesson plans should be examined before new lesson plans are prepared. (Reference: TSD Supplement, pp. 4-5-5 to 4-5-22)

#### 4.5 Conduct Training Program Tryout

Design and development activities produce the materials to be used during training. These materials specify learning activities needed to achieve the learning objectives. During training program tryout, data is compiled and evaluated to correct faults and improve the effectiveness of these training materials.

Training program tryout includes evaluation of training materials for technical accuracy and instructional effectiveness. During tryout, data is collected from a technical review, small trainee group evaluation, and the first run of the program. Results of the technical review are used to evaluate the materials for accuracy. The small group evaluation and the first run produce data on the training effectiveness of the materials from simulated and actual conduct of the program. After each step in the tryout process, data is collected and analyzed and decisions are made for revising the materials as described in Section 4.5.4.

The following procedures are performed when conducting a tryout of the training materials: (Reference: TSD Supplement, p. 4-6-3)

- o perform technical review
- o conduct small-group evaluation
- o conduct first run of the course
- o evaluate data and revise the materials

#### 4.5.1 Perform Technical Review

The goal of the technical review is to ensure the training materials are technically accurate, current, and consistent with plant systems, equipment, and procedures. The review is conducted by a subject matter expert who provides feedback to the program developer. A face-to-face discussion of comments permits effective exchange of views and clarification of materials when needed. Lesson plans, text material, trainee handouts and workbooks, audiovisual media, and test items should be reviewed, and deficiencies identified for analysis and correction. This review should be coordinated as materials are being developed. (Reference: TSD Supplement, p. 4-6-7)

Although technical review of training materials ensures technical accuracy, further tryout is recommended to determine training effectiveness. The small-group evaluation



and first run of the course serve this function and are discussed in the following sections.

#### 4.5.2 Conduct Small-Group Evaluation

After revisions from the technical review have been made, a tryout of the training materials is conducted on a small group of trainees. The trainees should possess the entry-level skills and knowledges expected of future trainees and should be informed of their role in the tryout. Although a minimum of one trainee is necessary, additional trainees should be used when personnel availability permits. During the tryout, the training setting is simulated as closely as practical. The training materials are presented and pre-tests, progress tests, and post-tests are administered and scored. Data is collected for subsequent analysis and is used to improve lesson plans, text material, trainee handouts and workbooks, audiovisual media, and test items. Effective small group evaluations include the following activities:

- o Trainees are monitored to determine if the presentation of material and directions for study are clear and easily understood.
- o Presentations and directions that require modification or clarification are documented.
- o Questions asked by the trainees that relate to effectiveness of training are recorded.
- o The length of time taken by trainees to complete training segments and tests is noted.
- o Test items answered or performed incorrectly by the trainees are identified.



- ◁ Trainee comments are obtained that address
  - difficulty of the material
  - length of the training
  - amount of material covered
  - clarity of the material
  - terminology used in the material
  - pace of the training
  - structure of the material
  - quantity and quality of practice exercises
  - quality of the media
  - relevance of the training to job performance

It is recognized that a small-group evaluation may not always be feasible, particularly with courses of lengthy duration. An alternative is to conduct small-group evaluations on the most important segments of the course. It is desirable, however, that small-group evaluation be conducted when new topics are being added to an existing course and on programs in which large numbers of trainees will be trained on a frequent basis. Courses or segments of courses not submitted to small-group evaluation should receive increased monitoring and emphasis during the first run.

#### 4.5.3 Conduct First Run

Analysis of data compiled during the small-group evaluation could result in further revision of materials and test items. During the first run of the course, the revised materials are subjected to another phase of training program tryout.

In addition to training the first group of trainees, the first run determines the usability of the training materials under intended conditions and confirms the revisions made to the materials during the technical review and small-group evaluation. The training is conducted by the instructor in

the actual training setting, with all trainees participating. The first run differs from subsequent training because the course material is still in a tryout phase. This requires close monitoring of course progress by training management and the provision of additional assistance to the instructor when needed. Although pretest, progress test, and post-test scores are indicators of training material effectiveness, diligence in evaluation of individual trainee progress is essential in ensuring that unsatisfactory performance is not caused by faulty material. Retesting of the trainees may be necessary in these instances.

During the first run, learning and administrative problems are noted, and trainee comments on the training program are obtained. Techniques for data collection are the same as those employed during the small-group evaluation. After collection, the data is analyzed and used to improve lesson plans, text material, trainee handouts and workbooks, audio-visual media, and test items.

#### 4.5.4 Evaluate Data and Revise Material

Data collected during the technical review, small-group evaluation, and first run are translated into findings with decisions made for revising the training materials. Results of the technical review disclose technical inaccuracies in the material.

Progress and post-test scores collected during the small-group evaluation and first run provide useful data for analysis. This is because the intended learning outcome is reflected in the learning objectives and their associated test items. If the training does not promote the intended learning outcomes, as reflected in trainee test scores, revision of training materials may be necessary. Conversely, faulty test items may not measure the intended learning outcome of the trainees accurately. Those test

Items consistently missed by trainees should be analyzed for faulty construction. Supporting training materials also should be analyzed for clarity, completeness, and technical accuracy.

Evaluation by the trainees can provide useful data for determining needed improvements to training materials. Trainees can detect errors in the presentation, materials, or media that may not be apparent to the program developer or instructor. Two data collection methods can be useful in obtaining trainee comments during the small-group evaluation and the first run: post-training questionnaire and interview. These methods present questions that address training program difficulty, length, clarity, terminology, pace, and structure. Whereas the questionnaire provides for alternate choices of opinion on a scale, the post-training interview seeks a more comprehensive and narrative answer to those questions. Both instruments should use questions that will support revision decisions. (Reference: TSD Supplement, pp. 4-6-11 to 4-6-15)

Changes made during the small-group evaluation and first run should be considered for permanent revision. Finally, data on the length required by the trainees to complete training segments is used to refine course length, loading, and scheduling.

Data compiled from the small-group evaluation and first run should be assessed to determine weaknesses that should be corrected in the training materials. (Reference: TSD Supplement, p. 4-6-19)

#### 4.5 Summary

Development activities address trainee learning experiences, activities in which the instructor(s) and trainees engage, and the content of the training program. During the development process, nine

training events are used to structure and sequence training. Learning activities then are derived from the learning objectives to define the activities that should occur during training.

The high cost of training material development requires that close attention be given to the collection, review, and selection of existing training materials. When these materials are not available or require extensive revision to meet plant-specific needs, new materials are prepared. Alternative training methods are considered for improving the learning process. Next, lesson plans are prepared for each training setting. In the final development activity, training program tryout is conducted to correct faults and improve the effectiveness of the materials. Data is collected and analyzed from a technical review, small-group evaluation, and the first run of the course, and decisions are made for revising the materials.

#### 4.7 Key Considerations

The following are key considerations that should be emphasized when performing and evaluating activities of the development process:

- o Training events define the structure and sequence of learning.
- o Learning activities are derived from the learning objectives.
- o Selection of media is based on the training setting, characteristics of the learning activities, and resource constraints.
- o The learning objectives guide the evaluation of existing training materials.
- o Development of new training materials is guided by the learning objectives, the learning activities, and the expected trainee entry-level skills and knowledges.
- o Training methods are appropriate to the training setting and learning activities.
- o Lesson plans provide a structured approach for conducting consistent training.
- o Data acquired during tryout of the training materials is used to determine technical accuracy and training effectiveness and guide any needed revisions.

Additional references on training system development are provided.  
(Reference: TSD Supplement, pp. 4-7-3 and 4-7-4)





SECTION 5

IMPLEMENTATION

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## 5. IMPLEMENTATION

During analysis and design, employee performance data is collected and analyzed, and specifications are established for the training program. During development, methods are determined and materials are produced. In this section, implementation of the training program is described.

Implementation is the process of putting training programs into operation. It is the culmination of systematic planning and development in which the trainees and the utility derive benefits of previous efforts through effective training.

The implementation activities described in this section should be applied based on the status of an existing program. Some activities are performed only once during implementation of a training program, while others are repeated each time the program is conducted.

There are four major implementation activities: (Reference: TSD Supplement, p. 5-1-3)

- o implement the training plan
- o conduct training
- o conduct in-training evaluation of program effectiveness
- o document training

During implementation of the training plan, procedures that govern activities for conducting classroom, laboratory/workshop, formal OJT, simulator, and self-study training are developed. Instructors are selected, trained, and evaluated against established criteria, and the availability of trainees, facilities, and resources is confirmed. Instructors prepare for training, pretest trainees, deliver lessons, and evaluate trainee performance. Effective implementation of training also requires that data be collected for evaluating program results and that the program and trainee participation be documented.

### 5.1 Implement the Training Plan

Design and development activities produce the training plan and materials used during training. In the first implementation activity,

procedures are prepared to help ensure successful operation of the training program. The emphasis then is to put the training plan into effect by ensuring that instructors and trainees are identified in a timely manner; that they know their responsibilities; and that facilities, equipment, and materials are available for training.

The following procedures are performed when implementing the training plan: (Reference: TSD Supplement, p. 5-2-3)

- o prepare implementation procedures
- o select, train, and evaluate instructors
- o confirm availability of the trainees
- o confirm availability of training facilities and resources

#### 5.1.1 Prepare Implementation Procedures

Implementation of the training plan should be governed by written procedures that clearly describe how training activities should be performed and the individuals responsible. Moreover, these procedures should address periodic internal audits of training to determine compliance with training goals, regulations, standards, and guidelines.

Implementation procedures should address activities that occur before, during, and after training is conducted. They should be clear and consistent and should be updated when changes in practice or policy dictate. Implementation procedures should address the following:

- o planning, developing, and scheduling training programs
- o selecting, training, and evaluating instructors
- o using, maintaining, and improving training facilities and equipment
- o procuring training equipment and materials
- o granting waivers or advanced placement in training
- o conducting training
- o administering tests, including storage, retrieval, reproduction, and instructions during testing
- o monitoring and evaluating trainee performance

- o counseling and remedial training of unsatisfactory trainee performance
- o certifying trainees' successful completion of training
- o maintaining records of trainee performance and training programs
- o internal auditing of training program implementation
- o conducting and monitoring program evaluations
- o improving training program effectiveness

Some of the above procedures can apply to all of a utility's or plant's training programs, while others should be prepared specifically for each program.

#### 5.1.2 Select, Train, and Evaluate Instructors

Instructor qualifications required should be determined systematically based on job requirements. They should address technical competence, including theoretical and practical knowledge, and work experience in the subject areas in which instructors will conduct training. In addition to technical competence, instructor qualifications should provide oral and written communication abilities, interpersonal skills, and instructional capabilities. INPO guideline Technical Instructor Training and Qualification (INPO 82-026) provides additional guidance in this area.

Instructors who do not meet these established requirements should be trained sufficiently in advance. The INPO guideline cited above recommends training requirements, certification procedures, and exemption guidelines for instructor candidates. Similar plant-specific requirements should be established and met by instructors before training begins.

In addition to initial instructor qualification, a continuing training program to upgrade and improve the technical and instructional capabilities of instructors should be established. Instructors also should remain current with job

requirements, plant changes, operating experiences, and technical specifications in the plant. Section 7 of the INPO guideline describes a recommended continuing training program for instructors.

Continuing training and development should be based on periodic evaluation of instructor performance. The evaluation should include direct observation by a qualified evaluator during training sessions and should address technical competence, instructional skills, and overall effectiveness in achieving the learning objectives. A recommended instrument for the evaluation of instructors is contained in Appendix B to the INPO guideline.

The use of both announced and unannounced evaluations can improve the overall effectiveness of instructor evaluations. Guidelines to be followed by the evaluator during the evaluation should include the following:

- o establish a relationship with the instructor based on mutual respect and trust
- o review the lesson plan and other course material prior to the training session in which the evaluation will occur
- o recognize that the primary purpose of instructor evaluation is to improve the quality of training
- o refrain from making comments or participating in training activities
- o schedule and conduct a critique of the evaluation with the instructor
- o provide a completed copy of the evaluation to the instructor
- o assist the instructor in developing a plan for correcting any deficiencies noted

#### 5.1.3 Confirm Availability of Trainees

Selection of trainees should be coordinated between the training and personnel departments to ensure that course loading



and scheduling requirements are met. Trainees selected should possess the required entry-level skills and knowledges of the scheduled program. Trainees should be selected sufficiently in advance to permit adjustments in scheduled training (e.g. remedial training) that may be required.

#### 5.1.4 Confirm Availability of Training Facilities and Resources

In addition to assigning qualified instructors and confirming trainee availability, the availability of training facilities and resources identified in the training plan should be verified. Conflicts in scheduling or availability should be resolved to ensure that facilities and resources required are available when training begins. The following guidelines assist in this effort:

- o confirm that the allocated training facility is adequate and appropriate for the number of trainees, learning activities, media, and the numbers and types of training equipment to be used
- o check the facility and correct any unsafe conditions
- o check equipment operability, including spare parts and maintenance support
- o confirm that sufficient training materials for the course are available (e.g., plant procedures, drawings/schematics, texts, handouts, audiovisual aids, tools, consumables)
- o verify that the facility is properly heated, cooled, lighted and is reasonably free of distractions
- o verify the availability of tests

## 5.2 Conduct Training

Prior to instruction, trainees should be pretested to ensure that they are prepared adequately. Lesson plans are also reviewed to ensure that the instructor is familiar with the lesson content and learning activities. During training, trainee performance should be monitored and evaluated, with feedback provided for recognizing successful performance and areas in need of improvement.

The following procedures are performed when conducting training:  
(Reference: TSD Supplement, p. 5-3-3)

- o pretest the trainees
- o prepare for training
- o deliver lessons
- o evaluate trainee performance

### 5.2.1 Pretest Trainees

Pretests measure the trainees' entry-level skills and knowledges and identify course learning objectives that they may have mastered previously. Pretest results can be used in the following manner:

- o confirm individual trainee preparation for entering the training program
- o identify remedial training requirements for trainees who do not meet the entry-level skills and knowledges
- o accelerate or exempt from segments of training those trainees who exhibit mastery of specific learning objectives
- o identify overall training program emphasis, based on common strengths and weaknesses of the group of trainees
- o preview course content and trainee performance requirements

Section 5.2.4 describes guidelines on administering tests.

### 5.2.2 Prepare for Training

Prior to a course, instructors should prepare sufficiently to ensure consistent and effective delivery of lessons and effective use of their time. During preparation, instructors should review lesson plans to ensure familiarity with lesson content, equipment and tools, and the use of media, text material, references, and tests. Technical errors should be identified for correction during this review, and the schedule and emphasis should be modified based on trainee pretest results.

Instructor preparation should include a review of all procedures that address training implementation. Additional preparation should reflect the following:

- o check the assigned training facility to ensure it is appropriate for the number of scheduled trainees, learning activities, equipment, and media to be used
- o verify ability to operate equipment and use tools effectively
- o ensure sufficient supplies of training materials are available (e.g., consumables, text material, handouts, workbooks, tests, etc.)
- o verify that the training facility is heated, cooled, and lighted properly and is reasonably free of distractions
- o review procedures for monitoring progress, evaluating performance, and counseling trainees
- o review test administration procedures for test storage, retrieval, reproduction, and instructions during and after testing

### 5.2.3 Deliver Lessons

Lesson plans outline instructor and trainee activities and the resources necessary to support training. Effective training presentation requires general adherence to the lesson plan and an understanding of the learning process. The following paragraphs address two important aspects of the learning process: trainee motivation and listening habits.

Instructors can guide trainee progress more effectively if they have a working knowledge of the learning process. Trainee motivation can be enhanced by providing an effective training environment, by identifying a clear indication of what must be learned, and by presenting the materials in an organized, concise, and factual manner. Organizing and presenting exactly what must be learned is central to the training system development approach and the use of learning objectives.

Techniques that instructors can use to contribute to trainee motivation include the following:

- o assist trainees in setting specific, attainable goals and identifying the means for achievement
- o involve the trainees actively in the learning process, including hands-on application (e.g., equipment, tools)
- o use rewards to recognize achievement (e.g., certificates, promotions keyed to training progression)
- o interject competition with self or others (e.g., accelerated pace, added skills an employee can use, new equipment the employee can operate/maintain, peer group recognition)

An effective training environment also requires that the trainee exercise good listening habits, which lead to improved note taking. The instructor should encourage the trainees to use the following to improve listening habits:

- o direct attention to the material being presented and eliminate distractions
- o relate material being presented in personal terms and to personal experiences
- o evaluate the material only after the facts have been presented
- o use learning objectives to organize ideas
- o ask questions when uncertain or confused
- o review and summarize the main idea(s)

#### 5.2.4 Evaluate Trainee Performance

Trainee performance must be evaluated regularly during and at the completion of the training program. Evaluation measures trainee progress and provides performance feedback to the instructor and trainees that serves to reward success and identify needed improvement in trainee performance. Trainee performance also is used to evaluate the effectiveness of the training program (Sections 5.3 and 6.2).

Pretests, progress tests, and post-tests are administered when scheduled in the lesson plan. The following guidelines should be used in administering tests.

- o Security of tests and answer keys should be maintained during storage, reproduction, and testing of trainees to prevent compromise.
- o Trainees should be given prior notification of scheduled tests and materials needed.
- o Instructions to the trainees should include the purpose of the test, the importance of following instructions, and time limitations.
- o Equipment and tools used during performance tests should be available and in operational condition.



Written tests should be corrected, graded, and returned to the trainees in a timely manner to enhance benefits derived from the test. In performance tests, deficiencies should be identified, a grade given, and the trainee advised of the results promptly.

Trainee performance and progress toward achieving mastery of the learning objectives should be monitored closely. Monitoring should identify satisfactory performance and trends that may indicate potential problems. Trainees should be counseled periodically and at any time when deficiencies occur. Counseling should address trainee performance deficiencies and include a plan for improvement. The trainees' functional supervisor(s) should be kept informed of trainee progress and be involved in counseling when performance problems warrant.

Standards for evaluating trainee performance should be applied consistently. Trainees should not be permitted to complete the training program or progress to another segment of training until deficiencies have been corrected and the training standards met. A program of remedial training or recycling to previous segments of training can be beneficial in correcting trainee performance deficiencies. It is a cost-effective alternative to removal from training. A program also should be established for the certification of trainees who complete training successfully.

### 5.3 Conduct In-Training Evaluation

During training, data should be collected for subsequent use in evaluating training program effectiveness. This section outlines activities occurring during training that are integral to program evaluation. These activities produce data on trainee test performance and instructor and trainee critiques of training that can be analyzed with other evaluation indicators for improving training program performance.



The following procedures are performed when conducting in-training evaluation: (Reference: TSD Supplement, p. 5-4-3)

- o collect test performance data
- o perform instructor critiques of training
- o obtain trainee critiques of training

Evaluation of the training program is addressed in Section 6. If the above data sources indicate recurring problems or suggest the need for improvement, follow the analysis and revision process outlined in Sections 6.2 and 6.3.

#### 5.3.1 Collect Test Performance Data

Trainee test scores should be used to assess trainee progress, and improve training and testing effectiveness. If a large number of trainees experience difficulty with a training segment, as reflected in their test scores, the training material or test items may be faulty and in need of revision.

Progress test and post-test scores should be compiled routinely during training. After the test scores are tabulated in a usable form, analysis should be conducted and interpretations made. Section 6.2 addresses various techniques that can be used to transform raw test score data into meaningful information for evaluation.

#### 5.3.2 Perform Instructor Critiques of Training

Instructors are a unique source of evaluation data. They can identify problems involving technical accuracy, completeness, pace, sequence, and level of difficulty of the training materials.

Instructors should establish a procedure for recording problems when they occur. Problems noted and suggestions for improvement should be reported in training critiques. The

critique should be submitted by the instructor at the completion of training segments or at any time a problem of significance is identified.

Instructor critiques should be analyzed using one of the techniques addressed in Section 6.2. Although instructor training critiques are a valid source of evaluation data, recommended changes should be analyzed along with supervisor's performance evaluation of the instructor and the success of trainees in completing the segment of training.

#### 5.3.3 Obtain Trainee Critiques of Training

Trainees can provide useful feedback to the organization and to the instructor for improving presentation of course material. A questionnaire completed by trainees after major segments of training should focus on course effectiveness and ways in which training can be improved. It should address the pace of training, clarity of the material, and the quality of the media.

Trainee critiques of training should be used by the instructors to improve their performance and can be helpful during instructor performance evaluations. Trainee critiques should be analyzed using one of the techniques addressed in Section 6.2.

#### 5.4 Document Training

Documenting training is an integral and significant part of training program implementation. The documentation of training includes preparing, distributing, storing, controlling, and retrieving records and reports that address the training program and trainee participation. These records and reports assist management in monitoring the effectiveness of the training program. They also provide a historical reference of changes that have occurred within a program due to evaluations.

The following procedures are performed when documenting training:

(Reference: TSD Supplement, p. 5-5-3)

- o maintain training program records
- o maintain trainee records
- o prepare training reports

#### 5.4.1 Maintain Training Program Records

Training program records should be maintained to permit review of content, schedules, and current and past program results. These records should be classified according to type and retention period. They should be located, organized, and indexed for ease of retrieval. Training program records should include the following:

- o job and task analysis data used in training program development
- o training plans
- o course schedules
- o lesson plans and tests
- o trainee attendance summaries (name, course, dates, and test results)
- o instructor evaluations
- o reports of program accreditation, audits, and evaluations

#### 5.4.2 Maintain Trainee Records

Records of the training and qualification of plant employees should be maintained. Records should be current and organized to permit efficient but controlled retrieval. A trainee's record should contain the individual's training history and the identification of required training that has not been completed. Specifically, trainee records should include the following:

- o summary of the individual's education, training, experience, and qualifications at the time of hire

- o summary sheet indicating the individual's current and previous positions with the company, training received, qualifications achieved, and continuing training required
- o record of training completed, including course title, attendance dates, test performance, and certifications of successful course completion
- o record of training attended but not successfully completed, including course title, attendance dates, and test performance evaluations
- o record of waivers or exemptions granted, including course titles and statements of justification

#### 5.4.3 Prepare Training Reports

The training organization should report periodically to appropriate levels of management on the status and effectiveness of training activities. Significant training events or problems should be identified and reported when they occur. Although specific aspects will vary with individual utilities, the reports should address the following:

- o completion of training programs, including course title, dates, and summary of trainees' performance
- o individual trainee attrition, including a summary of performance problems, remedial actions, and final disposition
- o evaluations and audits of training program effectiveness, use of training manpower and resources, and achievement of goals and objectives
- o recommendations for improving course scheduling
- o action plan for completing program improvements

### 5.5 Summary

Implementation activities produce implementation procedures and guidelines for the selection, training, and evaluation of instructors. They also ensure that the trainees, facilities, and resources are available when training is scheduled to start. Prior to training, trainees are pretested and instructor preparation is emphasized. Effective training presentation requires adherence to lesson plans and an understanding of the learning process. Effective delivery also requires consistent evaluation of the trainees' performance against established standards and the appropriate use of feedback, counseling, and remedial training during the evaluation process. Final implementation activities address the in-training evaluation of program effectiveness and the documentation of training.

### 5.6 Key Considerations

The following are key considerations that should be emphasized when performing and evaluating activities of the implementation process:

- o Procedures are developed and used to implement the training plan.
- o Technical and instructional qualifications are based on job performance requirements.
- o Trainees meet the training program prerequisites.
- o Training facilities and resources are available and appropriate for training.
- o Pretests are administered to trainees prior to training.
- o Instructors make all necessary preparations prior to training.
- o Instructors adhere to lesson plans.
- o Instructor performance is evaluated on a regular basis.

- o Using established performance standards, trainee performance is evaluated regularly and on completion of training.
- o Security of tests and answer keys is maintained to prevent compromise.
- o Instructor and trainee critiques of training and trainee test scores are sources of data for evaluating training program effectiveness.
- o Trainee and training program records are maintained for evaluating training program effectiveness.

Additional references on training system implementation are provided.  
(Reference: TSD Supplement, pp. 5-6-3 and 5-6-4)



SECTION 6

EVALUATION

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## 6. EVALUATION

During analysis, design, and development, job performance requirements are identified and converted to performance-based training programs. During implementation, employees are trained, and their performance is assessed; instructor performance also is evaluated. In each of the previous phases, evaluation activities were conducted to determine the quality of selected TSD materials and processes. To ensure that TSD is executed properly, each of the phases includes key process considerations that should be emphasized when performing and evaluating each activity. However, to ensure that competent employees are produced, training programs must be monitored, evaluated, and revised as necessary. Program evaluation focuses on the results of the training program, not the process of training.

Evaluation is the determination of a training program's effectiveness in producing competent employees. Evaluation is used to monitor, verify, and maintain program performance continually. The evaluation phase also includes activities designed to identify changing needs so training can respond to job, task, equipment, or procedural changes. Procedures for conducting program evaluation and assigning responsibilities for evaluation are outlined in Section 5.1.

The in-training evaluation of programs, including the evaluation of trainee performance and critiques by trainees and instructors, was presented in Section 5.3. This section describes the process for assessing overall effectiveness and improving the quality of training programs. The evaluation process identifies performance problems that can be solved by improved training and identifies new or changing training needs. The output of the evaluation phase serves as feedback (input) for the analysis, design, development, and implementation phases so the training program can be modified and improved. A thorough, systematic evaluation is a key step in ensuring that an existing training program is performance-based. One way of ensuring that job-specific tasks are taught in a program is to construct a cross-reference matrix from each job task to the appropriate training material document. Contact INPO for further information.

The quality of nuclear power plant training programs is maintained and improved in the following ways:

- o Plant operating, maintenance, and industrial safety experiences are reviewed to identify areas in which new or improved training may be needed to solve operational problems.
- o Employees and their supervisors provide feedback on how well training prepares workers to operate and maintain the plant and on how training might be improved.
- o Plant inspection, evaluation, and accreditation reports are reviewed for training implications.
- o Plant modifications and procedure changes are monitored to identify the need for revising or developing additional training.
- o Industry operating and maintenance experiences are reviewed for training implications.
- o Regulatory changes are reviewed for their effects on training.

This section outlines the use of training program evaluation to control and improve the training quality. There are three major evaluation activities: (Reference: TSD Supplement, p. 6-1-3)

- o monitor indicators
- o analyze information
- o initiate corrective actions

Before describing specific evaluation activities, the following three features of the process should be noted:

- o The evaluation process is based on the use of indicators of training system performance, most of which are available to the utility.

- o Because each of the indicators is affected by a number of factors unrelated to training, the root causes of performance problems must be identified. Training improvements and refinements are pursued only when analysis confirms an existing or anticipated training problem.
- o Approved refinements are incorporated into initial and/or continuing training as appropriate. In this way, all affected employees receive updated training.

#### 6.1 Monitor Indicators

The first step in evaluation is to identify and monitor indicators of training system performance and changing training needs. Plant reports, company employees, and reports from independent parties, other plants, and the NRC are all potential sources of information. Indicators of training effectiveness and potential changes in training needs include the following:

- o plant operating, maintenance, and industrial safety experiences
- o employee and supervisor feedback
- o plant inspection, evaluation, and accreditation reports
- o plant modifications and procedure changes
- o industry operating and maintenance experiences
- o regulatory developments
- o in-training evaluation data (instructors and trainees)

##### 6.1.1 Review Plant Operating, Maintenance, and Industrial Safety Experiences

Plant operating, maintenance, and industrial safety experiences should be monitored to identify employee performance problems caused by improper training and areas in which training should be revised. Plant event and industrial accident reports can identify tasks for which inadequate training may be contributing to equipment damage, excessive unavailability, unscheduled maintenance, rework, unsafe practices, or lack of adherence to approved procedures.

Training personnel should monitor the frequency of personnel errors and should review accident and event reports for training implications, using the following considerations:

- o Did the problem result from employee error or failure to follow prescribed procedures?
- o Did the problem result because the employee improperly diagnosed the situation?
- o Was the employee misinformed or unaware of the correct procedure?
- o What specific sequence of events caused the problem?
- o Has this problem or a similar problem occurred in the past?
- o Is it likely to reoccur?
- o Was an individual injured?
- o Was equipment damaged?
- o Was a significant amount of work time lost?
- o Was a technical specification violated?
- o Does the report describe a new or unusual situation?
- o Was the employee newly assigned to this position?
- o Are job performance standards different from those used in training?

Maintenance experiences also can be indicators of training performance. However, this information is difficult to obtain from maintenance records and is best derived from interviews with maintenance supervisors and engineers. (Section 6.1.2.)

#### 6.1.2 Collect Feedback From Employees and Supervisors

Employees and their supervisors are valuable sources of evaluation data. They can provide information on the overall quality, relevance, and timing of training. The usefulness of data from recently trained workers is limited by their brief on-the-job experience, but they can comment legitimately on the training they received. Experienced employees know more about job requirements, but may not recall as much about their training. Interviewing or surveying trainees six months to



one year after their completion of initial training can help identify program strengths and areas in need of revision; information from more experienced workers can reveal needs for refresher training or other continuing training. The following types of questions are suitable for employee interviews or surveys:

- o What additional training have you received since being assigned to your job?
- o What unexpected difficulties or problems in job performance have you experienced?
- o Has your supervisor given you instructions different from those you learned during training? What were they?
- o Have you noticed other differences between the training you received and what is expected of you now?
- o Have changes occurred in your job since you were assigned?
- o How were you prepared to handle these changes?
- o What tasks do you find easiest?
- o Which tasks do you find especially challenging?
- o Looking back, what specific training benefited you most?
- o What kinds of errors have been committed on the job?
- o How could training better have prepared you for your job?
- o What suggestions would you make to improve training?
- o What additional training do you need for your job?

Supervisors are an excellent source of information on employees' capabilities and on training program effectiveness. They are qualified to rank individual job performance, describe common performance problems, and identify anticipated changes in job requirements. Supervisors should be interviewed periodically as to how well training is preparing new employees to perform their jobs and what training is needed for current employees. The following types of questions can be used to collect supervisors' responses:

- o How well do employees (both newly trained and experienced) perform on the job?
- o What tasks were newly trained employees best prepared to perform?
- o For what tasks were they inadequately prepared?
- o Are employees able to diagnose conditions and identify alternate solutions for accomplishing a task?
- o What kinds of errors have employees committed?
- o Which tasks require excessive time for employees to complete?
- o How do recently trained employees compare to those who received earlier training?
- o What additional training have they received since they were assigned job responsibilities?
- o Have employee errors caused equipment damage or failure?
- o Has rework by maintenance personnel been required due to personnel errors or lack of adequate training?
- o Have increases in rework, unscheduled maintenance, or overtime occurred in jobs performed by recently trained employees?
- o Have employees been commended or warned for unusually good or bad job performances?
- o Have you observed unexpected results from training?
- o Has training created any new problems?
- o What suggestions would you make to improve initial or continuing training?
- o Do you expect any changes in job assignments or equipment that will require additional training or changes in current training?
- o What current training do you consider to be excessive or unnecessary?

In brief, interviews should be held in a controlled environment, free of noise or disruption. Responses are summarized on an interview form and later reviewed and analyzed for training program implications.

Post-training surveys can be used with or in place of employee interviews and offer another way of obtaining employee feedback. In addition to the types of questions listed above, surveys of former trainees or their supervisors can include portions of task lists to determine how effectively trainees were prepared to perform selected tasks. A task list can be modified easily into a part of a post-training employee survey. (Reference: TSD Supplement, p. 6-2-3)

Survey data can help answer the following evaluation concerns:

- o How do employees rate the effectiveness of training?
- o How job-relevant do employees find training?
- o How well is training timed to meet actual job demands?
- o What specific tasks require more emphasis during training?
- o What topics require less emphasis?

These surveys can be administered to individuals or groups. Group surveys should be administered using the testing procedures described in Section 5. Data obtained in a group setting tends to be more reliable because the same conditions are present for all respondents. This level of control is not present in mailed surveys. Mailed surveys should include a letter from a senior company official that explains the purpose of the survey, solicits the individual's help, and thanks the respondents for their time. Surveys distributed without addressing these topics usually have very poor results.

#### 6.1.3 Review Plant Inspection, Evaluation, and Accreditation Reports

Plant and corporate quality assurance audits may identify training-related discrepancies. These reviews can improve training effectiveness by helping answer the following questions:

- o How effectively is training preparing employees to conform to plant procedures?

- o To what extent do training activities conform to established procedures?
- o In what areas of training is improvement needed?

Results of plant evaluations are used to identify good practices and areas in which improvements are necessary. Findings and recommendations for improvement are reported in the following areas:

- o training organization and administration
- o licensed and non-licensed operator training and qualification
- o shift technical advisor training and qualification
- o maintenance personnel training and qualification
- o technical staff training
- o supervisors and managers training
- o general employee training
- o training facilities and equipment
- o simulator training
- o quality control inspector and nondestructive examination technician training and qualification
- o radiation protection personnel training and qualification
- o chemistry personnel training and qualification

The accreditation process examines the entire training system using self-evaluations and accreditation team visits. Recommendations and comments on utility training are provided in the following program areas:

- o operations area
  - non-licensed operator training
  - reactor operator training
  - senior reactor operator/shift supervisor training
- o maintenance and technical support area
  - shift technical advisor training
  - instrument and control technician training
  - electrical maintenance personnel training

- mechanical maintenance personnel training
- chemistry technician training
- radiological protection technician training
- technical training for technical staff and managers

In addition to plant evaluation findings and accreditation recommendations contained in individual utility reports, INPO periodically publishes listings of recurring findings, recommendations, and good practices from plant evaluations. It also issues recurring problems and good practices identified during accreditation visits. These reports should be reviewed for information that may be applicable to a particular utility.

Reports from NRC inspections also may identify training-related weaknesses and should be reviewed.

#### 6.1.4 Review Plant Modifications and Procedure Changes

Plant modifications may require special training, changes in existing training, and provide input for continuing training. Approved design changes, plant modifications, and procedure changes should be reviewed for training implications and considered for incorporation into existing training programs.

#### 6.1.5 Review Industry Operating and Maintenance Experience

Incorporating industry operating experience into training enables utilities to benefit from each other's experiences. Nuclear plant safety and reliability information, significant events, and operation and maintenance reminders can be followed by using NUCLEAR NETWORK and the Significant Event Evaluation Information Network (SEE-IN).

NUCLEAR NETWORK, an international communication network available to all nuclear utilities, offers current information on plant design, construction, operation, and training activities. Monitoring and using this system can provide industry data that is helpful in evaluating and improving training.



SEE-IN, a communication system designed to help utilities benefit from each other's operating experience, allows utilities to focus on significant industry events only, without being overwhelmed by the large number of insignificant events. Using data gathered from NUCLEAR NETWORK entries, monthly operating reports, Licensee Events Reports, the Nuclear Plant Reliability Data System, operating experience, and suppliers/participants, SEE-IN screens events to identify potential areas of concern.

Depending on an event's level of significance, one of three actions can occur. For a less significant event, utilities are sent an operations and maintenance reminder (O&MR) via NETWORK. More significant events are communicated as significant event reports (SERs) through NETWORK. The most important events result in significant operating experience reports (SOERs), which are mailed to all utilities. An SOER provides a thorough analysis of a significant event, including a summary description of the event, its significance, and recommended actions. Recommendations include training that should be changed or added.

Screening industry operating and maintenance experience (event) reports involves answering the following questions:

- o How unique is the event?
- o Do similar conditions exist at this plant?
- o What is the potential for the event to occur here?
- o What consequences to personnel or equipment will result if the event occurs?
- o Is there evidence that this event may be part of a trend?
- o What specific training should be provided to prevent the occurrence or mitigate the consequences of such an event at this plant?



### 6.1.6 Monitor Regulatory Developments

Activities of the NRC have a significant influence on the industry. Consequently, training personnel should monitor NRC IE bulletins, circulars, information notices, letters and directives, NUREG documents, and special reports for information and changes in requirements affecting training.

The impact of regulatory changes can be evaluated using the following questions:

- o What conditions does the change address?
- o Do those conditions exist at this plant?
- o Will changes influence the way our personnel perform their tasks?
- o What specific effects will this change have on training?
- o Does it require an immediate response?

### 6.2 Analyze Information

Previously identified sources of program evaluation information must be analyzed before this information can be used to identify changes needed in training. This section describes two methods for converting evaluation information into training program performance information.

Before selecting an analysis method, the following three questions should be asked:

- o What information is needed?
- o What type of information will be analyzed?
- o What is the simplest method of analysis that will yield the information required?

Appropriate information sources for various data types include reports, interviews, surveys, and trainee performance data. Analysis methods include exception analysis and content analysis, described below. Some types of data should be organized and tabulated using frequency distributions prior to analysis. While such analysis

techniques can be very useful, they are not substitutes for experience and judgment; they are tools to support them. Any apparent performance discrepancies must be verified through discussions with appropriate personnel. (Reference: TSD Supplement, p. 6-3-5)

#### 6.2.1 Construct Frequency Distributions

Frequency distributions are used for organizing, summarizing, and displaying data. Constructed using simple counting, averaging, and graphing procedures, they show how often particular events have occurred. They are most appropriate as a first step in analyzing responses to surveys and trainee progress test results.

After all completed surveys are collected, responses are tabulated. Totals are entered into the corresponding spaces on a blank survey. (Reference: TSD Supplement, p. 6-3-9)

After the frequency distribution is recorded, the average (mean) response for each item should be calculated. In some cases, a bar chart may be developed. A bar chart presents survey information in a simple visual form; it highlights high and low values and permits easy comparison with acceptable performance standards or sets of previous data. A similar procedure can be used to display the distribution and average scores for a series of progress tests. (Reference: TSD Supplement, p. 6-3-13)

#### 6.2.2 Conduct Exception Analysis

Exception analysis is used for reviewing data to detect unacceptable variations from a predefined standard. The following steps are involved:

- o define a standard
- o determine actual performance or results
- o compare performance to the standard
- o investigate below-standard performance to determine cause(s)

Plant operating, maintenance, and industrial safety experience can be analyzed using this method. Increases in the frequency of accidents, injuries, personnel errors, rework or unscheduled maintenance, or increases in overtime above "normal" levels may signal the need to provide additional training or improve existing training. Acceptable levels for each of these parameters should be established as standards for comparison; when any observed value deviates from the standard, the cause should be investigated.

Feedback from employees, supervisors, and instructor/ trainee critiques also may be analyzed using this method, especially if surveys are used. High or low ratings, either in absolute terms or relative to ratings of previous groups, may indicate a training problem and should be investigated.

This method may be used to analyze results of trainee progress tests to identify subjects or topics that trainees may not be learning as well as they should.

#### 6.2.3 Perform Content Analysis

Content analysis depends primarily on the expertise and professional judgment of the individuals performing it. Data is evaluated subjectively to identify possible training problems requiring action. Content analysis can be used for essentially all types of information and may be used with exception analysis.

In analyzing interview responses, every answer should be examined. The following guidelines help interpret and apply interview data:

- o Look for agreement. If respondents provide the same or similar answers, these are more likely to be valid.

- o Do not disregard responses. Second-guessing employees, supervisors, or subject matter experts is ill-advised. If a response seems erroneous or exaggerated, follow it up with observations and additional discussion.
- o Focus the analysis on discovering specific tasks or subject areas in which training refinements seem necessary.

#### 6.2.4 Identify Root Causes

Analysis of a performance problem is not complete until the root cause is identified; only then can appropriate corrective action be determined. If the problem can be solved by training, changes or additions should be initiated. Both training personnel and personnel from plant functional departments should be involved in the identification of root causes and the determination of appropriate solutions. This process is similar to the needs analysis activities described in Section 2.

In identifying the root cause of a personnel performance problem, a general approach may be specified, but specific steps depend on the situation. In general, the following sequence should be followed:

- o identify specific symptoms of the problem clearly
- o list possible alternative causes of the problem
- o investigate each alternative cause until it is eliminated or confirmed

This sequence can best be illustrated with the following example:

- o problem symptoms
  - newly trained non-licensed operators are slow in completing some assigned tasks as compared to experienced non-licensed operators

- newly trained non-licensed operators require excessive instruction, supervision, and monitoring
- o alternative causes
  - lack of familiarity with proper procedures
  - lack of knowledge of systems
  - lack of knowledge of locations of equipment and local controls
- o investigation
  - interviews and discussions determined that newly trained operators' knowledge of procedures and systems is satisfactory
  - spot-check indicated lack of plant location familiarity, especially in the auxiliary building

The above example illustrates how identification of the root cause of a performance problem can make selection of the appropriate corrective action much easier. In this case, actual operation of auxiliary building equipment (under supervision), rather than just system training, should be required during on-the-job training. The investigation eliminated the possible need for expanded classroom training on systems and procedures.

In some situations in which individual tasks are not being performed properly, identification of root causes may be aided by the use of job performance measures produced during the design phase (as described in Section 3). When plant events or feedback from employees or their supervisors indicate that workers have difficulty with specific tasks, administering applicable JPMS to a group of workers may disclose the nature of the problem and its cause.



### 6.3 Initiate Corrective Action

When analysis results confirm program effectiveness, no corrective actions are needed. Analysis results should be retained to document evaluation activities, and indicators should continue to be monitored. However, if a performance discrepancy or potential problem is discovered and analysis confirms that training can contribute to a solution, action to correct or prevent the problem should be initiated. Training modifications initiated due to existing deficiencies in personnel performance and those resulting from changing needs should be processed in a similar manner.

Because of the amount of work and cost involved, the decision to modify training should be weighed carefully. Each utility should establish a procedure for deciding whether or not training should be changed and, if so, how it should be changed and to whom the new or modified training should be provided.

Improvements and changes to training should be initiated and tracked in a formal manner. One approach is to use the Training Development Recommendation form described in Section 2. It includes three parts. Part 1 is completed by the originator to define the problem clearly and to suggest a training solution. In parts 2 and 3, appropriate personnel review the recommendation and decide if the proposed change is necessary. The Training Development Recommendation form is completed when a training change appears necessary. It may be originated by training, operations, maintenance, engineering, technical support, or management personnel.

Depending on the training problem, the solution may involve performing activities or revising materials associated with any phase of the training process--analysis, design, development, or implementation. For example, addition of a new task, system, or piece of equipment to a person's job responsibilities would require analysis of the associated training need followed by design, development, and implementation of additional training. The new training would be provided to current job incumbents, as well as to future trainees. On the other

hand, a procedure change or system modification may require only minor changes to existing training materials and routing of new procedures to affected individuals. Some performance deficiencies can be eliminated by better implementation of an existing program, with no changes in the program itself.

#### 6.4 Summary

Evaluation consists of activities used to ensure the training system's capability to produce competent employees. It closes the loop among job and task analysis, training, and job performance. By monitoring key performance indicators, evaluation helps confirm program effectiveness, detect emerging deficiencies, initiate appropriate corrective actions, and maintain program quality. Without evaluation, a training system's effectiveness is very likely to decrease, and this decrease may go undetected.

Plant reports, reports from independent agencies, employees performing the job for which they were trained, and their supervisors are sources of data used to monitor plant-specific program performance. Industry sources provide a broader information base and can help alert training managers to potential problems or operational concerns. Activities of regulatory agencies can affect training and also are reviewed carefully for training consequences. When analysis of indicators suggests the need for revision, the root cause is identified, and appropriate corrective action is taken.

#### 6.5 Key Considerations

The following are key considerations that should be emphasized when performing and evaluating activities of the evaluation process:

- o Responsibility for monitoring indicators, analyzing data, and approving revisions is defined clearly.
- o The training department is alerted to plant operating, maintenance, and industrial safety experiences.
- o Communication on training effectiveness occurs between plant supervisors and the training department.

- o Employee opinion on the quality and effectiveness of training is collected periodically.
- o The training department is alerted to employee performance errors.
- o Meetings between training and maintenance supervisors/engineers are held to determine potential training problems.
- o Training uses plant inspection, evaluation, and accreditation reports to guide program revisions.
- o Plant modifications and procedure changes are monitored for training consequences.
- o Training monitors industry operating and maintenance experiences for program impacts.
- o Regulatory changes are reviewed for training consequences.
- o Program performance data is analyzed.
- o Proposed changes are reviewed for root causes by appropriate plant and training personnel.
- o Training changes are tracked.

Additional references on training system evaluation are provided.  
(Reference: TSD Supplement, p. 6-4-3)

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UNITED STATES  
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April 19, 1994

MEMORANDUM FOR: Darlene Huyer  
Anstec, Inc.

FROM: Tremaine Donnell, INPO Coordinator  
Records and Archives Services Section  
Information and Records Management Branch  
Office of Information Resources Management

SUBJECT: ESTABLISHMENT OF DATA RECORD FOR INPO  
DOCUMENTS

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