EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Computer-Based Training Course on the Maintenance Excellence Matrix

1010268

Computer-Based Training Course on the Maintenance Excellence Matrix

1010268

Technical Update, December 2005

EPRI Project Manager

Ray Chambers

ELECTRIC POWER RESEARCH INSTITUTE
3420 Hillview Avenue, Palo Alto, California 94304-1395 ▪ PO Box 10412, Palo Alto, California 94303-0813 ▪ USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

ORGANIZATION(S) THAT PREPARED THIS DOCUMENT

Electric Power Research Institute (EPRI)

This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.

NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

CITATIONS

This document was prepared by

Electric Power Research Institute (EPRI)
1300 W. WT Harris Blvd.
Charlotte, NC 28221

Principal Investigator
R. Chambers

Handshaw, Inc.
9625 Research Drive
Charlotte, NC 28262

Principal Investigator
D. Handshaw

This document describes research sponsored by the Electric Power Research Institute (EPRI).

This publication is a corporate document that should be cited in the literature in the following manner:

Computer-Based Training Course on the Maintenance Excellence Matrix. EPRI, Palo Alto, CA: 2005. 1010268.

REPORT SUMMARY

This Report is a status of the continuing research work and plans that will develop a training course from information developed in a previous EPRI Maintenance Management & Technology Program, MM&T, guidelines. The intent will be to assist the EPRI member Generating Stations with improving their own maintenance assessment processes by training on the activities that contribute to a well developed and organized assessment team that will focus on the Maintenance Excellence Matrix as a source material guide. This training then becomes the tool that is used periodically to train a Self-Assessment team capable of evaluating an existing maintenance program. The Maintenance Excellence Matrix is directed toward how a particular utility or plant measures up to what is defined as 'Standard Best Practices', and what needs to be done to improve in areas of identified weaknesses.

This report provides details on how EPRI will use an effective approach to develop the course content and delivery at the desired level of detail, and graphically depict how the process should work to allow for communicating the performance and strategic decision making for assessing maintenance programs. This report also provides the strategy on how the course material will utilize the specific maintenance elements of the EPRI Maintenance Excellence Matrix to allow the EPRI members to effectively use the information to assist with their targeted improvement areas.

The business environment that has prevailed in recent years in the power generation industry has been to improve plant reliability, and availability, and to accomplish this with the same or reduced resources. One of the ways that EPRI has helped the member utilities meet these demands is through improved maintenance process applications and procedures. These maintenance improvement programs started with the development of advanced monitoring and diagnostic instrumentation, then progressed to implementing thorough Predictive Maintenance Programs, and finally to the overall optimization of the maintenance program. The first step in initiating these program improvements has been to assess the current state against a standard set of performance objectives then through a gap analysis, target areas of improvement.

Numerous technical reports have been developed since the early 1990s that contain valuable information to support improvements of the various elements and sub-elements that make up the 'Business of Maintenance.' Over 100 technical reports were reviewed and referenced specifically in this Maintenance Excellence document to the specific elements of maintenance to which they pertain. As a result, EPRI members should be able to use this document, develop an assessment of each element and sub-element of maintenance, and easily reference the library of EPRI information to support targeted improvements of their performance of maintenance. However, many have seen it as complex and have indicated that results can be inconsistent. Therefore EPRI proposed to provide a training package that would help the users to understand and consistently implement the assessments.

Objectives

The objectives of this product will be to create a self-paced training tool by which the stations can train their assessors to fully understand the Matrix, the assessment process, and provide consistent results. They will be able to take advantage of all of the experience and expertise acquired through the years by EPRI in the development of maintenance tools, technical reports, and training to train and organize their assessment teams. The activities required to improve maintenance effectiveness are many and varied. Periodic assessments of the maintenance program provide the continuous improvement target projects to ensure they are appropriately focused and add value. The planned training tool will not only accumulate the best examples of a well-run maintenance program; but, it also provides training on the performance-base techniques necessary to make a self-assessment of the programs effectiveness, and point out clearly where improvements can be made for benefit.

Approach

In order to arrive at a comprehensive training module that includes the knowledge gathered regarding maintenance issues, practices, and concerns, background information was gleaned from the numerous maintenance improvement related Reports and Guidelines generated by the EPRI MM&T Program under EPRI-funded research projects over many years. Inputs were also obtained from Nuclear Maintenance

organizations such as INPO and NRC documents and other Industries experiences and documents that address maintenance processes, practices, and improvements that can be used as the content for high quality training. It was felt that the preparation of a beneficial Self-assessment and Maintenance Optimization training course could only be achieved by providing detailed information on all aspects of the maintenance process from many directions and viewpoints. This computer based course will reflect these efforts.

Utility Perspective

The preparation of reliable maintenance improvement information represents a significant advantage in the competitive market that the power industry has been facing in recent years. The EPRI member utilities have implemented many of the maintenance hardware tools and condition monitoring and predictive maintenance programs that have been developed; and, as a result, have realized substantial benefits. However, the goals leading to maintenance optimization and improved maintenance effectiveness have not been met in all cases. This computer based training module will not only contribute substantially to the identification of the areas that need improvement to achieve those 'Best Practices' goals; but, the use of performance based assessment techniques can be used as part of continuous improvement efforts that are needed achieve high performance maintenance organizations and to maintain future competitive positions. Performance based assessments focused on the results of actions supporting best practices instead of just auditing to determine the existence of a process (which may or may not be contributing value.) Realizing that resources are limited and overly taxed in many cases, the utilities have the option of enlisting the support of EPRI, or even outside Contractors, to assist plant personnel in the Self-assessment and Optimization processes through the use of this training module.

EPRI Perspective

This project is part of EPRI's development efforts under the Maintenance Management & Technology Program, number 69 in 2005 and completing in 2006. MM&T's mission is to lead the industry by developing and demonstrating products and services that will improve use of power plant maintenance resources and increase profitability for generation businesses.

CONTENTS

1
INTRODUCTION

1.1 Background

EPRI has been working with the utility industry for a number of years in the development and implementation of advanced maintenance processes and technologies; and, has also been working with the participating utilities in the assessment of their current maintenance program. These efforts included developing the means to assess the progress of key aspects of the maintenance program to determine their status compared to the highest industry standards. The focus of all of these activities has been to improve maintenance effectiveness.

This Computer Based Training tool will provide the consistent understanding of how to quickly and effectively implement the use of the Maintenance Excellence Matrix developed in 2002. In addition to EPRI's expertise and experience, EPRI realizes that there are other organizations that have similar expertise and experience. Therefore, this training tool also captures the experience of other industry organizations, INPO, NEI, and utility expertise in the techniques trained up.

The training module uses comprehensive information gathered to date and organized through the 'Maintenance Excellence Matrix', which identifies and defines all categories, elements, and sub-elements of maintenance to allow the EPRI members to effectively assess maintenance and strategically and effectively target needed improvements.

The extensive work performed through the EPRI MM&T Program over the past decade, and the work of nuclear organizations in parallel efforts regarding maintenance assessment, performance monitoring and maintenance optimization has shown there are techniques capable of measuring program performance. The knowledge and lessons learned are extensive however the matrix development has been no easy means for a fossil generating organization to integrate into a single comprehensive approach that allows for effective self-assessments and targeted maintenance improvements.

Utility insurers reinforce the importance of good maintenance programs through credits available to plants that substantially reduce insurance premiums based on the presence of specific maintenance program elements applied to critical components and systems at the plant. Accessing these credits requires having strong self assessment programs performing effectively. Training the staff and other assessment team members will be critical to achieving the credits.

This computer based course will provide the insight to the performance objectives and the elements' criteria to enable the assessors to observe and validate the performance of the site staff in the following areas;

- The Management Team's support of the program and the Work Culture promoted within the organization
- The Maintenance Process

- The Maintenance Staff and Craft's utilization and skills, including the human performance of the staff and Craft
- The Technologies which are necessary to assure an efficient use of the processes and to determine the condition of the equipment

These comprise the four major categories of Maintenance.

This course is intended for use by the utility to assist them in developing effective self assessment teams who will conduct self-evaluations of their maintenance program and subsequently more effectively help develop a strategy targeting improvements. However, if the utility wants support from subject matter experts, this document could be used to train a contractor or EPRI service support personnel to facilitate the assessment process.

As a result of these efforts, this computer based training will be prepared to present a process that can be applied when performing Self-Assessments and developing improvement plans that will make the plant's maintenance practices even more effective.

1.2 Document Approach

This document is divided into the following five Sections.

- Section 1 covers the background need for the training module and the benefits of using it.
- Section 2 addresses the method of determining the expected audience profile so that the level of detail is appropriate.
- Section 3 outlines the development of the task analysis of a typical maintenance assessment using the Maintenance Excellence Matrix to ensure the course is designed to deliver the content needed.
- Section 4 discusses how the academic approach (or systematic approach) to training will be used to provide a high quality and engaging course.

2
AUDIENCE ANALYSIS

The Audience Analysis identifies the audience for the training along with their general characteristics and entry behaviors. Major expectations from the Analysis will include the following:

- The range of job roles is represented within the audience with the primary target audience comprised of Maintenance Management and Technical Staff. The CBT will provide a general overview of the Maintenance Guidelines and Matrix, along with a description of the self-audit process. Precautions will be taken when making assumptions regarding prerequisite knowledge.
- The education level of Maintenance Management and Technical Staff will be assessed and the CBT should follow the technical writing standard for high school graduates of an 8th grade reading level. However, it will avoid oversimplifying in a way that will alienate the more highly educated audience members.
- Most audience members may have prior experience with CD-based or online training; however, a short introduction is planned. Audience members should be experienced with computers and the internet. The CBT could provide an optional introductory lesson on how to take web-based training if the audience analysis indicates a need, but will assume comfort with browser interfaces as an entry behavior.
- There will be an assumption the audience members are employees of a variety of utilities with company-specific processes and procedures. The CBT will avoid using language that is specific to any one utility.
- Previous audience analysis has indicated that members expressed a preference for instructor-led training and coaching. The CBT will address audience members in the second person singular ("you") to simulate the personal touch provided by an instructor. The CBT should also provide tools such as a glossary, references, and FAQs to provide answers to questions a learner might develop during the course.

The Audience Analysis is a key component of the Analysis phase of the course. The Audience Analysis typically includes a questionnaire that seeks answers to the following types of questions:

- What is your level of schooling?
- How long have you worked in your present position?
- Have you taken any training, specifically computer-based training (CBT) or web-based training (WBT)?

In the Audience Analysis, EPRI describes both the general characteristics and entry behaviors of the audience.

General characteristics describe the audience in demographic terms, such as age, gender, education, and attitude. EPRI makes decisions about both writing style and instructional strategies based on these characteristics.

Entry behaviors describe skills learners possess prior to training. This information is vital for the development of truly individualized, self-paced instruction.

The questionnaire is typically comprised of 20 or more questions. The results will be compiled to reflect the composite audience, and a summary of responses and implications will be documented as a part of the background information on the course.

3
TASK ANALYSIS

The Task Analysis is an examination of the knowledge, skills, and attitudes taught in the web-based training program. The task analysis is based on the instructional goal of the course and attempts to capture enough information about the content to allow the designers of the course to develop an effective approach to the training. We gather additional details during the actual writing of the training materials throughout the development stage. The Task Analysis was used to derive the Performance Objectives of the course.

Performance Objectives establish the criteria for testing mastery of the information contained in the training and set the requirements for performance.

The Instructional Goal for this one-hour web-based course is:

The performer will be able to use the Maintenance Excellence Matrix as a guide to perform an assessment of a plant's Maintenance Program, design an implementation plan to address any deficiencies identified, and provide for a continually improving Maintenance Program.

Learners will demonstrate achievement of this goal by meeting the terminal objectives such as:

1. Given the need for a quality maintenance program, learners will perform a performance based assessment of the current program.
2. Given the need to identify the assessment performance objectives and criteria, learners will select the relevant criteria from the key elements of the matrix.
3. Given the need for a quality program, learners will develop an implementation plan.
4. Given the need for a quality maintenance program, learners will conduct follow-up assessments after the implementation plan is executed.

Enabling objectives are the sub-steps in accomplishing the terminal objectives. These enabling objectives outline specific performances that would enable a learner to reach the terminal objectives and course goal.

4

ACADEMIC APPROACH TO TRAINING ON MAINTENANCE EXCELLENCE MATRIX

Overall the course development will follow the classical approach on training development, delivery, and feedback. The nuclear industry addresses this as the Systematic Approach to Training or SAT, where most educational program addresses it as the Academic Approach to Training. Both are using the same process and practices. The process method follows these techniques;

- Assess the needs of the audience from the *prior to trained state* to the *trained and qualified state* which would include the average entry level knowledge expected of the learner.
- Design a course design that will engage the interest of the learner to transfer the desired knowledge.
- Develop the course content to be consistent with the design. The content requires that real information be obtained through Technical Advisory Groups, TAGs, to ensure realistic information is provided. Additionally, testing of the course can be easily addressed through the TAG.
- Integration of the course into industry use through distribution to members
- Evaluation and feedback of the course's functional capabilities to transfer the desire knowledge.

5
INSTRUCTIONAL STRATEGY

5.1 Instructional Media

The course will be approximately one-hour developed using the Learning Content Management System, LCMS, platform and the EPRI standard template used in previous MM&T sponsored CBTs. A web-based course allows standardized content to be delivered cost effectively to a geographically dispersed audience. It also allows students to take the course on a schedule that is most appropriate to their career and management development.

5.2 Instructional Page Types

Text Pages
Text pages contain information, instruction, and media required to address a given performance objective. Learners interact with text pages by reading the content and studying the media presented on the page.

Interactive Pages
Interactive pages require learners to interact with elements on the page in order to receive information or instruction on a given performance objective. Learners may be required to click on words or graphics to receive additional information related to the topic addressed on the page.

5.3 Question Types

We have identified performance objectives where learners will have the opportunity to practice what they've learned by answering objective-based questions. The LCMS platform can present learners with the following questions types:

- True/False
- Single Select
- Multiple Select
- Short Answer/Fill in the Blank
- Rank Order
- Matching

These question types may incorporate media (graphics, animation, etc.) as part of the question or in the possible responses.

5.4 Assessing Performance

The Maintenance Excellence Matrix CBT is an awareness-level course, which requires no formal assessment. Instead, learners will have the chance to self-assess through practice questions

embedded in each learning object as described above, which will use pictures and documents from actual sites to re-enforce their understanding and observational capabilities.

5.5 Course Structure

Course content will be presented in a linear fashion with a suggestion that the learner complete the lessons in the order shown on the course menu. This structure is suggested for the following reasons:

- The diverse audience prevents us from making assumptions about entry-level knowledge in order to eliminate the presentation of lower-level objectives.
- The procedural content lends itself to a linear presentation.
- Application-level objectives can be presented later in the course to build upon knowledge-level objectives presented at the beginning of the course.

Because of the potential for portions of the course to be used for on-demand learning, the learner will be allowed to access any lesson in the course at any time.

5.6 Toolbar Buttons

Buttons on the toolbar will include:

- Home – takes the learner to the course Home Page.
- Objectives – pops up a small window containing the performance objectives for the current lesson.
- Contents – pops up a small window containing a menu of lessons and pages in the module.
- Glossary – pops up a small window containing the course glossary.
- Reference – pops up a small window containing additional reference material needed for a particular course.
- About – pops up a small window containing information about EPRI, MM&T, and how to complete a CBT course.
- Exit - exits the lesson, the course, and the browser. Learners are prompted whether they want to bookmark. If they do, when they return to the course, they begin at the screen they bookmarked.

5.7 Embedded Buttons

The following buttons will be embedded in the content pane of the course:

- Forward – moves the learner forward one page. The Forward button will be a graphic of a right-facing arrow. For questions, Forward is disabled until the learner gets a correct answer or exit feedback.
- Backward – takes the learner back one page, to review pages they have already covered. The Backward button will be a graphic of a left-facing arrow.
- Check Answer – on question screens, allows the learner to submit his or her answer. Check Answer is disabled until the learner has made a legitimate choice.

5.8 Learner Location Information

The learner's position in the course will be displayed on each content page adjacent to the Forward and Backward buttons.

The title of the lesson will be displayed in the top third of the page as a part of the graphical header.

5.9 Contents Page

From any page in the course, the learner will be able to click the Contents button to pop up a small window containing a menu of lessons and pages in the module. The learner will be able to jump to any page of any lesson in the module.

5.10 Exiting and Book Marking

A learner can exit from any lesson on any screen by clicking the Exit button. At this point, the learner is prompted to place a bookmark at the current page. The Exit button exits the lesson, course, and Web browser. When the learner re-enters the course he or she will have the choice to return to the bookmark or begin at the Home Page.

5.11 Glossary Page

The Glossary Page will be displayed if the Glossary button is clicked or if the learner clicks on a highlighted glossary term in the text. It will contain an alphabetical list of terms and their definitions.

5.12 About Page

The About Page will be displayed if the About button is clicked. It will contain information about EPRI and MM&T. It will also contain information about how to complete a web-based training course, including navigation and how to complete each type of interaction.

Export Control Restrictions

Access to and use of EPRI Intellectual Property is granted with the specific understanding and requirement that responsibility for ensuring full compliance with all applicable U.S. and foreign export laws and regulations is being undertaken by you and your company. This includes an obligation to ensure that any individual receiving access hereunder who is not a U.S. citizen or permanent U.S. resident is permitted access under applicable U.S. and foreign export laws and regulations. In the event you are uncertain whether you or your company may lawfully obtain access to this EPRI Intellectual Property, you acknowledge that it is your obligation to consult with your company's legal counsel to determine whether this access is lawful. Although EPRI may make available on a case-by-case basis an informal assessment of the applicable U.S. export classification for specific EPRI Intellectual Property, you and your company acknowledge that this assessment is solely for informational purposes and not for reliance purposes. You and your company acknowledge that it is still the obligation of you and your company to make your own assessment of the applicable U.S. export classification and ensure compliance accordingly. You and your company understand and acknowledge your obligations to make a prompt report to EPRI and the appropriate authorities regarding any access to or use of EPRI Intellectual Property hereunder that may be in violation of applicable U.S. or foreign export laws or regulations.

The Electric Power Research Institute (EPRI)

The Electric Power Research Institute (EPRI), with major locations in Palo Alto, California, and Charlotte, North Carolina, was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment. EPRI's members represent over 90% of the electricity generated in the United States. International participation represents nearly 15% of EPRI's total research, development, and demonstration program.

Together…Shaping the Future of Electricity

Printed on recycled paper in the United States of America

1010268

ELECTRIC POWER RESEARCH INSTITUTE

3420 Hillview Avenue, Palo Alto, California 94304-1395 • PO Box 10412, Palo Alto, California 94303-0813 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com