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Guidelines for Implementing a Training Review Process to Address Continuing Training Needs

Technical Report

Guidelines for Implementing a Training Review Process to Address Continuing Training Needs

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PRODUCT DESCRIPTION

This report discusses guidelines for implementing a review process to address continuing training needs. Continuing training is one component of a four-part strategy for maintaining a skilled work force in today's power plants. Uncertainty regarding what constitutes a continuing training program as well as how to design and implement such a program presents a challenge for many electric power producers in the United States and around the world.

Results and Findings

This report presents a review of systematic approaches to training, followed by a description of continuing training and information on selecting and evaluating continuing training topics, continuing training methods, and remedial training.

Challenges and Objectives

The electric power industry is continually changing. These changes include advancements in technology, increased intricacy in the regulatory environment, a reduction in projected work force, and increased attention to soft skills. Many of these changes dictate modifications to a company's or plant's training program, particularly in the category of continuing training.

Using background knowledge of systematic approaches to training program design, companies can use guidelines to update, enhance, or otherwise improve their plant continuing training programs.

Applications, Value, and Use

This report provides guidelines for addressing continuing training needs. Companies that incorporate these guidelines will avail themselves of the most systematic practices offered and used in the fossil power plant industry.

EPRI Perspective

EPRI is working with its members on a continuing basis to meet the needs of the industry. With this type of relationship, EPRI has the advantage of collecting information related to best practices, situations to avoid, and companies or organizations that can provide the most help in resolving continuing training program design and development issues.

Approach

This report supports the maintenance of a skilled work force by helping organizations to focus on continuing training. Many companies already have comprehensive initial training programs in place but may be uncertain how to implement or improve their continuing training programs. This report addresses the various types of continuing training and the methods employed in their creation.

Keywords
Continuous training
Simulator
Continuing training
Drills evaluation

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1
SYSTEMATIC APPROACHES TO TRAINING

Training has been defined as learning that is provided in order to improve performance on the present job.[1] An individual's job performance is improved by showing the person how to master a new or established technology. The technology may be a piece of plant equipment, a control system, or an operating procedure. This includes training new personnel to perform their jobs, introducing a new technology, or bringing an employee up to standards.

Designing and Developing a Training Program

There are several established methods by which a training program can be designed. Commonly used systems are performance-based training (PBT), training system development (TSD), instructional systems design (ISD), criterion-referenced instruction (CRI), and the system approach to training (SAT). All of these approaches have the following elements in common:

- **Basing on competency:** Trainees are required to master skills, knowledge, and attitudes. Training focuses on the job by requiring trainees to achieve criteria or standards necessary for correct task performance.
- **Sequencing:** Training is presented logically and sequentially, building upon previous training.
- **Tracking:** Tracking systems allow changes and updates to training and materials. This is especially germane to continuing training.
- **Evaluation:** Evaluation and corrective action allow for the continuous improvement and maintenance of the training program to reflect current status and conditions.

These systematic approaches to training program development provide a means for sound decision making to determine content of the training. The systematic approach is based on obtaining an overall view of the training process and is characterized by a structured process for gathering and analyzing job performance requirements. The application of a systematic approach to training ensures that training programs and materials are continually developed in an efficient and effective manner to keep up with the needs in the power plant and in the rapidly changing utility market.

This report section focuses on the ISD model. This model is interchangeable with the SAT model and consists of the following five elements: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. Figure 1-1 shows the ISD model pictorially.

[1] Leonard Nadler. *The Handbook of Human Resource Development* (glossary). New York: John Wiley & Sons, 1984.

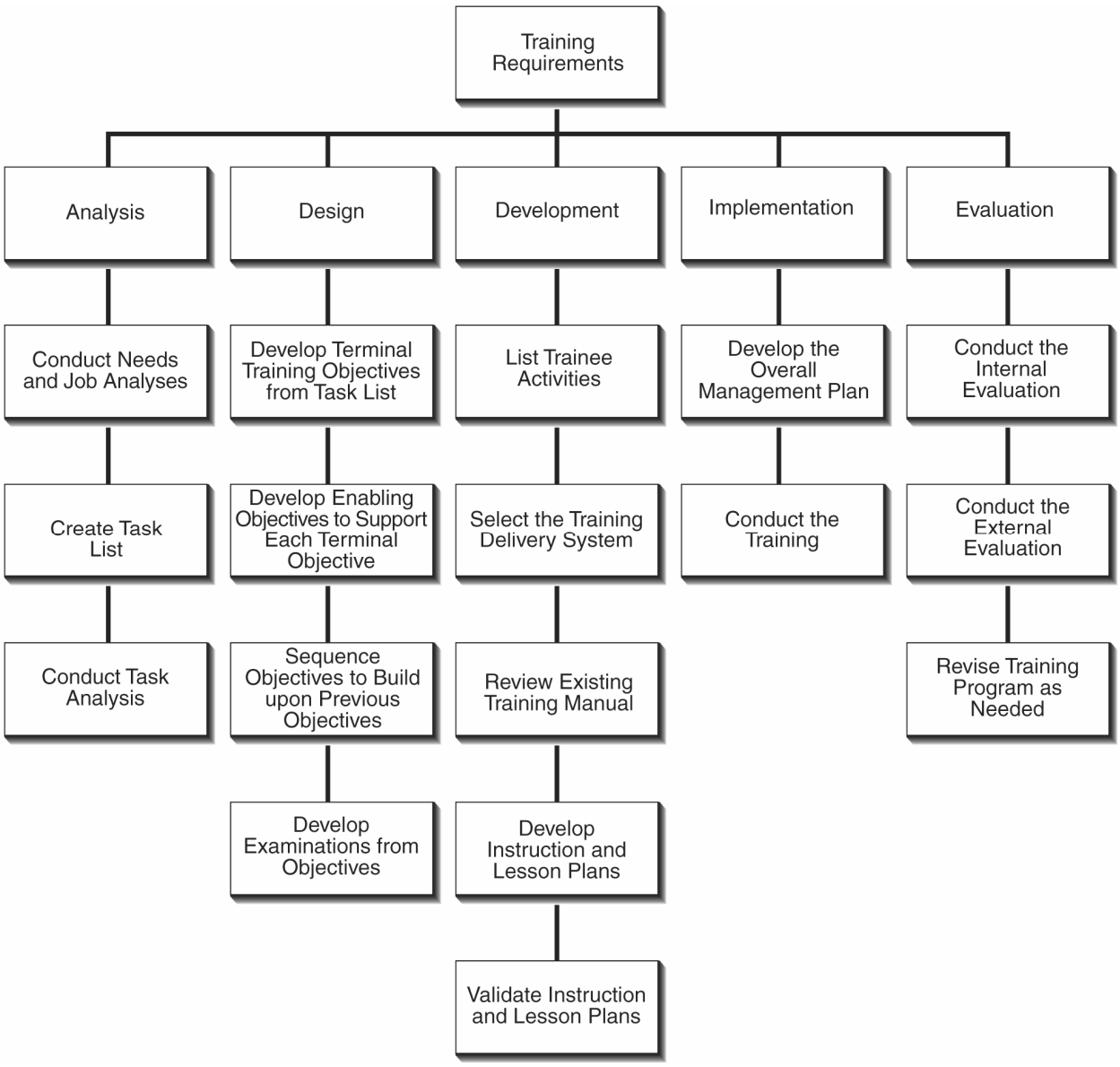


Figure 1-1
ISD Model Structure

Analysis Phase

The analysis phase provides the core information essential to establishing the job-related training program. Training needs are initially identified by reviewing applicable regulatory requirements and operator certification requirements. Initial and continuing training needs are established by conducting a needs analysis.

Needs Analysis

The needs analysis for technical training is conducted by determining discrepancies between actual and desired job performance and the factors that prevent desired performance. This analysis is conducted by reviewing occurrence reports, performance indicators, and written requests for training changes. Issues addressed are:

- Identification of performance deficiencies
- Employee capability of performing jobs
- Frequency of performing jobs
- Previous employee ability of performing jobs
- Adequacy of, or recent changes in, operating procedures
- How deficiencies are training related

The needs analysis also includes conducting interviews with subject matter experts (SMEs), supervisory personnel, and employees. Data collected from these interviews are used to determine training-related actions taken to minimize performance deficiencies.

Task List Development

A job analysis is then conducted to develop the detailed list of tasks for each of the operations positions. The generated list allows comparison of existing training programs to established requirements and facilitate the identification of discrepancies. In developing the task list, the following are reviewed:

- Standard operating procedures (SOPs)
- Station and departmental procedures
- Directives and practices
- Technical safety requirements
- Occurrence reports

Each job is broken down into duty areas that are part of the job responsibilities, and the task list is derived from these duty areas.

Task Analysis

Management, supervisory personnel, employees, and SMEs review the task list for accuracy and address the following concerns:

- Whether all tasks performed are included on the task list
- Whether task statements accurately describe the tasks
- Whether only tasks associated with the particular job are included on the list

Tasks are also validated by conducting an employee survey to determine the frequency, importance, and difficulty of each task. A commonly used tool is the difficulty-importance-frequency (DIF) decision tree shown in Figure 1-2.

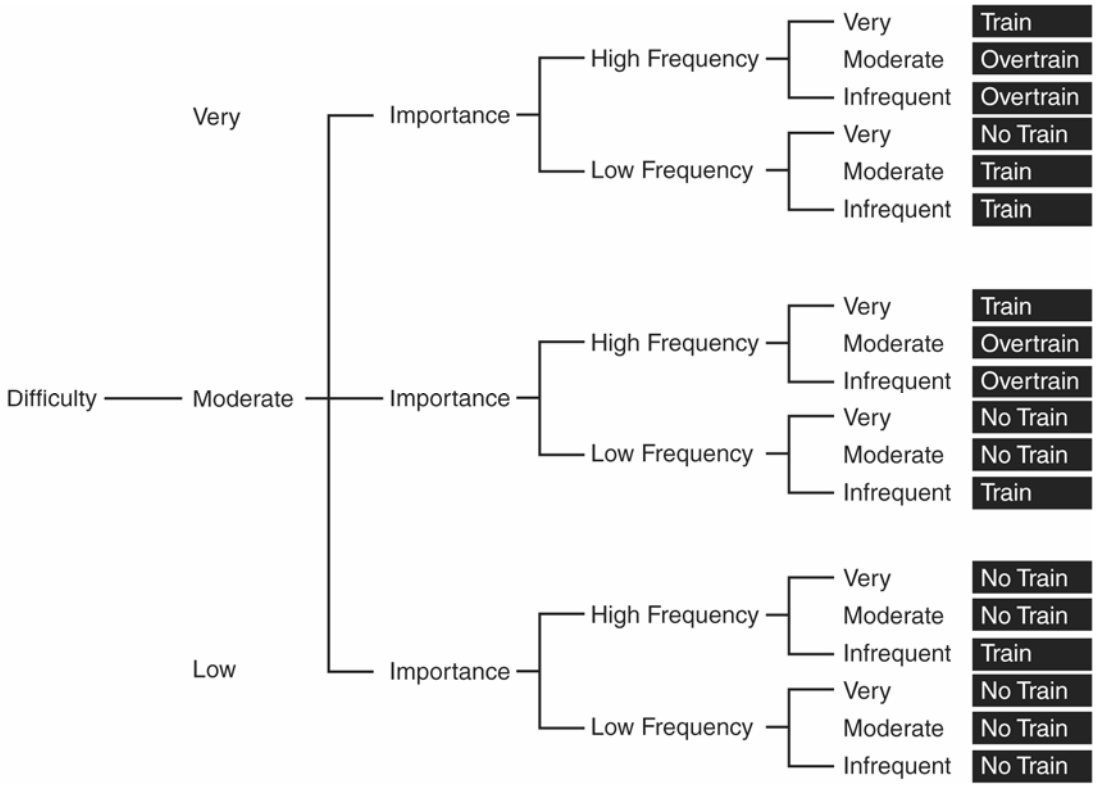


Figure 1-2
DIF Decision Tree

Each task is assigned one of the following ratings:

- "Train"—requires initial training
- "No train"—requires no formal training
- "Overtrain" also referred to as "retrain"—requires initial and continuing training (for example, qualification with a simulator, and subsequent periodic checks)

Preparation of the Formal Report

All data gathered, actions taken, and decisions made are summarized into a formal training analysis report.

Design Phase

Development of Terminal Objectives

The terminal objectives are the learning objectives that state the measurable performance that the employee will be able to demonstrate at the end of training. Developing these objectives is a process that takes into consideration conditions and standards of performance, translated directly from the task list. Each terminal objective is established considering which of the following training settings is necessary to accomplish the objective:

- Self-paced instruction
- On-the-job training
- Simulator
- Lab/workshop
- Classroom

All terminal objectives are classified according to complexity and sequenced so that each objective is based on the previous one. This determines the difficulty progression for the entire training program.

Development of Training/Evaluation Standards

Training/evaluation standards ensure that training materials that are developed and selected in the future will be directly linked to the terminal objectives. This provides the basis for the development of objective-based training materials. Each training/evaluation standard is linked to a specific job task or group of tasks identified and classified during the analysis phase. The training/evaluation standard contains two parts: training and evaluation. The training section is developed to contain the task title and number, terminal and enabling objectives, and applicable references. The evaluation section contains a performance test that includes prerequisites, conditions and standards, instructions to the trainee, and instructions to the instructor.

When developing the training/evaluation standards, a series of steps are followed, as detailed in the following discussion.

Determine Testing Limitations

This step involves reviewing the task and its terminal objective in order to determine potential testing constraints. Tests must reflect the terminal objective. The constraints include availability of time, limitations of the work force, and availability of resources.

Determine Elements of the Task to Be Tested

This step uses the results of the task analysis to determine what portions of the task will actually be tested. In this step, all elements of the task are listed, and the elements that include important decision points that can be used to measure successful performance of the task are listed.

Identify Knowledge, Skills, and Abilities

In this step, a list of knowledge, skills, and abilities is generated using the task elements that are subject to testing. The list includes entry-level requirements for new employees.

Write Enabling Objectives

Enabling objectives are learning objectives that support the terminal objective. These objectives are written using the Knowledge, Skills, and Abilities list. The enabling objectives are sequenced logically, from simple to complex, in a manner similar to the sequencing of terminal objectives.

Determine Scoring Methods

The scoring methods are documented in the form of a checklist that incorporates the action steps and elements of each task performance.

Development of Test Items

The training program test items track the learning objectives. During this phase, the SMEs determine the test formats, establish the number of test items to be developed, validate the content of test items, and incorporate test items into a bank for future use.

Creation of the Training Program Administrative Guide

The training program administrative guide is where the actual design comes together and is the management tool for the design and management of the plant training program. This guide addresses the following issues:

- Development of training material
- Review of training material
- Presentation and documentation of training material
- Selection of the plant training administrator

The training program administrative guide includes trainee evaluation guidelines, required instructor qualifications, required training resources and facilities, test administration guidelines, training record requirements, and course curriculum development guidelines.

Implementation Phase

During the implementation phase, the management plan for the training is created and the training is conducted. Training can be conducted in a variety of ways, including the following:

- Classroom training
- System walk-throughs
- Simulator training (initial and refresher)
- Self-study courses (workbook style or CD interactive)
- Drills and scenarios

Evaluation Phase

During this phase, the preceding phases (analysis, design, development, and implementation) are evaluated to determine whether the training program is accomplishing its objectives. External observations are performed to determine if the tasks that were presented during training are actually being performed better than before the training was conducted.

Advantages and Disadvantages of Systematic Approaches to Training

The ISD model, along with similar approaches, is a management tool that makes training material development and production more efficient. Training program effectiveness is more likely because the ISD and related models increase the probability that training material will match the required objectives. The systematic approach is scientific as well as empirical and can be replicated. Training materials can be improved through data collection and analysis.

The major disadvantage of the ISD model and similar models is that these models are often perceived as mechanistic and linear in their approach. This is a misconception, however, because these models are exploratory problem-solving techniques that use evaluation and feedback to improve performance. The models may be structured as shown in Figure 1-1, but the actual model dynamics, shown in Figure 1-3, reveal that these models are in fact not mechanistic or linear at all.

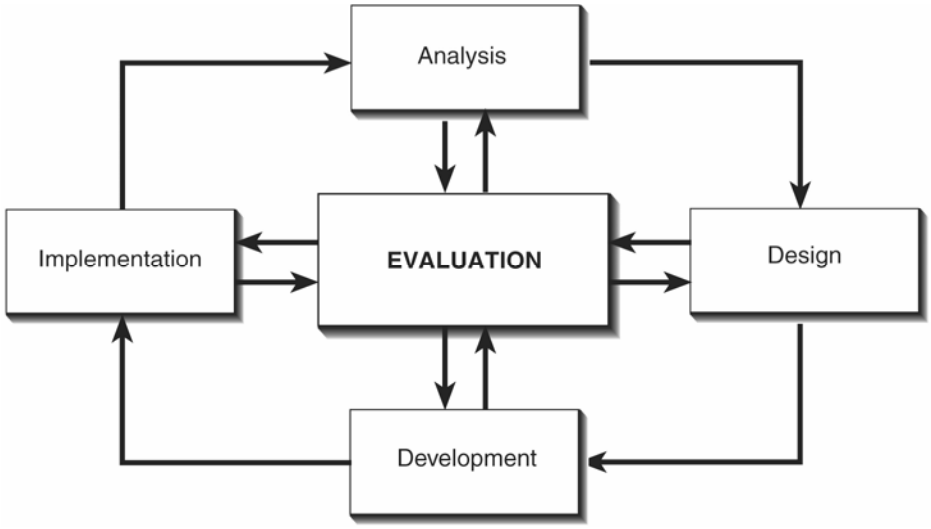


Figure 1-3
ISD Dynamics

2
OVERVIEW OF CONTINUING TRAINING

The Definition, Objectives, and Goals of Continuing Training

Continuing training can be defined as a post-qualification training program that is implemented in order to maintain a high level of operator performance. A continuing training program improves the knowledge and skills of personnel when changes in job scope are identified. A continuing training program also maintains the applied fundamentals knowledge of employees, with emphasis on areas of demonstrated weaknesses. Continuing training is a vital part of an overall strategy to recruit and maintain a skilled work force, as shown in Figure 2-1.

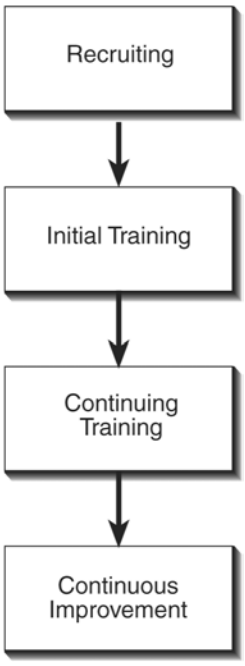


Figure 2-1
Continuing Training as Part of a Skilled Work Force Maintenance Strategy

The goals of continuing training are to maintain and enhance the ability of operators and maintenance personnel to perform job assignments while ensuring plant safety and reliability.

A continuing training program should be flexible enough to cover industry operating experiences, performance problems, retrofits, and changes in regulations and regulatory policies.

A plant can meet these needs by ensuring that continuing training satisfies the following objectives:

- Upgrade and maintain the skills and knowledge necessary for workers to perform routine and emergency duties
- Maintain employee awareness and understanding of the need for safe operation
- Stress the importance of "lessons learned" to personnel in order to prevent repetition of errors
- Correct performance deficiencies
- Evaluate individual and team performance in order to spot areas for improvement
- Train on equipment retrofit and regulation changes in a timely manner
- Maintain teamwork and diagnostic skills
- Maintain personnel professionalism
- Maintain excellence in operating practice

Types of Continuing Training

A continuing training program encompasses a variety of training types conducted at different intervals. Continuing training is divided into two major categories: fixed continuing training and flexible continuing training, as shown in Figure 2-2.

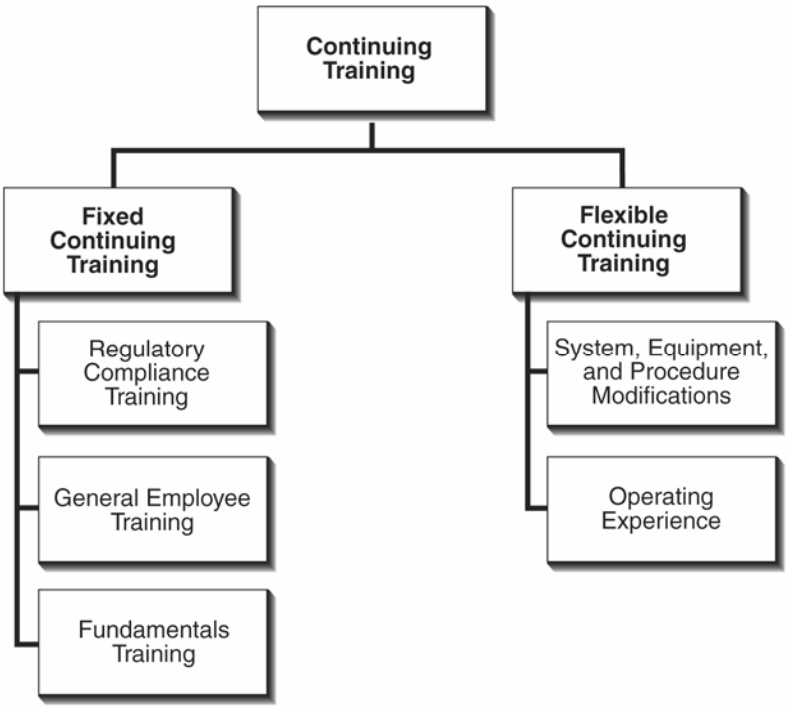


Figure 2-2
Fixed vs. Flexible Continuing Training

Fixed Continuing Training

Fixed continuing training addresses needs analysis results and job analysis results, and it includes regulatory compliance training, general employee training, and fundamentals training. Plant-specific job and needs analysis data provide the basis for determining the continuing training program content as well as the frequency at which the training should be covered.

Regulatory Compliance Training

Regulatory compliance training is considered to be fixed continuing training. Regulatory compliance training is the mandated training required by federal regulations such as the Occupational Safety and Health Act (OSHA). The plant training department should monitor federal regulations, special reports, and Federal Register notices for information and changes in requirements that influence training. Any changes should be incorporated into the fixed continuing training program.

General Employee Training

Modifications to general employee training should be part of a plant continuing training program. Exact repeats of general employee training are not necessary; rather, any changes that may have occurred in previously addressed topic areas of the initial general employee training program should be included in the continuing training program.

Fundamentals Training

Selected fundamentals and knowledge training is normally included in a plant continuing training program. Certain knowledge can be lacking when equipment is operated infrequently or when newly supplied equipment malfunctions. Because of this, instruction on selected fundamentals topics should be provided on a continuing basis. The fundamentals section of the continuing training program should be derived from training needs analysis data, performance deficiencies, and operating experience.

Flexible Continuing Training

The flexible continuing training program content is based on feedback from line supervision, training evaluation instruments, industry operating events, and changes to plant equipment, systems, and procedures. Flexible continuing training is offered in different settings, depending on the nature of the material being presented.

Topics that have an immediate impact on plant safety, availability, and reliability should be presented as soon as possible to plant personnel, with management endorsement. Likely settings for this are a shift supervisor's meeting or safety meeting. This training should be documented and attendance tracked to ensure that all pertinent individuals receive the information presented.

Plant System, Equipment, and Procedure Modifications

Information regarding plant modifications and procedure changes should be provided to the affected individuals as soon as possible. Changes to emergency procedures and safety-related systems must be reviewed before the individuals involved perform work that might be affected by the change.

Plant management and the plant training department should work together to determine which changes are to be covered as part of the flexible continuing training as well as to determine the appropriate setting. Shift supervisors should guide personnel in interpreting the germane aspects of plant equipment and procedure changes. This can be done as a preshift discussion or training session. Qualified guest lecturers such as managers or engineers are used to supplement the shift supervisors and instructors during these training sessions.

Operating Experience

The plant should incorporate operating experience into its continuing training program. One method is the case study, which can be presented in the classroom, as role play, or on the simulator.

A second approach is to provide raw data concerning an event to individuals or team members attending the continuing training. The individual or team will then analyze and present the information to the remainder of the audience.

A third approach is to provide each individual with a role to play during an event scenario conducted during the training session. After the scenario, the instructor and participants will critique how the roles played affected the results.

3
DESIGN AND EVALUATION OF CONTINUING TRAINING

Selection of Topics for Fixed Continuing Training

The evaluation and selection of fixed continuing training subject matter is accomplished in much the same manner as evaluation and selection of initial training matter.

If needs and task analyses have been conducted, the task difficulty, importance, and frequency of performance should be incorporated to determine the frequency and depth of training presentation. This is normally accomplished using the DIF decision tree presented in Section 1 of this report (reproduced here as Figure 3-1, for proximity of reference). Based on the outcome of decision tree iterations, tasks are rated as train, no train, or overtrain.

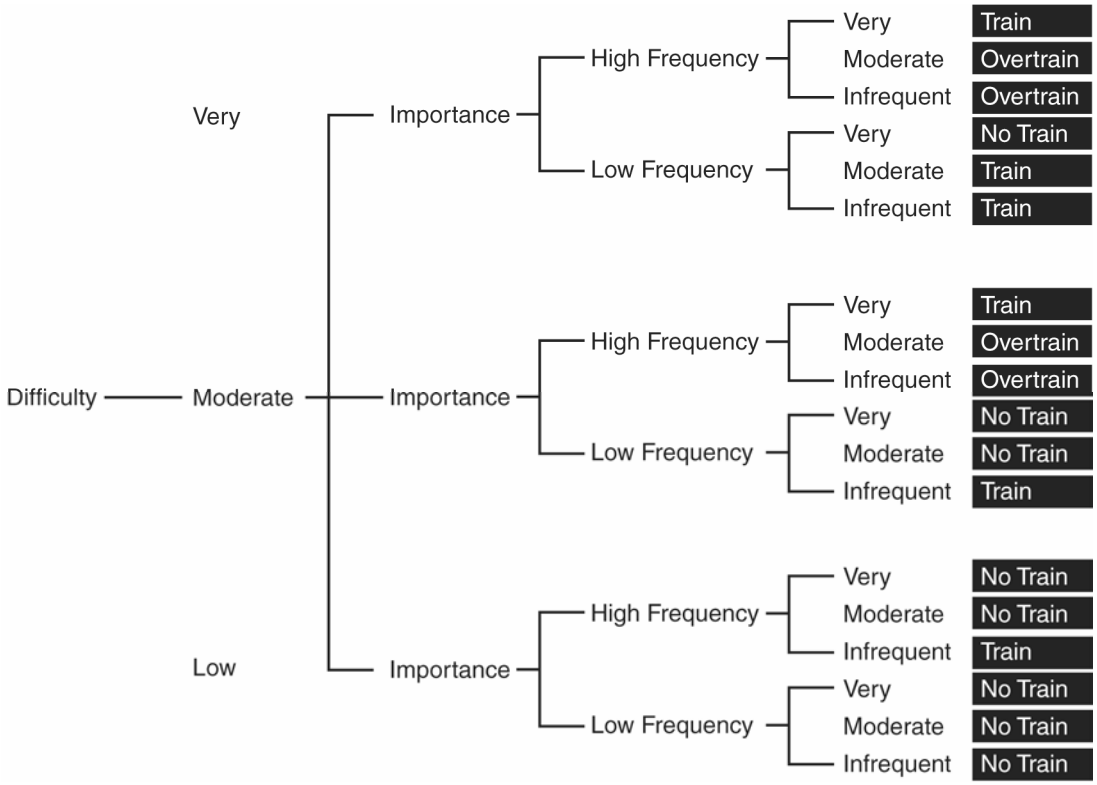


Figure 3-1
DIF Decision Tree

The assignment of train, no train, and overtrain ratings must always be validated by SMEs and plant management. All tasks performed by plant personnel should be included in the analysis. Tasks rated as overtrain tasks during the analysis process are those tasks that require both initial training and continuing training in order to maintain competency.

If few or no tasks are selected as overtrain tasks, the fixed portion of the continuing training program may be based primarily on regulatory training, general employee training, and fundamentals training as described in Section 2 of this report.

Table 3-1 illustrates examples of fixed training topics.

Table 3-1
Examples of Fixed Continuing Training Topics

Annual Training	
Training Motivators	**Examples and Settings**
Critical tasks	Abnormal operating conditions – simulator drill
	Emergency response – drill
	Fire brigade training – drill
	Lock-out/tag-out – performance test
Regulatory compliance training	HazCom training – classroom and written examination
	Safety training – classroom and written examination
	Material Safety Data Sheet (MSDS) training – classroom and written examination
	OSHA awareness – classroom and written examination
Biennial Training	
Training Motivators	**Examples and Settings**
Overtrain tasks	Medium- and high-voltage switchgear training – classroom, demonstration of technical competence, written examination
	System and unit startup/shutdown – simulator refresher training

Selection of Topics for Flexible Continuing Training

The nature of flexible continuing training is often dictated by operating experience, incidents, and lessons learned. These factors can be either positive (as in improvements in performing tasks) or negative (incidents leading to a death or injury, damage to equipment, or a unit trip). Most of the time, task analyses are not necessary because the objectives are determined by the nature of the motivator. Some examples of training motivators are listed in Table 3-2.

Table 3-2
Flexible Continuing Training Motivators and Examples

Training Motivators	Examples
Information gathered from continuing training program evaluation	Evaluation instruments (instructor, simulator, classroom evaluation from tabulated results)
Operating experience	Lessons learned
	Events, issues, and situations
	Equipment and procedure changes
Correction of performance deficiencies	Remedial training

If the flexible continuing training is to be conducted in response to equipment/system modifications or procedure changes, plant management should notify the training department of these changes as soon as possible so that the appropriate training can be prepared and implemented. Plant management should not wait until the completion of the modification before notifying the training department. Training should be completed by personnel before they use the system/equipment that has been modified.

If training is to be conducted in response to operating experience, the trainees should discuss the problem(s) and conduct a root cause analysis. Structured critiques of this communication should include problems observed, factors that affected the severity of the event, and the short- and long-term corrective actions to be taken in order to prevent recurrence.

Evaluation of Continuing Training

Continuing training evaluation determines the training's effectiveness in meeting its intended purpose. Evaluation is the quality assurance component to a systematic approach to a training program. This applies to fixed and flexible continuing training as well as initial training.

The first step in evaluating a facility's continuing training is to identify the questions to be answered by the evaluation. Should the continuing training program be modified? What performance gains are expected and realized? Is the need for continuing training being addressed in the best way possible? The purposes of the evaluation process include the following:

- To determine if the continuing training is accomplishing its objectives
- To identify strengths and weaknesses in a particular continuing training lesson
- To identify which trainees benefited the most or least from a continuing training lesson
- To determine if a continuing training course was appropriate for its intended purpose and target audience

Training evaluations are conducted in all training settings and at various times. There are four levels of evaluation:

- Level I – Reaction: Determines the trainees' opinion of the continuing training lesson
- Level II – Learning: Measures the achievement of the continuing training goals by the trainees
- Level III – Application: Determines if the trainees are using the new or modified skills on the job
- Level IV – Results: Measures whether training has a significant influence on plant operation

Levels I and II are primarily internal evaluations, which are the processes that collect data by reviewing course materials, trainee test and performance data, reactions to training, and instructor evaluations by the training staff.

Levels III and IV are external evaluations that focus on the impact that the continuing training has on the actual job. External evaluation is the process that collects data from previous trainees, supervisors, managers, and other outside sources that are beyond the actual boundary of the training program/department. An example of external evaluation is to directly observe the training graduate during actual job performance. This is the most direct approach to obtaining an answer to the question of whether the graduate can perform, on the job, the tasks that he or she was trained to perform.

Evaluation Instruments

Several training evaluation instruments are available that are useful in rating the effectiveness of continuing training. (The same instruments are used in the evaluation of initial training as well.)

Numerical Rating Scale

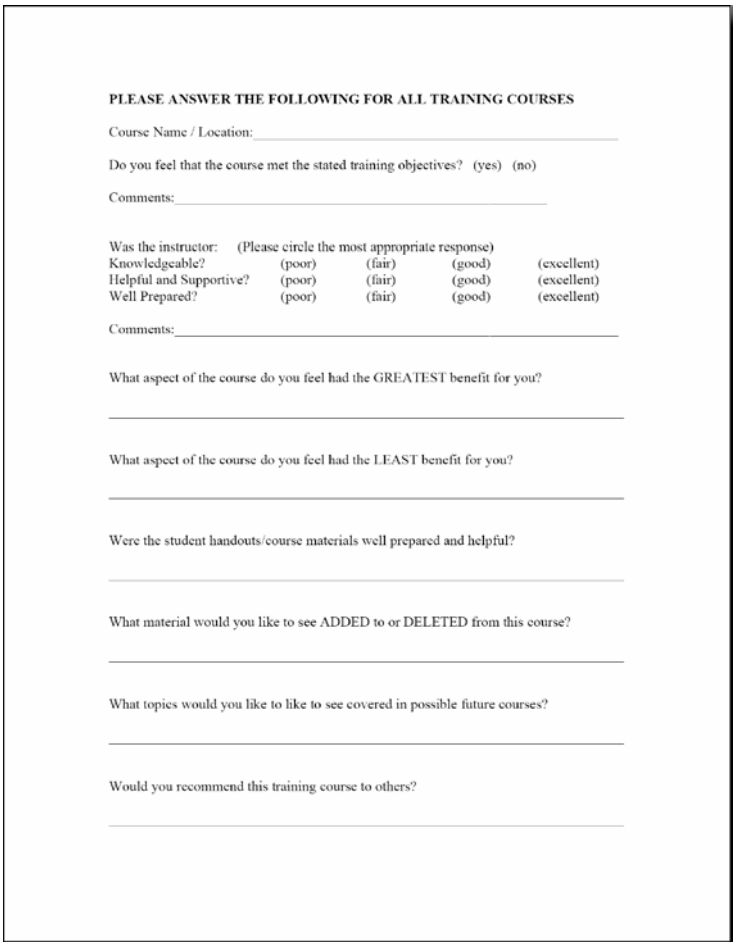
The numerical rating scale is used to evaluate a trainee's performance on a number of tasks, assess group interactions, evaluate instructor performance, or collect plant management feedback. The numerical scale format helps control the subjectivity of the evaluator and provides improved feedback over the simple "satisfactory/unsatisfactory" format. A well-designed numerical rating scale should do the following:

- Define the process or products to be evaluated
- Define the response scale
- Define each point on the response scale

The chosen rating scale should be used consistently for all continuing training and related activities.

Questionnaire

A questionnaire format (as shown in Figure 3-2) is normally used to obtain information, solicit opinions, and collect feedback regarding the training environment.



PLEASE ANSWER THE FOLLOWING FOR ALL TRAINING COURSES

Course Name / Location: _____

Do you feel that the course met the stated training objectives? (yes) (no)

Comments: _____

Was the instructor: (Please circle the most appropriate response)

Knowledgeable?	(poor)	(fair)	(good)	(excellent)
Helpful and Supportive?	(poor)	(fair)	(good)	(excellent)
Well Prepared?	(poor)	(fair)	(good)	(excellent)

Comments: _____

What aspect of the course do you feel had the GREATEST benefit for you?

_____

What aspect of the course do you feel had the LEAST benefit for you?

_____

Were the student handouts/course materials well prepared and helpful?

_____

What material would you like to see ADDED to or DELETED from this course?

_____

What topics would you like to like to see covered in possible future courses?

_____

Would you recommend this training course to others?

_____

Figure 3-2
Example Questionnaire Format

Questionnaires are very useful for collecting post-training feedback on continuing training program effectiveness.

Checklist

Checklists are used to assess a process to determine if the actions or results meet standards and objectives. A typical application of a checklist is to determine if job performance is satisfactory after continuing training has been conducted or if a classroom session was conducted properly.

Interview

Interviews permit an evaluator to clarify questions about a particular situation and to probe deeper into areas of interest or concern. The distinct disadvantage of the interview process is that it is labor-intensive. Personal interviews are often necessary when collecting feedback regarding the effectiveness of training.

Observation

Observation is by far the most effective when collecting trainee performance data three to six months following training. Task observation is time-consuming, and its effectiveness is dependent on when the task is performed and on the expertise of the observer. A task observation is most effective when accompanied by a checklist.

4
CONTINUING TRAINING METHODS

Skills Training

Continuing training is used to maintain operation and maintenance skills. For this to be effective, personnel should practice operations with the first-line supervisor leading the exercises. These skills training drills should be repeated until weaknesses are identified and corrected and competency is demonstrated. First-line supervisors should themselves engage in hands-on practice to maintain familiarity with operation and maintenance of the equipment.

Each facility should use its plant-specific task list, industry operating experience, in-house operating experience, and other forms of feedback to develop its own items to be included in the continuing training program. These lists should be based on analysis data and performance feedback from individuals during actual plant operation, simulator evaluations, system walk-throughs, and drill evaluations. If performance trends indicate that performance of a task or tasks is declining, the task should be covered in training more frequently. If performance trends do not indicate any performance issues associated with certain tasks, those tasks can be covered less frequently.

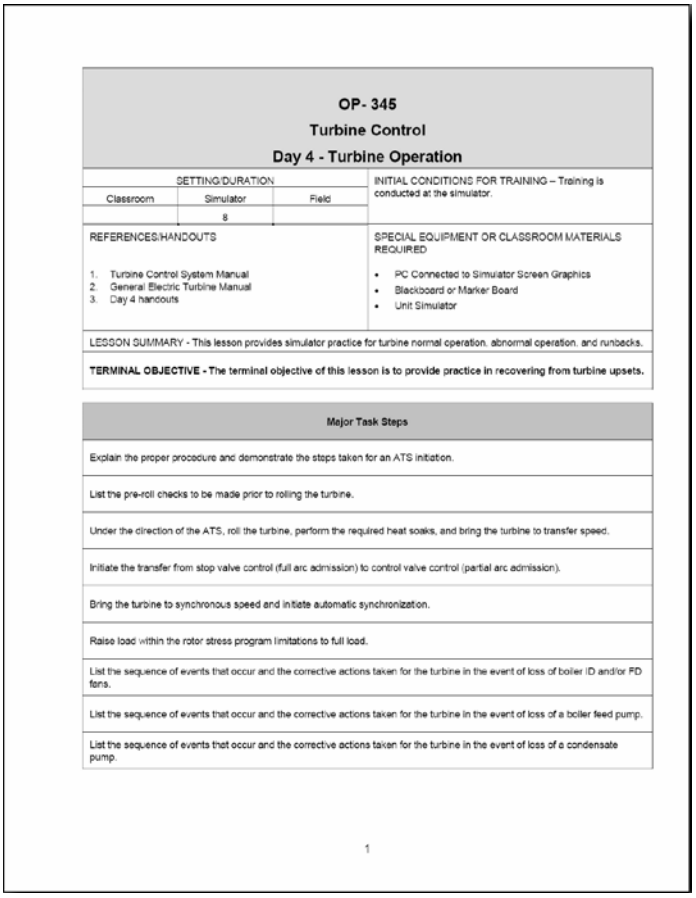
Simulator Exercises

Simulator exercises should address performance tasks identified for continuing training (that is, overtrain task items) at a frequency short enough to ensure that skills are maintained. The skills portion of continuing training should address the following areas of responsibility:

- Normal operation, including preventive actions
- Troubleshooting and response to abnormal operating conditions
- Troubleshooting and response to emergency conditions that could present a safety hazard

Simulator training must reflect the actual plant unit(s) as closely as possible. The simulator exercises can also be used to incorporate theory and fundamentals presented in classroom lecture sessions. Simulator exercises must also take into account facility and industry operating experiences, because they provide examples of initiating events, event sequences, and lessons learned. New exercises should be added periodically to present varying situations and to prevent the simulator scenarios from becoming “stale.”

Exercises involving abnormal and emergency conditions should address scenarios at various degrees of severity and complexity caused by equipment failure, instrumentation failure, or human error. Each exercise should contain no more than one major failure of a piece of equipment or plant system; however, the exercise can include more than one minor failure. Sufficient time must be allotted for each scenario to be handled. An example simulator exercise lesson plan that can be used for both initial and continuing training is shown in Figure 4-1.



OP- 345

Turbine Control

Day 4 - Turbine Operation

SETTING/DURATION			INITIAL CONDITIONS FOR TRAINING – Training is conducted at the simulator.
Classroom	Simulator	Field	
	8		

REFERENCES/HANDOUTS	SPECIAL EQUIPMENT OR CLASSROOM MATERIALS REQUIRED
1. Turbine Control System Manual 2. General Electric Turbine Manual 3. Day 4 handouts	• PC Connected to Simulator Screen Graphics • Blackboard or Marker Board • Unit Simulator

LESSON SUMMARY - This lesson provides simulator practice for turbine normal operation, abnormal operation, and runbacks.

TERMINAL OBJECTIVE - The terminal objective of this lesson is to provide practice in recovering from turbine upsets.

Major Task Steps
Explain the proper procedure and demonstrate the steps taken for an ATS initiation.
List the pre-roll checks to be made prior to rolling the turbine.
Under the direction of the ATS, roll the turbine, perform the required heat soaks, and bring the turbine to transfer speed.
Initiate the transfer from stop valve control (full arc admission) to control valve control (partial arc admission).
Bring the turbine to synchronous speed and initiate automatic synchronization.
Raise load within the rotor stress program limitations to full load.
List the sequence of events that occur and the corrective actions taken for the turbine in the event of loss of boiler ID and/or FD fans.
List the sequence of events that occur and the corrective actions taken for the turbine in the event of loss of a boiler feed pump.
List the sequence of events that occur and the corrective actions taken for the turbine in the event of loss of a condensate pump.

1

Figure 4-1
Example Simulator Exercise Lesson Plan

The simulator is an excellent training tool with which to conduct team training. The individuals who normally work together as a shift should make up the training teams. The exercises should provide opportunities for the teams to practice teamwork and troubleshooting under normal operating conditions and during abnormal operation and emergencies. A professional demeanor should be expected of the team during all training as well as during actual operation of the plant.

Drills

Drills provide a means of training in the response to conditions that cannot be covered adequately in the classroom or at the simulator. All plants should have a facility drill program as part of continuing training to address plant evacuation, equipment failure, fire-fighting responsibilities, and selected tasks performed outside the envelope of normal plant operation. Established criteria must be used to evaluate employee performance during all drills. Drills should involve the following activities:

- Reviewing the plant procedure steps
- Performing or simulating actions necessary to establish stable plant conditions
- Identifying equipment control locations and functions
- Identifying expected plant instrumentation and alarm responses
- Including maintenance personnel, operations support, and technical staff when possible
- Practicing the communications necessary to gather information and coordinate correct responses
- Simulating adverse plant environments (for example, no lighting or high noise levels)

Each drill must be carefully planned and monitored in order to be effective. A review of plant and industry operating experiences provides examples of initiating cues, event sequences, and lessons learned that can be used when developing the drill exercises. Each drill scenario should include:

- A list of objectives to be covered during the drill
- The authority of the evaluators
- Precautions, including conditions under which the drill will be stopped
- Reference materials
- Prerequisites for the drill initiation
- Narrative summary of the drill sequence
- Provisions for drill critiques
- Performance tests

Performance testing is used to evaluate employee proficiency in the performance of assigned drill tasks. Performance deficiencies identified in the critique should be reviewed by line management and the results provided to the employee in a confidential manner.

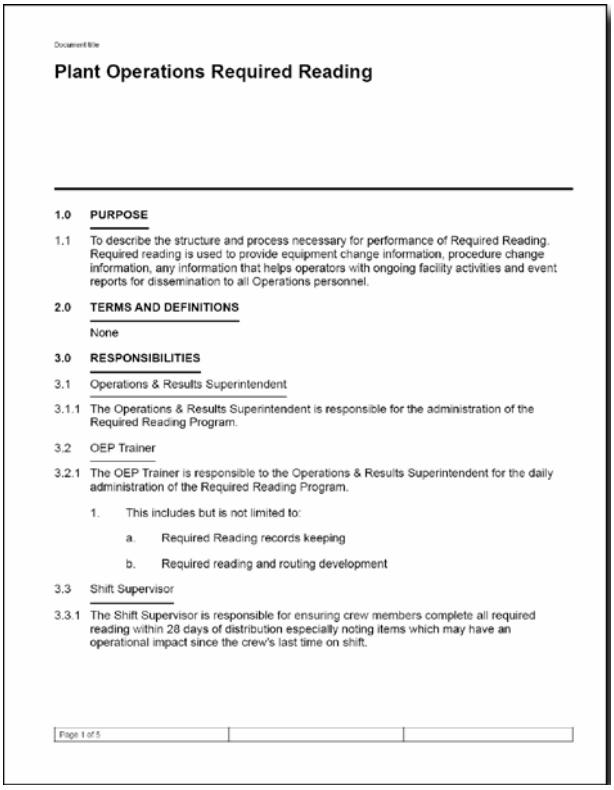
Lectures

Continuing training programs should include planned classroom lectures conducted on a regular basis. This training is used to correct identified weaknesses in fundamentals, to provide review of selected initial training material, or to introduce new material. Lectures should also refresh trainee knowledge of essential plant operating practice and discuss pending plant modifications and procedure changes.

Lecture topics are selected using a systematic training process with line management approval and should reinforce the simulator and hands-on portions of the continuing training program. The frequency of lecture topic presentation should be based on needs and task analysis data as well as the use of supporting fundamental knowledge.

Self-Study

Self-study periods should be scheduled with the lecture series to provide opportunities for studying new or additional material. Individualized study should be encouraged but not used as a substitute for lecture sessions conducted by an instructor. An example self-study administrative guide excerpt is shown in Figure 4-2.



Document title

Plant Operations Required Reading

1.0 PURPOSE

1.1 To describe the structure and process necessary for performance of Required Reading. Required reading is used to provide equipment change information, procedure change information, any information that helps operators with ongoing facility activities and event reports for dissemination to all Operations personnel.

2.0 TERMS AND DEFINITIONS

None

3.0 RESPONSIBILITIES

3.1 Operations & Results Superintendent

3.1.1 The Operations & Results Superintendent is responsible for the administration of the Required Reading Program.

3.2 OEP Trainer

3.2.1 The OEP Trainer is responsible to the Operations & Results Superintendent for the daily administration of the Required Reading Program.

1. This includes but is not limited to:

a. Required Reading records keeping

b. Required reading and routing development

3.3 Shift Supervisor

3.3.1 The Shift Supervisor is responsible for ensuring crew members complete all required reading within 28 days of distribution especially noting items which may have an operational impact since the crew's last time on shift.

Page 1 of 5

Figure 4-2
Required Reading Program Excerpt

5
REMEDIAL TRAINING

Identifying Human Performance Deficiencies

Most plant facilities have methods in place for identifying human performance deficiencies as a part of their incident investigation and reporting systems. In these cases, it is important to emphasize the proper identification of the incident root cause rather than assuming that the performance deficiency is a result of inadequate training. Human performance deficiencies can also be found by using methods such as supervisory observation or self-evaluation.

An important consideration in the identification of performance deficiencies is to anticipate barriers to achieving deficiency improvements and develop ways to mitigate these barriers. Human performance improvements are both those related to improving competencies and those related to developing new competencies. In either case, both training and non-training measures are implemented.

For all improvements associated with human performance, the systematic approach is to be used to analyze, design, develop, implement, and evaluate the necessary changes, including remedial training.

The Need for Remedial Training

Remedial training is part of a plant continuing training program and is provided to individuals for whom it is necessary to refresh and upgrade knowledge and skills related to their duties. Personnel having deficiencies in one or more of the following areas should be assigned to remedial training:

- Performance of duties identified by the line manager
- Performance test results
- Simulator performance
- Written test results
- Facility drill task performance

Individuals with significant deficiencies in important duties should be removed from duty until the associated remedial training has been successfully completed.

Remedial Training Content and Completion

The line manager should provide subject matter input to plant management and the plant training department based on a review of individual deficiencies and a root cause analysis of the deficiencies. The training department is responsible for designing and approving remedial training, with plant management approval.

Remedial training normally involves a variety of training methods, including skills training exercises involving actual plant equipment or the simulator. Remedial training may also include planned lectures, interviews, and directed self-study. The type of training used is dictated by the extent of training required and by individual performance.

Successful completion of remedial training is determined by testing. The test should cover all areas previously identified as deficient and may include an on-the-job observation, interview, oral examination, or written test. Performance standards for remedial training should be the same as those for original training.

6
RESOURCES

Maintaining a Skilled Workforce: Strategies and Implementation Plan. EPRI, Palo Alto, CA: 2004. 1008410.

United States Department of Energy Handbook. *Guide to Good Practices for Continuing Training*. October 1999.

United States Department of Energy Training Program Handbook. *A Systematic Approach to Training*. August 2004.

A
ADDITIONAL TOPICS RELATING TO CONTINUING TRAINING IMPLEMENTATION

Examples of Continuing Training

Business Training as Related to the Power Industry

Today's electricity market emphasizes the production of electrical power at the lowest possible cost. A significant portion of the responsibility involved lies in the hands of control room operators and even outside operators.

Lead operators, shift supervisors, and their organizations can benefit from applied business training that emphasizes the power plant as a profit center in addition to the manufacture of electricity. Included is training in "engineering economics" that presents the time value of money as it relates to operating and maintenance costs as well as decision analysis skills training and operations management training. For example, General Electric offers courses entitled *Utility Economics* and *Competitive Power Generation*.

Heat Rate and Efficiency Training

Heat rate and efficiency training goes hand in hand with the "power-plant-as-profit-center" approach. Control room operators can save their companies a considerable amount of money by knowing how to operate equipment at maximum possible efficiency and troubleshoot equipment that is not working properly.

An example curriculum for a heat rate/efficiency course might include the following topics:

- Review of Thermodynamic Terms
- Navigating the Steam Tables
- Introduction to the Station Heat Balance Diagram(s)
- Turbine Efficiency
- Pump Efficiency and Performance
- Feedwater Efficiency and Performance
- Condenser Efficiency and Performance
- Determining the Performance of Plant Steam Traps

- The Cost of Steam and Hot Water Leaks
- Boiler Efficiency Issues

Computer Training

Today's operators must be familiar with commonly used computer software such as the Microsoft Office suite of programs, AutoCAD, and Adobe Acrobat or Acrobat Reader. Training in the use of spreadsheets is especially valuable if it is used in conjunction with training in performance and heat rate calculations; in addition, spreadsheets often interface with the control room distributed control system (DCS).

Soft Skills for Lead Operators and Shift Supervisors

Knowledge is virtually useless without the accompanying people skills. Most companies already have programs in place that focus on these skills. The following abbreviated lists present some examples.

For Supervisors and Lead Personnel

- Establishing Performance Expectations
- Fostering Improvement and Innovations
- Giving Constructive Feedback
- Recognizing Positive Results
- Developing Job Skills

For All Personnel

- Stress Management
- Positive Responses to Negative Situations
- Getting Your Point Across
- Personal Development
- Progressive Diversity
- Mastering Change
- Creativity on the Job

Equipment Retrofit Training

All power plant facilities have added to or improved upon their environmental control systems. In addition, many older plants are undergoing major modifications and retrofits in lieu of new plants being built.

Often, original equipment manufacturers (OEMs) such as ALSTOM Power provide classroom training as part of the new equipment purchase package. If the OEM does not normally provide training as part of the purchase price, it should be negotiated by plant management.

It is very important for plant management, engineers, supervisors, and lead personnel to understand how the retrofitted equipment might affect the operation of preexisting equipment. Therefore, comprehensive training for personnel at these levels must take into consideration the full scope of the systems targeted by the training.

Shift Mentoring

Shift mentoring is exactly what the term implies. A shift mentoring session involves a mentor (senior operator, supervisor, or consultant) who acts as a coach for one or more control room operators or control room operator candidates. Shift mentoring differs from simulator training because, with the former, the trainee is operating live equipment.

If the mentor is a plant employee, he or she must demonstrate qualification by having successfully completed all initial training in a timely manner. If the mentor is an outside consultant, it is **imperative** that this person has a background in operations, including time spent as a control room operator.

Cross Training

Cross training is intended to assist the plant management in providing multiskilled personnel to perform the variety of tasks necessary for efficient operation of their plant.

The cross training program is **not** established to make an employee in one department into an expert in any additional department but will make the employee more knowledgeable in all areas of power production, therefore making the employee more versatile.

The cross training curriculum and courses can be developed in-house, developed by an outside consultant, or purchased from a commercial training vendor. Figure A-1 illustrates a program structure for cross training developed in-house.

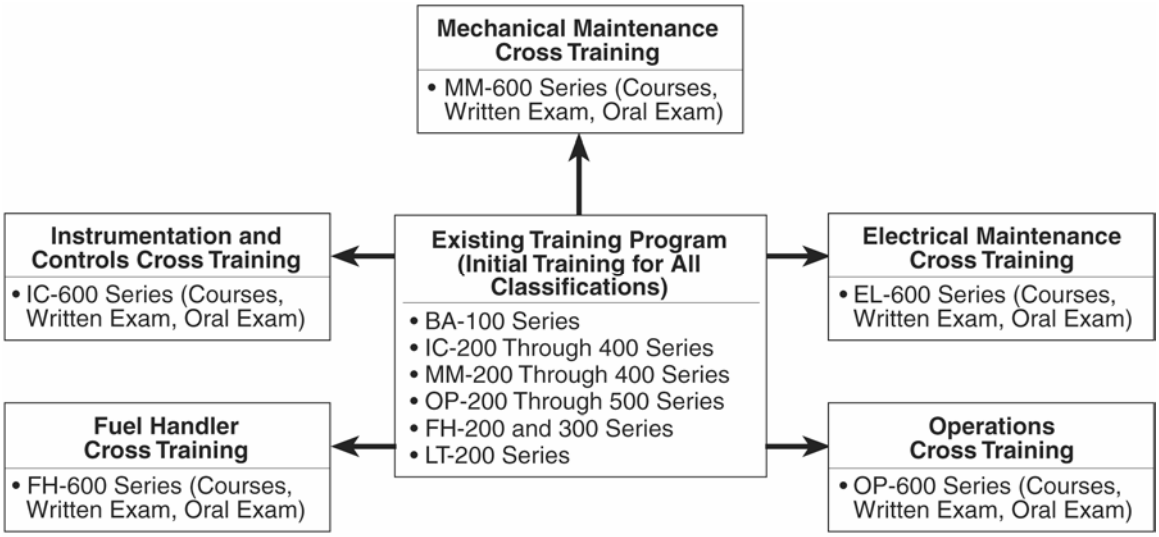


Figure A-1
Cross Training Structure Developed In-House

Example

In the cross training program of one large independent power producer (IPP), each employee receives a training logbook. The first half of the book documents all required promotional training for the individual (check-offs, written examinations, oral examinations, on-the-job-training [OJT] qualification, and simulator qualification). The organization's training coordinator records all scores and dates to keep each employee's logbook current. All initial training is also recorded and initialed by the training coordinator.

The second half of the training logbook has all of the cross training lessons along with the practical applications. In this example, the company chose to purchase Web-based lessons.

At each plant location, each department (operations, mechanical maintenance, electrical, and instrumentation) appoints an expert assigned for each specific subject, whether it is a system check-off or a practical skill. This expert is responsible for ensuring that the employee has exhibited adequate knowledge and skills prior to signing and entering the date completed in the check-off logbook.

The employee wishing to be checked off in an area is responsible for contacting the expert, scheduling a mutually agreeable time to perform the check-off, and bringing the check-off logbook to the appointment.

Continuing Training Involving the Simulator

Refresher Training

Simulator refresher training involves one-on-one requalification of incumbent control room operators. Included in this type of training is instruction in "best operating practice."

Team Training

The simulator can be a valuable tool for teamwork training. In this type of training, an entire shift of personnel responds to various normal and abnormal operating scenarios.

There is no instructor per se in team training; however, there is an experienced person who oversees the training. Often, this person is an outside consultant who specializes in both technical and nontechnical team training. This person can facilitate the training and advise on group dynamics issues. In addition, a subject matter expert may also be present.

Remedial Training

Specific remedial training for personnel may be required in order to refresh and upgrade knowledge and skills related to their job duties and responsibilities. Remedial training is often given when an employee fails to pass an examination or OJT qualification set.

Operator Certification

Jurisdictional

Many jurisdictions require outside operator certification for persons who operate boilers (including those at utility and large industrial power plants). These certification programs are usually developed by the individual jurisdictions (for example, the state of Ohio or the commonwealth of Massachusetts), or a jurisdiction can incorporate a certification program that has already been developed, such as the American Society of Mechanical Engineers (ASME) QFO and QRO certification programs.[2]

Company Policy

Many power generation organizations have operator certification requirements as mandatory company policy, or an individual plant manager may require certification for plant employees.

[2] QFO refers to the Standard for the Qualification of High Capacity Fossil Fuel Fired Plant Operators; QRO refers to the Standard for the Qualification of Municipal Waste Facility Operators.

Voluntary

Often, self-motivated individuals will obtain operator certification on their own. This should be encouraged, with monetary reimbursement offered by the organization as incentive.

Training

There are many operator certification training programs that have been developed by consultants. Also, an experienced plant employee who has obtained certification previously can develop a review course in-house. In either case, operator certification review training should be part of a plant's continuing training program.

Motivation

Incentive to pursue continuing training can be a major issue. The following paragraphs explore some of the methods used to encourage participation in continuing training.

Mandatory Status

This is a self-explanatory "no-brainer." The easiest way to foster continuing training motivation is to make the training a condition of employment. The advantage of this approach is its simplicity of implementation. The major disadvantage is the possibility of compromising employee morale.

Succession Planning

Continuing training is often used as part of succession planning when an individual is being groomed for a promotion to a higher position. In this instance, continued training is offered to elite personnel. This is normally management and supervisory training.

Incentives and Bonuses

One IPP uses continuing training as part of an incentive program. In this instance, an exemplary employee who has completed all initial training for his or her job classification receives a 4% raise. If this employee completes cross training, he or she is eligible for an additional 1% raise.

Many companies use voluntary completion of continuing training courses as contributing factors in bonuses paid over and above annual raises.

Step-Up

Companies will sometimes allow an employee to step up to the next job classification (with an accompanying hourly pay increase) if he or she has completed prescribed continuing training courses or completes initial training for the next step.

Self-Motivation

There are many operators who are proud of their profession and will complete as many continuing training courses as permitted. Such individuals should be encouraged by monetary compensation for training time, tuition reimbursement, recognition lunches or dinners, and certificates of completion.

Motivation Matrix

Table A-1 presents a suggested cross-reference between the types of continuing training offered and the motivation types.

Table A-1
Continuing Training Matrix

		Motivation				
		Mandatory	**Succession Planning**	**Incentives and Bonuses**	**Step-Up**	**Self Motivation**
Continuing Training Type	Business training		X			X
	Heat rate and efficiency training	X		X		X
	Computer training		X			X
	Soft skills		X			X
	Equipment retrofit training	X				X
	Shift mentoring	X			X	X
	Cross training	X		X	X	X
	Simulator refresher training	X				
	Simulator teamwork training	X		X		
	Remedial training	X				
	Operator certification	X		X	X	X

A Caveat

Continuing training in today's power industry is a must. However, continuing training **must** be germane to an employee's job duties as well as his or her job duties in the next step in order to promote motivation and interest in the material presented.

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