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Maintenance Basis Experience

Common Maintenance Basis Issues in Fossil Plants

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ABSTRACT

Plant Reliability Optimization (PRO) is a program to create a work environment that optimizes the use of resources, maintenance processes, employee skills, and technology for the purpose of meeting the reliability objectives. This is achieved by looking at four major areas:

- Management and Business Culture
- Maintenance Processes
- People Skills/Work Culture
- Technology

When looking at Maintenance Processes it is necessary to establish a Maintenance Basis. The Results section of this report details common Maintenance Basis-related findings of 111 surveys conducted by EPRI Solutions, Inc.

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MAINTENANCE BASIS OPTIMIZATION

Maintenance Basis Definition

The Maintenance Basis is a documented rationale for understanding expected equipment and system failures as well as their associated maintenance tasks and frequencies to achieve an organization's desired goals for safety, equipment reliability, and O&M costs.

The MBO process is a step-by-step approach to optimize the Maintenance Basis by incorporating plant knowledge, maintenance history, and industry experience. (One form of Maintenance Basis Optimization is the well-known Reliability Centered Maintenance (RCM) Analysis process).

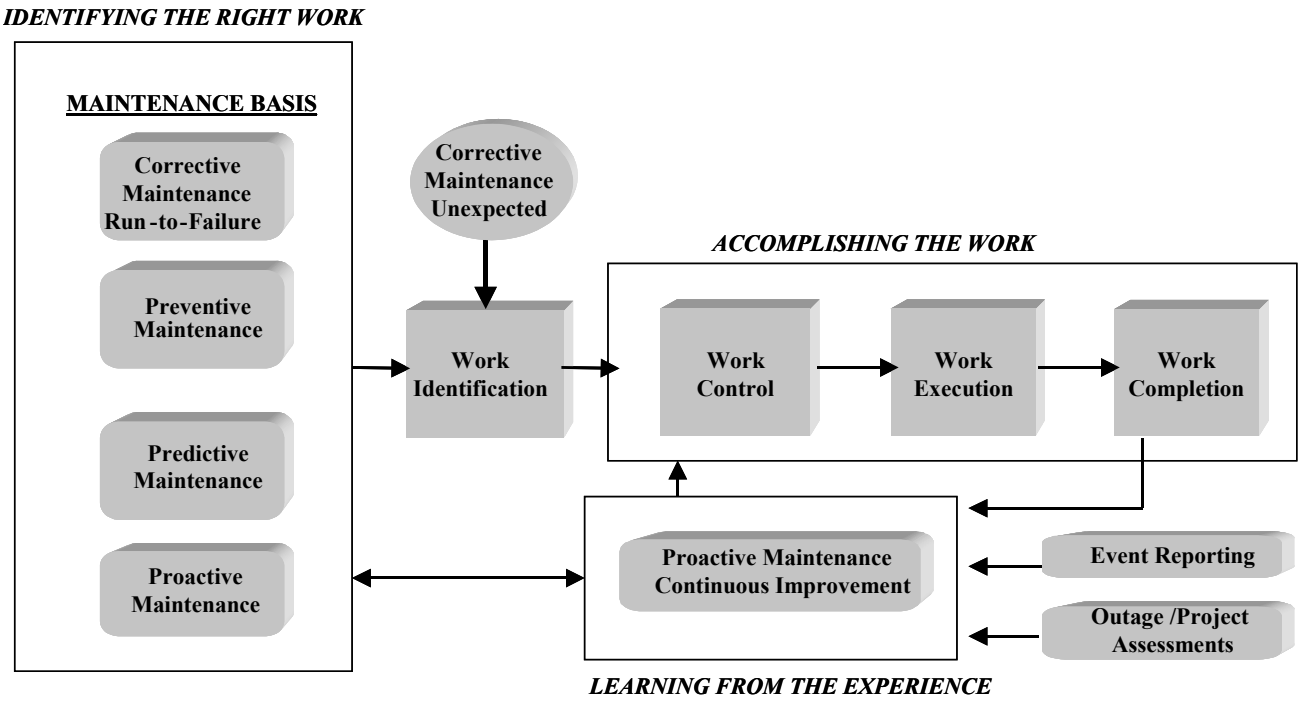

Figure 1-1: Sample Maintenance Workflow

Maintenance Basis Optimization (MBO) Process Description

The Maintenance Basis protects critical plant assets from premature failure by specifying and utilizing the most cost-effective methods to manage these assets. PMO dictates that the plant will maintain a plant Maintenance Basis document that will be updated, when necessary, as new information is available.

Developing, modifying, and updating the Maintenance Basis is accomplished through the Maintenance Basis Optimization (MBO) process, which is a modified Reliability Centered Maintenance (RCM) Process. Through this process, a maintenance organization is able to document the basis for the maintenance program, assist in managing the changes to the program, develop standards for preventive maintenance work activities, and match resources to high value work.

Maintenance Basis Optimization Actions

The basic tasks in a Maintenance Basis Optimization are as follows:

- Establish criteria determine the criticality of plant systems and equipment based on safety, environmental, reliability, cost, and efficiency.
- Ranking of equipment based on aforementioned criteria.
- Identification of non-critical (run-to-failure) equipment.
- Determination of failure modes and causes for critical equipment.
- PM identification and frequency
- Management and review process of Maintenance Basis
- Establish ownership of the Maintenance Basis

Maintenance Basis Resources

To find out more about Maintenance Basis Development, the reports in the following table should prove to be helpful.

Table 1-1: Maintenance Basis Development Resources

Number	Product Title	Date
TR-109795	Streamlined Reliability-Centered Maintenance (SRCM) Program	12/97
TR-109795-V2	Streamlined Reliability Centered Maintenance (SRCM) Implementation Guidelines	10/98
TR-109795-V3	Streamlined Reliability Centered Maintenance (SRCM) Implementation Guide	10/99
1004016	Streamlined Reliability Centered Maintenance Analysis Application Update	10/01
1004376	Streamlined Reliability Centered Maintenance at Reliant Energy	11/02
TR-107902	Cost Benefit Analysis for Maintenance Optimization	12/99
1004018	Boiler Reliability Optimization Guideline	9/01
TP-114094	Equipment Maintenance Optimization Manuals (2)	12/99
1006537	EPRI Boiler Reliability Optimization Program: Case Studies from 1998-2001	12/01
1007442	Reliability Assessment of the Coronado Generating Station	3/03

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THE ROLE OF MAINTENANCE BASIS OPTIMIZATION IN PLANT RELIABILITY OPTIMIZATION

What is Plant Reliability Optimization?

Plant Reliability Optimization (PRO) is a program to create a work environment that optimizes the use of resources, maintenance processes, employee skills, and technology for the purpose of meeting the reliability objectives. The PRO Categories include:

- Management and Business Culture – Creating a positive work environment that promotes a learning organization and optimizes plant reliability. This is accomplished by: setting goals; providing strong leadership; promoting good communication; establishing an organization where individuals know their roles and responsibilities and are held accountable; and, providing the means to learn from the staff's experiences. Metrics are tracked for the purpose of understanding the areas where improvement opportunities exist and are corrected.
- Maintenance Processes – Using the industry's best maintenance practices to minimize the impact on production and to maximize the workforce utilization optimizes Plant maintenance. This is accomplished by identifying work at the right time so it can be prioritized, planned, scheduled, and performed. Work is documented and reviewed to learn from the experience. These processes include day-to-day work, both planned and unplanned outage work and work resulting from proactive activities such as engineering projects.
- People Skills/ Work Culture - Plant reliability is optimized by developing a highly motivated, qualified and skilled workforce, and a safe work environment. This is accomplished by providing an effective training and qualification program, and by implementing a human performance initiative that stresses positive behaviors and values.
- Technologies – Plant reliability is optimized by utilizing cost effective technologies that maximize maintenance process efficiencies, provides timely information on equipment condition, and captures the lessons learned. Integration technologies are incorporated that allow access to multiple plants and department data sources, and allow the findings, recommendations, and corrective actions to be shared.

The Categories as shown in Figure 2-1 are expanded to include 19 Elements with each Element having a number of Sub-elements.

Categories	*Elements*	*Sub-Elements*						
1.0 Management & Business Culture	Benchmarking	Within Industry	Outside Industry	N/A	N/A	N/A	N/A	N/A
	Goals/Business Plan	Org Perf Goals	Maint Dept. Goals	Individual Goals	Business Planning	N/A	N/A	N/A
	Organization	Roles & Respons.	Specialty Teams	Contract Mngmt	Facilities	N/A	N/A	N/A
	Leadership	Direction	Policies & Processes	Discipline	Empowermt	Motivation	N/A	N/A
	Communication	Ops,Maint, Eng	Mangers to Workforce	Workforce to Mgmt	Peer Group Meetings	Wrkr - Wrkr Comm.	N/A	N/A
	Metrics	Overall Goals	Maintenance Dept. Goals	Plant Goals	Customer Satisfaction	N/A	N/A	N/A
	Accountability/ Ownership	Personnel Performance	Bus. Plan Adherence	System/ Comp Own	Craft Owership	N/A	N/A	N/A
	Continuous Improvement	Self-Assessment	Change Mgmt Prog	Process Improvement	Use of OE	CAP Program	R&D Activities	Empl Ideas Solicited
2.0 Maintenance Processes	Work Identification	Work ID Procedures	Maint. Basis	Corrective Maint.	Preventive Maint.	Predictive Maint.	Proactive Maint.	Work Order Generation
	Work Control	Work Mgmt Process & Procedures	Outage Mgmt Process & Procedures	Prioritize Work	Risk Assessment	Stores/Inv. Management	Planning	Scheduling
	Work Execution	Work Exec Procedures	Equip Clearance & Tagging	Tools/Mat. Control/Staging	Pre-Job Briefs	Perform Maint Tasks	Work Quality	Safety
	Work Closeout	Work Close Procedures	Post Maint Testing	Post Job Critique	Data Capture & Feedback	House Keeping	Return Equip to service	N/A
3.0 People Skills & Work Culture	Training	Processes & Policies	Personnel Skills Dvlpmnt	Plant Systems	Mgmt /Spvr development	Business Literacy	Contractor Training	Specialty Training
	Utilization	Mgmt/Union Interaction	Multi - Discipline	Mbl/Shared Workforce	Productivity / Metrics	N/A	N/A	N/A
	Human Performance	Behaviors & Values	Procedure Use	Self Check	Peer Check	CAP Prog Utilization	Conflict Resolution	N/A
	Qualifications	Personnel Selection	Qualification Process	Re-Qualification Process	Contractor Quals	Qual Tracking Program	Succession Planning	N/A
4.0 Technologies	Maintenance Management System	CMMS	Risk Assmnt Tools	Scheduling Tools	Reporting & Decision	N/A	N/A	N/A
	Maintenance & Diagnostic Technology	Execution Tools	Cond Mon. On-line	Cond. Mon. Periodic	Technology Software	Process Data Utilization	Equip Perf Mon. Tools	N/A
	Information Integration System	Financial	Budget & Schedule	Equip Cond. Data	Dispatch System	Industry databases	Equip Tech. Documents	N/A

Figure 2-1
Maintenance Excellence Matrix

To get more details on the Plant Reliability Optimization process, EPRI has compiled various reports spanning all aspects of PRO. However, a comprehensive summary of the practices and methods of PRO is detailed in *Consolidated Plant Maintenance Optimization Guideline For Fossil Power Plants,* EPRI, Palo Alto, CA: 2003. Product ID 1004377.

What is the Role of Maintenance Basis in Plant Reliability Optimization?

The Maintenance Basis fits into "2.0 Maintenance Processes" in Figure 2-1. From the Maintenance Basis work identification, control, execution, and closeout are all established and prioritized.

3
SURVEY RESULTS

EPRI Solutions, Inc. has conducted many surveys over the past five years. While each plant's results are unique, there are often patterns in the problems found.

Maintenance Basis Survey Results

The tables that follow represent the results of EPRI Solutions, Inc. working with a total of 111 fossil plants. The work consisted of performing maintenance assessments covering the Preventive Maintenance (PM) program, the Condition Based (CBM)/ Predictive Maintenance (PdM) Program, the Work Flow Management and the continuous improvement effort. The assessment process included working with the craft, middle and senior management to establish the current condition of the plant's maintenance process and performing a gap analysis to determine how best the plants can improve their maintenance program.

Common Maintenance Basis Issues

The following 16 issues were found at more than half of the sites surveyed.

Table 3-1: Common Maintenance Basis Issues

Issue	Frequency
Plant personnel believe that the lack of resources is the primary reason for the decline in the effectiveness of the PM Program and the reactive approach to maintenance.	98%
System Owner approach to managing the maintenance basis for their system is not understood at fossil plants.	96%
PM Work Orders are sacrificial. Most reactive work will cause PM work to be delayed or cancelled.	95%
There is limited ownership and management of the PM Basis.	95%
PM Programs have not been optimized and there is little documentation on how it was developed.	92%
Plants have a reactive approach to maintenance. Most are in a "firefighting" mode.	90%
A comprehensive condition-based Equipment and Condition Indicator (E&CI) matrix, is not part of the Maintenance basis. This has not been developed for all critical components.	87%
Current PM Programs do not take sufficient advantage of Condition Based Maintenance technologies and processes.	81%
Formal program for Root Cause Analysis (RCA) of Maintenance Basis Violations is not a routine practice.	78%
There is a lack of understanding of the importance of operations in supporting the failure defense plan and the fact that Operator rounds are PMs and need to be part of the PM Basis.	78%
Plant personnel do not know what equipment failure modes are protected by the PM Basis.	77%

Issue	Frequency
The workforce at fossil plants recognize the negative effects on equipment condition cause by not performing PMs.	75%
Operations defer PMs to Maintenance	72%
There is limited recognition at the plants of the importance of having a failure defense plan, consisting of a PM Basis, Condition Maintenance Program and a Proactive Active (Continuous Improvement) Program.	72%
Older RCM studies did not emphasis the importance of implementing the PMs into the CMMS.	65%
PM work orders are "turned off" in the CMMS, which makes it hard to track PM compliance.	55%

Other Maintenance Basis Issues

While these issues were not found a majority of the time, they were found frequently enough to warrant mentioning.

Table 3-2: Other Maintenance Basis Issues

Issue	Frequency
PM work orders are closed without being performed, which makes it difficult to monitor the effectiveness of the PM Program.	48%
Over time the PM basis of the plant has become corrupt with additional tasks that do not always address failure modes.	46%
Plants have a concern that if they develop a PM Basis, they will not have the resources to implement it.	38%
The conversion from an old CMMS to a new CMs creates some loss in the PM program	25%

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