

Guidelines for Enhancing the Functions of Critical Equipment Owners at Fossil Power Plants

Technical Report



Guidelines for Enhancing the Functions of Critical Equipment Owners at Fossil Power Plants

1012279

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REPORT SUMMARY

Background

With the increase in utility mergers, subsequent changes in organizational structure, and the loss of seasoned engineering expertise throughout the U.S. power industry, the benefits of and the need for the critical equipment owner are being evaluated by many plant managers. In 2004, the Electric Power Research Institute (EPRI) Nuclear Maintenance Applications Center (NMAC) was asked to study the component engineering function in light of these recent industry trends and to provide a current analysis of the roles, responsibilities, and interfaces that could ultimately lead to improved equipment reliability. This effort resulted in the 2005 publication of *Guidelines for Effective Component Engineering* (1011896). As a follow-up to that effort, the NMAC report was revised to produce a Technical Update, *Guidelines for Enhancing the Functions of System Owners at Fossil Power Plants* (1010274), which was a work in progress sponsored by the EPRI Maintenance Management and Technology (MM&T) Group. The intent was to use that Technical Update as a basis for developing and publishing this technical report for users in the fossil power industry in 2006.

The purpose of this guideline is to present a compilation of data regarding the roles, responsibilities, organizational structure, and interfaces of critical equipment owners at fossil power plants.

Objectives

- To define common functions and responsibilities of critical equipment owners
- To identify and describe options of various organizational structures employing other personnel to fulfill these roles
- To identify the pros and cons of the various approaches being utilized in the industry, including both successful and unsuccessful approaches
- To evaluate the critical equipment owner's interfaces with the maintenance, operations, outage planning, design engineering, and procurement organizations and determine how their role integrates with the plant operations and processes

Approach

In cooperation with interested MM&T members, a task group of utility engineers and industry experts was formed. This group identified key issues regarding the roles and responsibilities of critical equipment owners at fossil power plants and provided input used in the preparation of the guidance set forth in this document. Proven practices and techniques were identified during this effort and compiled in this report.

Results

The report provides a mission statement and presents key critical equipment owner functions that add value. It also discusses skills and performance attributes essential among critical equipment owners and typical staffing. The focus of the report provides guidance for establishing effective organizational interfaces, both internally and externally, and for determining appropriate engineering outputs provided by the critical equipment owner. The report also provides the owner with several examples of component health reporting, presented at the corporate, site, and unit levels. Typical benefits and industry-wide lessons learned are also presented.

EPRI Perspective

The information contained in this guideline represents a significant collection of human performance information, including techniques and good practices, related to critical equipment owners in their support of various work activities common at a fossil power plant. Assemblage of this information provides a single point of reference for future and present plant engineering and maintenance personnel. Through the use of this guideline, in close conjunction with the industry guidance provided, EPRI members should be able to significantly improve and consistently implement the processes associated with the critical equipment owners assigned at both the site and corporate levels. This will subsequently help members achieve increased reliability and availability of the components for which the critical equipment owner is responsible.

Keywords

Critical equipment owner
System owner
Fossil power plant
Interface

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INTRODUCTION

1.1 Purpose and Scope

The purpose of this technical report is to describe the role of critical equipment owners at fossil power plants, considering responsibilities, organizational structure, and interfaces. Specific objectives of the task and the subsequent guideline that was developed in 2006 are as follows:

- Define common functions and responsibilities of critical equipment owners
- Identify and describe options of various organizational structures employing other personnel to fulfill these roles
- Identify the pros and cons of the various approaches being utilized in the industry, including both successful and unsuccessful approaches
- Evaluate the critical equipment owner's interfaces with the maintenance, operations, outage planning, design engineering, and procurement organizations and determine how their role integrates with the plant operations and processes such as, but not limited to, the following:
 - Equipment reliability program
 - Predictive monitoring program
 - Preventive maintenance program
 - Component health monitoring program, including some examples of component health reports
 - Component aging management
 - Maintenance task selection and prioritization
 - Plant staffing/shifts

1.2 Background

With the increase in utility mergers, subsequent changes in organizational structure, and the loss of seasoned engineering expertise throughout the U.S. power industry, the benefits of and need for the critical equipment owner are being evaluated by many plant managers. In 2004, the Electric Power Research Institute (EPRI) Nuclear Maintenance Applications Center (NMAC) was asked to study the component engineering function in light of these recent industry trends and to provide a current analysis of the roles, responsibilities, and interfaces that could ultimately lead to improved equipment reliability. This effort resulted in the 2005 publication of *Guidelines*

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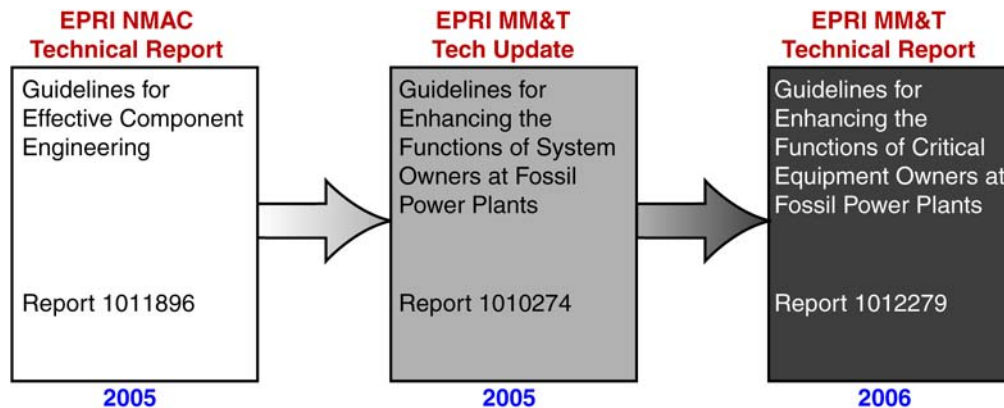


Figure 1-1
Background Regarding the Development of This Technical Report

1.3 Use and Implementation of this Technical Report

As stated in the previous section, the purpose of this report is to describe the use of critical equipment owners at fossil power plants, considering their roles, responsibilities, order in the organizational structure, and interfaces. The information presented in this report is intended as guidance and should be used as such. In some cases, the guidance will validate existing engineering organizations and their functions. In other cases, the information will provide guidance and direction for establishing or re-establishing critical equipment owner organizations. In these latter cases, the owner may choose, through a gap analysis, to develop needs and areas for improvements. The information may then be adapted to meet plant-specific needs and conditions.

1.4 Identification of Issues and Definition of Problems

The changing dynamics within the fossil power industry affect the efficiency and effectiveness of both the engineering and maintenance organizations. Many utilities have undergone extensive reorganizations in recent years, some of which have either established or eliminated the role of critical equipment owner. Complicating this issue are the different roles and responsibilities that the critical equipment owner assumes, depending on the level at which they perform those duties (at corporate, site, or unit levels).

1.4.1 Identification of Issues

Listed below are a number of issues that have already been identified by personnel in the fossil power industry that are addressed in this report.

1.4.1.1 Training and Development of Critical Equipment Owners

- Good practices
 - Assigned based on skills and interests
 - Responsible for their system during periodic outages
 - Involved in the capital project process from start to finish
 - Conduct classes in their systems twice a month
 - Train others to be secondary critical equipment owners
- Threats to plants
 - Inefficient utilization of processes
 - Mass confusion
 - Loss of revenue due to equipment unavailability
 - Frustration of the individuals
- Opportunities
 - Educate the management on the structured effort.
 - Establish consistency between the plants.
 - Use EPRI Solutions' MBO process as a catalyst for process improvements.
 - Make EPRI Solutions' time-tested methods and processes available.
 - Use common definitions, metrics, and processes across the fleets and between utilities, which allows for sharing of information and benchmarking.
 - Share knowledge and experience between the member utilities.

1.4.1.2 Roles and Responsibility of Critical Equipment Owners

- Good practices
 - Have a critical equipment owner handbook.
 - Provide critical equipment owner training.
 - Utilize EPRI Solutions' system owner training certifications.
 - Implement a formalized selection process for critical equipment owners.

- Threats to plants
 - System and plant reliability, availability, performance, and costs-risk degradation
 - Employee morale and burnout
- Opportunities
 - Develop best practices standards for a critical equipment owner handbook, training, and selection process.

1.4.2 Problem Definition

Listed below are a number of problem areas and related issues that were identified by owners and that prompted either the establishment of the critical equipment owner function or a clarification of their roles and responsibilities. The problem areas are illustrated in Figure 1-2.

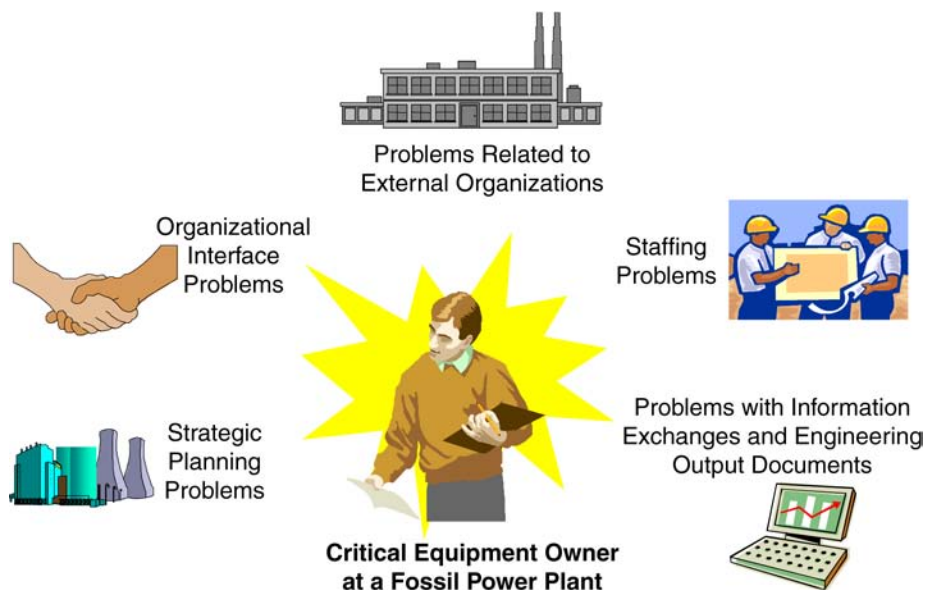


Figure 1-2
Problem Areas Necessitating the Critical Equipment Owner Function

1.4.2.1 Organizational Interface Problems

Organizational interface problems are one of the primary concerns for the critical equipment owner and the main contributor to ineffectiveness. Examples of problems include the following:

- Poor definition of roles and responsibilities between corporate-level engineers with component expertise and system owners and equipment owners at the various sites
- Gray definition between the system and critical equipment owner's roles versus procurement, design, and system engineering organizations

- Lack of ownership of issues between system owners and critical equipment owners
- Limited system influence of critical equipment owners caused by reporting to various management groups
- Lack of a single point of contact for component-related issues
- Lack of organizational performance indicators

1.4.2.2 Staffing Problems

Staffing is another issue that plagues many fossil plant organizations, not only in terms of numbers but also in the depth of technical expertise as well. Some examples of staffing issues facing organizations at fossil power stations are the following:

- Engineering personnel have a high turnover rate.
- Component-specific expertise is difficult to maintain in a resource-thin environment; consequently, critical equipment owners attempt to handle many types of components within their discipline.
- Engineering organizations are characterized as an aging workforce.
- The time necessary to develop component expertise causes some to “stagnate” within the organization.
- Management becomes hesitant to move or promote critical equipment owners because of their unique technical expertise.

1.4.2.3 Strategic Planning Problems

One common issue that is closely related to the staffing problem is the difficulty many critical equipment owners have in contributing to strategic planning and in prioritizing their work activities. Examples include the following:

- Program and long-term planning is limited due to emergent work support.
- There is insufficient time for equipment-specific program improvement (day-to-day issues consume time).
- Component long-range plans fail to get implemented (from lack of budget or management support).

1.4.2.4 Problems with Information Exchanges

Communicating information about components continues to be another major stumbling block to the efficient use of the critical equipment owner. This information exchange is twofold, as it includes both the efficiency with which component information is gathered as well as how that information is compiled and communicated to others. Examples of this problem area include the following:

- Poor access to technically accurate component information for maintenance activities
- Poor prioritization of design changes to improve equipment reliability

1.4.2.5 Problems Related to External Organizations

Another general area where problems arise for the critical equipment owner involves the interactions with external organizations such as equipment manufacturers and service/refurbishment vendors. Examples of these types of problems include the following:

- Poor quality of equipment refurbishment provided by some vendors
- No single point of contact for potential equipment manufacturers to assist in developing specifications for replacement components

1.5 Summary of Perceived and Actual Benefits of Critical Equipment Owners

Depending on the organizational structure of the utility, the benefits are grouped for corporate , multisite, and single-unit levels.

1.5.1 Corporate/Fleet Level

The primary benefits of the critical equipment owner function at the corporate level are as follows:

- The engineering organization with critical equipment owners provides a fleet overview for the following:
 - Standardization of responsibilities and improved efficiency
 - Reduced costs by adopting a fleet approach to component purchases and repairs

1.5.2 Multiunit Site Level

The primary benefits of the critical equipment owner function at the multiunit site level are as follows:

- Has the ability to work with craft labor to resolve in-progress issues
- Can work with planning to resolve issues that are scheduled
- Is a single point of contact for component issues, including troubleshooting of failures and root cause/failure analysis
- Has a better focus on component/equipment long-range planning
- Assists in development of on-site subject matter expert at the level of the component-specific vendor
- Handles consistent maintenance strategy implementation for like components
- Is the primary interface with vendors
- Is the consistent interface with maintenance organization
- Has component expertise at the site level, not at corporate, which facilitates better response to critical component issues
- Has specialized technical expertise in each major type of component

1.5.3 Unit Level

Typical at a fossil power plant, the critical equipment owner is responsible for his/her designated equipment at the plant level to include all operating units. This is primarily a result of limited personnel at the plant and an inability to assign separate equipment owners at each unit at that site.

1.6 Report Structure and Content Overview

1.6.1 Basic Premises

The terms *critical equipment owner*, *component specialist*, and *component engineer* are often used interchangeably throughout the fossil power industry, and the user should not infer that the individual assigned to the critical equipment owner responsibilities must have an engineering degree in all cases. The use of these terms does not imply that the individual designated as a critical equipment owner at one site is more qualified than a component specialist/component engineer designated at another site.

The skills and attributes of a typical critical equipment owner recommended in this report are provided for illustrative purposes only and should not be interpreted as minimum requirements for qualification or certification purposes. Instead, the owner should use this information as a benchmark for use within each owner's plant-specific organizational structure and technical programs. This report recognizes that it is in rare cases when any one individual will exemplify all of the characteristics described in this guideline.

1.6.2 Structure and Content of the Report

Figure 1-3 illustrates the general structure and content of this technical report. The figure identifies key sections in the report that provide guidance to owners for effectively addressing critical equipment owner issues.

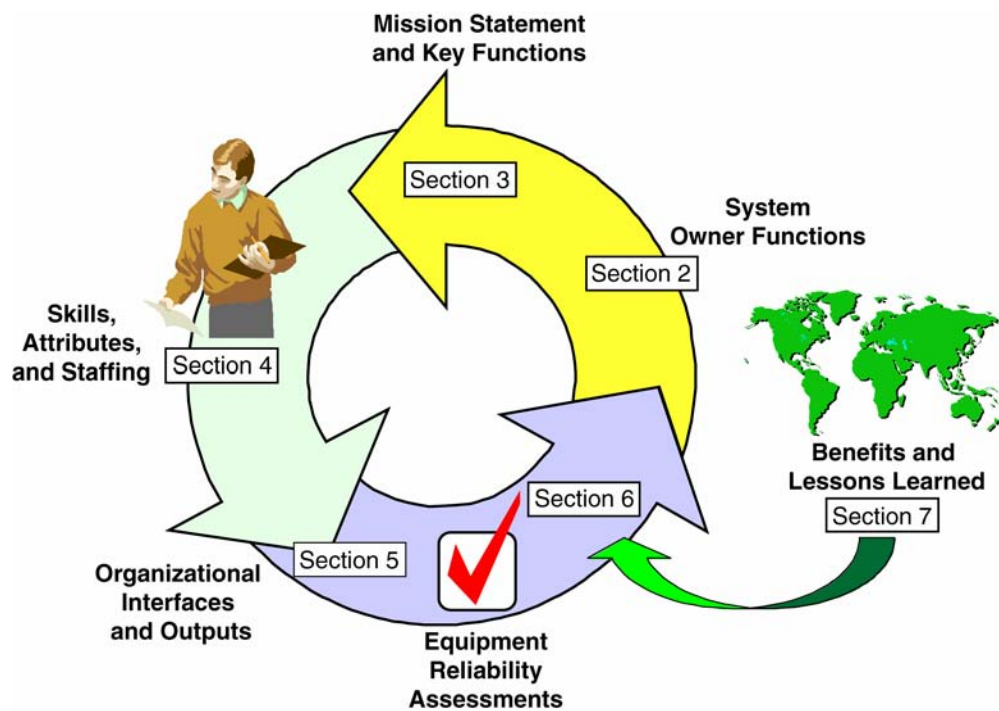


Figure 1-3
Scope and Content of EPRI Technical Report

Section 2 provides an overview of the functions and responsibilities of a system owner. Section 3 provides a mission statement and presents key critical equipment owner functions that add value. Section 4 discusses skills and performance attributes essential among critical equipment owners and typical staffing. The focus of the report is Section 5, which provides guidance for establishing effective organizational interfaces, both internally and externally. It also provides guidance for determining appropriate engineering outputs provided by the critical equipment owner. Section 6 provides the owner with several examples of component assessments, presented at the corporate, site, and unit levels. Typical benefits and industry-wide lessons learned are

presented in Section 7, and Section 8 is a list of the numerous reference and source materials used during the development of this report.

1.6.3 Overview of System/Component Level Interfaces

Figure 1-4 illustrates in general terms the organizational interfaces for the critical equipment owner at a typical fossil power plant site.

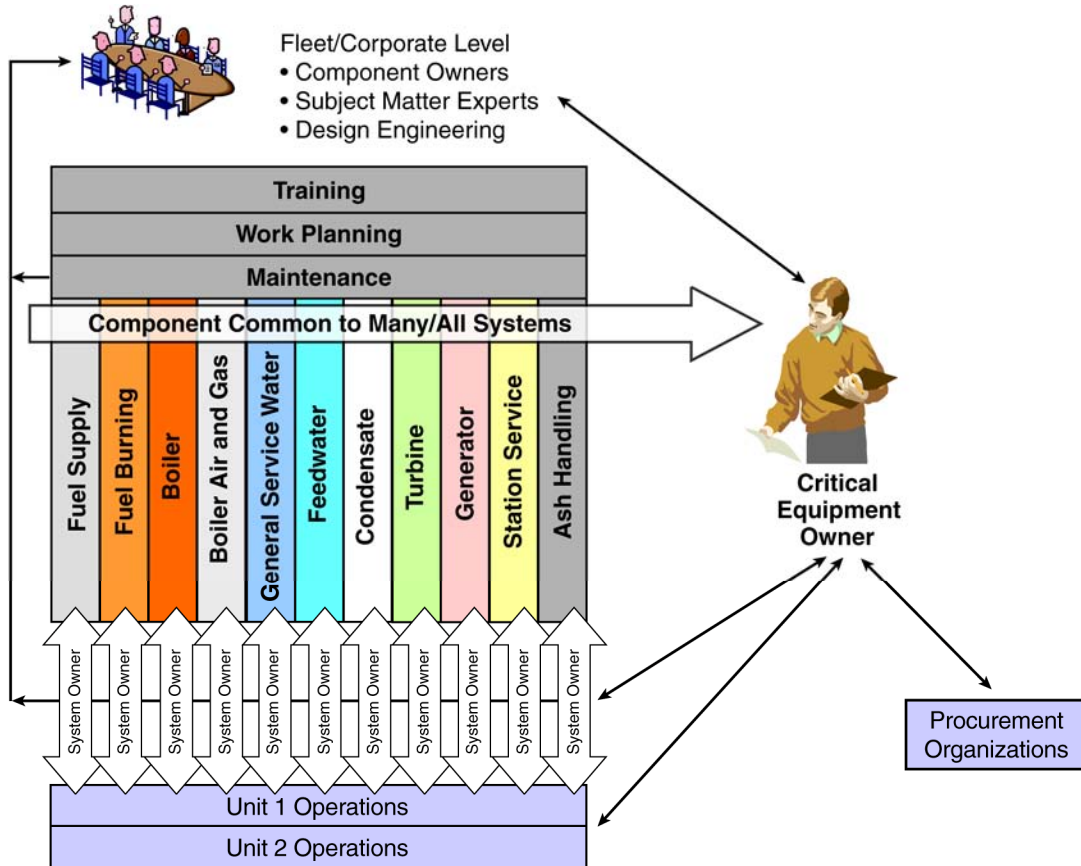


Figure 1-4
Overview of Organizational Interfaces for the Site-Level Critical Equipment Owner

The figure depicts eleven key systems, for which there are typically assigned system owners. The system owners serve as the primary interface with operations, maintenance, work planning, and training regarding the system for which they are assigned. Although the figure shows only one critical equipment owner (for simplicity), there may in fact be a number of these individuals assigned for various types of components at a fossil power plant. The figure illustrates the following key points regarding the typical interfaces for the critical equipment owner:

- The critical equipment owner is responsible for a given component that cuts across many systems; thus, interfaces tend to be more horizontal.
- At the plant level, the critical equipment owner indirectly contributes to long-range planning, most likely through the system owner.

Although not shown on the figure, three other key points about the critical equipment owner function are as follows:

- In larger utilities with multiple sites, the critical equipment owners at the plants are often relieved to some degree of long-range planning issues. At the corporate level, they tend to focus more on long-range issues, whereas the plant-level critical equipment owners are allowed to focus more on day-to-day component performance issues.
- Major initiatives are defined and developed at the fleet level, but their implementation occurs at the plant level, involving the critical equipment owner to the extent that the initiative affects their line of components.
- Critical equipment owners tend to interface mostly with maintenance regarding technical activities, whereas system owners interface mostly with maintenance regarding longer-term activities such as budgeting, capital improvements, project management, and root cause analysis

1.7 Glossary of Terms and Acronyms

1.7.1 Industry Definitions and Nomenclature

Component health report – A document used to communicate the status of a given component (or group of like components) installed at a fossil power plant.

Critical equipment owner – An engaged, professional, well-trained individual who takes proactive and effective measures to improve equipment reliability, reduce costs, and prevent plant challenges due to component failures. (This term is synonymous with *component specialist* and *component engineer*, which are often used interchangeably.)

Engineering program – A program created to enable an engineering organization to carry out its assigned engineering responsibilities; generally, highly technical or complex in nature.

Program – An organized set of activities, directed toward a common purpose or goal, in order for an organization to carry out its responsibilities. A program generally is used to accomplish routine tasks that are highly complex or whose success is reliant upon a high level of coordination between numerous organizations. The key attributes of a program include a mission, an owner (single point of contact), a defined sequence of activities and tasks, clearly identified responsibilities for those performing the tasks (stakeholders), and indicators to monitor program performance, health, and effectiveness. Key program attributes are generally documented in a plan or procedure.

Program health report – A document used to communicate the status of a given program at a fossil utility, site, or power plant.

System health report – A document used to communicate the status of a given operating system installed at a fossil power plant.

System owner – An engaged, professional, well-trained individual who takes proactive and effective measures to improve system reliability, reduce costs, and prevent plant challenges through close interface with plant operations, maintenance, work planning, and training organizations.

Technology owner – An individual typically assigned to the engineering organization, who, through recognized experience or expertise, is responsible for applying a particular technology to the design, operation, and maintenance of plant systems and components.

1.7.2 Acronyms and Abbreviations

AOV – Air-operated valve

ASHR – Automated station health report

ASME – American Society of Mechanical Engineers

BOM – Bill of material

CAP – Corrective action process

CBA – Cost-benefit analysis

CBM/PdM – Condition-based/predictive maintenance

CHIP – Component health indicator program

CHR – Component health review

CMMS – Computerized maintenance management system

CSR – Condition status report

E&CI – Equipment and Condition Indicator

EFOR – Equivalent forced outage rate

EMOM – Equipment maintenance optimization manual

ERP – Equipment reliability process

ESP – Engineering support personnel

I&C – Instrumentation and Control

IT – Information technology

MM&T – Maintenance Management and Technology

MOV – Motor-operated valve

MW – Megawatt

NDE – Nondestructive evaluation

NMAC – Nuclear Maintenance Applications Center

NP – Nuclear power

O&M – Operations and maintenance

OE – Operating event(s) or operating experience

OEM – Original equipment manufacturer

P&S – Planning and scheduling

PM – Preventive maintenance

PMO – Plant maintenance optimization

PR – Proactive

PMP – Performance monitoring plan

PMT – Post-maintenance testing

SME – Subject matter expert

TR – Technical report

1.8 Relationship with EPRI's Maintenance Management & Technology Group and to other EPRI Reports

The development of this report was made possible through the close working relationship between the utility component/system engineering community and EPRI's Maintenance Management & Technology (MM&T) Group. During the development of this report, a number of EPRI products were identified that already provide detailed guidance regarding some critical equipment owner functions, outputs, and the organizational structure. These existing EPRI reports were primarily used as source material to ensure consistency of applied guidance among owners and include the following:

- *Guideline for System Monitoring by System Engineers (TR-107668)*
- *Guidelines for Effective Component Engineering (1011896)*

- *Guidelines for Enhancing the Functions of System Owners at Fossil Power Plants* (1010274)
- *Key Information for Replacing Components at Nuclear Power Plants* (1011857)
- *NMAC Post Maintenance Testing Guide, Revision 1* (1009709)
- *System and Equipment Troubleshooting Guideline* (1003093)
- *System, Component, and Program Health Reporting* (1009745)
- *The Maintenance Engineer Fundamentals Handbook: An EPRI Course* (TR-106853)

1.9 Key Points

Throughout this report, key information is summarized in Key Points, which are bold-lettered boxes that succinctly restate information covered in detail in the surrounding text, making the Key Point easier to locate.

The primary intent of a Key Point is to emphasize information that will allow individuals to take action for the benefit of their plant. The information included in these Key Points was selected by MM&T personnel, consultants, and utility personnel, who prepared and reviewed this report.

The Key Points are organized according to three categories: O&M Costs, Technical, and Human Performance. Each category has an identifying icon, as shown below, to draw attention to it when users are quickly reviewing the guide.



Key O&M Cost Point

Emphasizes information that will result in reduced purchase, operating, or maintenance costs.



Key Technical Point

Targets information that will lead to improved equipment reliability.



Key Human Performance Point

Denotes information that requires personnel action or consideration in order to prevent injury or damage or to ease completion of the task.

Appendix A contains a listing of all Key Points in each category. The listing restates each Key Point and provides reference to its location in the body of the report. By reviewing this listing, users of this guide can determine if they have taken advantage of key information that the writers of this guide believe would benefit their plants.

2

OVERVIEW OF THE SYSTEM OWNER

The purpose of this section is to provide an overview of the system owner at a fossil power plant so as to better understand the roles, responsibilities, and interfaces of the critical equipment owner that will be discussed in more detail in Sections 3 through 6 of this report. The guidance provided in this section supports an overall objective of maximizing plant equipment performance and reliability by optimizing plant maintenance activities. The work processes described in this section are commonly referred to as plant maintenance optimization (PMO).

2.1 Functional Overview, Selection, and Training

2.1.1 Functional Overview

A system owner should be an individual willing to accept ownership within his/her system. The system owner owns the maintenance basis for the system and has knowledge of, or a willingness to learn, monitor, and optimize, plant equipment utilizing all condition-based/predictive maintenance (CBM/PdM) data, process data, and plant expertise. The owner must be able to communicate to the plant on all issues, concerns, and successes. The system owner advocates for the system's condition and the system's backlog with planning and scheduling (P&S) and also supports the corrective action process (CAP) program for his/her system.

2.1.2 Selection of System Owner

A system owner does not have to be an engineer but should have the knowledge and expertise of the system. The system owner is generally a candidate from maintenance or operations.

2.1.3 Building the System Team

The system owner should assemble a team for his/her system that includes personnel from operations, maintenance, planners, critical equipment owners, and others who have knowledge of the CBM/PdM programs.

2.1.4 Training of the System Owner

It is essential that the system owner be properly trained to fulfill his/her role in the PMO process. A recommended training matrix for a system owner should be developed by station management personnel in concert with the training organization. Typical areas of training that would benefit an individual assigned to system owner responsibilities are provided in Table 2-1.

**Table 2-1
Recommended Areas of Training for the System Owner**

General Area	Suggested Topics of Instruction	
Programmatic	PDM program implementation	Plant maintenance optimization process
	System owner program implementation	Root cause analysis - critical thinking
	Streamlined reliability-centered maintenance	Level of awareness PMO
	Equipment maintenance optimization manual development (EMOM)	Maintenance asset management
Equipment	Cyclone boiler unit operations	Generator monitoring and diagnostics
	Drum boiler unit operations	Valve maintenance
	Boiler operations and theory	Air-operated control valve application and maintenance
	Boiler tube failure reduction	Air-operated valve (AOV) diagnostics
	Cycle chemistry optimization	Check valve monitoring and diagnostics
	Feedwater heater operation and maintenance	Pressure relief valve application, maintenance and testing
	Heat exchanger performance prediction	Motor-operated valve actuator maintenance
	Tubular heat exchanger inspection, maintenance and repair	Cooling water systems: developing effective water treatments and optimizing water usage
	Balance of plant heat exchanger NDE and condition assessment	Actuator drive selection and installation
	Service water system heat exchanger testing	Substation/switchyard predictive maintenance program
	Pump design, operation and maintenance	Transformer performance, monitoring, and diagnostics

Table 2-1 (continued)
Recommended Areas of Training for the System Owner

General Area	Suggested Topics of Instruction	General Area
Equipment (continued)	Pulverizer maintenance and fuel system optimization	Cooling tower maintenance and inspection
	Turbine operations and theory	Bearings design, monitoring, and repair
	Steam turbine performance monitoring, diagnostics, and improvement	Motor monitoring and diagnostics
Technologies	Infrared thermography, Level I training and certification	Visual examination, Level III
	Infrared thermography, Level II training and certification	Ultrasonic examination, Level I
	Infrared thermography, Level III training and certification	Ultrasonic examination, Level II
	Substation thermography	NDE of high-energy piping
	Mechanical vibration analysis, Level I training and certification	Advanced UT training for ASME Section XI piping examination
	Mechanical vibration analysis, Level II training and certification	Basic eddy current theory and application with HX emphasis
	Machinery alignment, Level I training and certification	Nondestructive evaluation (NDE) of fossil plants
	Machinery alignment, Level II training and certification	Flow measurement
	Visual examination, Level I	Basic corrosion
	Visual examination, Level II	Microbiologically influenced corrosion
Plant Operations	Maintenance data analysis	Combined cycle unit operations
	Steam plant operations for plant personnel	Operations for non-operators (fossil)
	Supercritical steam plant operations	Coal-fired power plant operation

2.2 System Owner Roles and Responsibilities

The following sections discuss the system owner's responsibilities for each phase of the PMO process. Continuing performance of the system owner's roles and responsibilities to the PMO project is essential for the overall success of the project.

2.2.1 Maintenance Basis Process

The maintenance basis process identifies critical plant equipment and its applicable time-directed maintenance activities and frequencies. The maintenance basis provides for the linkage between expected equipment failure modes and the associated preventive maintenance (PM) task. The maintenance basis is therefore the core document for maintenance activities. In addition, the maintenance basis is a living program and is updated when a system, component, or testing procedure changes.

2.2.1.1 Maintenance Basis Development and Control

The system owner is responsible for the maintenance basis strategy for his/her respective system. This means that the system owner will participate in the review process and accept ownership of the components selected, as well as the PM tasks and their associated frequencies, as determined to protect the components. The system owner is also responsible for the execution of the maintenance strategy to ensure effective and efficient operation of each component.

The system owner will follow and update post-maintenance testing (PMT) for adequacy and quality. The maintenance basis process will establish baseline PMT, but modifications may be required as the system's condition changes.

2.2.1.2 Maintenance Basis Changes

The maintenance basis is a living program requiring continuous evaluation for improvement. Because of this, all personnel, and particularly the system owner, should be alert for possible changes to the maintenance basis program that may be beneficial in improving plant reliability and performance.

2.2.2 Condition Based/Predictive Maintenance Process

The condition-based/predictive maintenance process (CBM/PdM) requires technologies and people skills while combining and using all available diagnostic and process data, maintenance histories, operator logs, and design data to make timely decisions about the maintenance requirements of major and critical equipment.

The system owner relies on all of this data to determine and manage a component's condition. The system owner also utilizes the system team during this process. It is the responsibility of the system owner to convert the data to information and then action. The following are descriptions of specific activities the system owner has responsibility for, relating to the CBM/PdM process:

- Review the Equipment and Condition Indicator (E&CI) Matrix spreadsheet. Any new opportunities for condition indication should be added to the E&CI Matrix located in the PdM Module of PlantView® or in an equivalent condition status report (CSR) tool.
- Use data historians (such as PI) to configure important condition-indicating parameters for diagnostic purposes.
- Own the overall equipment condition assessment. Data to determine these conditions are supported by plant personnel (for example, CBM/PdM Group, System Team).
- Recommend that the PlantView® PdM Module, or an equivalent CSR tool, be used to review equipment condition data and to provide an overall evaluation of the equipment's condition. This is commonly referred to as an equipment assessment. The PlantView® PdM Module or an equivalent CSR is a tool that aids in data integration and analysis and is used for reporting on the equipment and system conditions throughout the plant. The system owner should use the plant's data historian software, such as EPRI's PlantView®.
- Assess the overall health of the equipment based on the results of the condition indicator analysis. A technology owner analyzes the equipment's condition and enters the results into the PlantView® PdM Module or equivalent. The system owner can then assess the overall health of the equipment based on the results of the condition indicator analysis. The system owner will obtain support, if needed, from the CBM/PdM team and others.
- Note the severity of the equipment condition, analysis results, and the recommendations and action taken into the PlantView® PdM Module or equivalent, when the analysis is completed.
- Ensure that the severity codes for the equipment assessments relate to established threshold levels for the specific equipment being evaluated.
- Be an integral part of the PMO Team, and provide information and analysis for CBM/PdM evaluations.
- Generate the work orders, work requests, and job requests that are necessary to perform the work.

2.2.3 System Reliability Meetings

System reliability meetings should be held on a monthly basis. The reliability meeting is conducted by the system owner with the system team participating.

This meeting should include the following:

- Review the status of the PMO/CBM program
- Illustrate the leading and lagging metrics

- Review the cost-benefit analysis (CBA)
- Review the system equipment conditions from the PlantView® PdM Module or its equivalent
- Review and update the short-term (T-4 advocated work), mid-term (near-term outages), and long-range (outage scope modifications) plans
- Periodically review the criticality of selected equipment in the maintenance basis (minimum once per year)
- Review the list of repeat problems and recommend proactive (PR) or CAP tasks (yearly)
- Review the equipment maintenance tasks and initiate modifications to the maintenance basis

2.2.4 Work Week Management

2.2.4.1 System Backlog

The backlog includes all planned jobs that are not yet complete. Therefore, a job enters the backlog after it is planned. It is removed only after the work is complete, or it is deleted for whatever other reason. This definition of backlog includes repair work as well as preventive tasks. It also includes routine daily work and work to be done during an overhaul or turnaround. Finally, it includes maintenance work and capital project work that will utilize plant craftspeople. The backlog comprises all planned uncompleted maintenance work. Thus, for effective management purposes, all of this work should be captured in one place, ideally in the plant's computerized maintenance management system (CMMS) or an equivalent system such as P3.

2.2.4.2 Ranking the Backlog

The system owner, with help from the system team, can value rank the backlog and can communicate information to schedulers regarding the value of the work. This is a relative rank, ranging from most important to least important, that is assigned by the system owner for work to be completed. Ranking the backlog in this manner will aid the planners and schedulers as to what equipment needs to be prepared for work and the order in which it is to be scheduled.

2.2.4.3 Developing Mid- and Long-Term Plans

The benefits of maintenance planning cannot be overstated. Good planning results in having the proper resources available and at the right time.

- Mid-term planning is dictated by the continuous monitoring of the system's condition as reflected in the CSR.
- The long-range plan should call for existing and potential proactive (PR) work. It is expected that the system owner will identify these activities in the yearly or five-year plans.

- The system owner should begin a long-term project of reviewing PM work packages for his/her systems.
- These plans will improve availability and reduce the equivalent forced outage rate (EFOR).

2.2.4.4 Planning and Scheduling Process: Advocating T-4 Work

The workweek process should consist of a rolling four-week schedule developed by the supervisor, superintendent, or work control coordinator of planning and scheduling, with input from the system owner, planners, maintenance, and operations and engineering. The rolling schedule should be updated weekly at the planning and scheduling meetings.

During the weekly planning and scheduling meeting, the four-week work plan and the associated resource allocations should be discussed. This is a verification/decision-making meeting where the T-1 schedule has already been distributed to the appropriate maintenance, operations, PdM/CBM, planning, scheduling, and engineering personnel early in the week. The purpose is to verify that resources, equipment availability, ranking sequence, and then scheduling are based on criticality. Therefore, the T-1 schedule is only being verified, with the exception of any last-minute changes. Additional discussions should include future work (T-2 to T-4), T-0 carryover, quarterly, end-of-year projections, and five-year budgets.

The system owner's roles and responsibilities in this area are the following:

- Be an advocate for the system's conditions and system's backlog at the T-4 scheduling week.
- Track work orders for the system to ensure that they are being acted on in the recommended time period, and if not, to ensure that they will be done.
- Own the equipment plans for the system. These plans include short- and long-term maintenance activities and budgets. The system owner should generate short-term actions, which are those PMs and CDs providing time-dependency and ranking information. The long-range plan will call for existing and potential PR work. The system owner should identify those activities within the yearly and five-year plans.
- Provide feedback on work sequencing as it applies: quality, post-maintenance testing, and cost.
- Perform actual cost versus budget tracking for system maintenance.
- Rank all work orders in the backlog for his/her system.
- Track system PM compliance (>95%).
- Ensure that the number of new P-1 and work orders are on a downward trend.
- Participate in weekly planning and scheduling meetings, when necessary.
- Advocate scheduling of work orders in week T-3.

2.2.5 System Documentation

The system owner must ensure that all documentation is correct, complete, and available, and that the related information to his/her system is kept up to date.

2.2.6 Outage Responsibilities

The system owner and his/her team should be intimately involved in the outage process to ensure that the plant resources are available, that there is good coordination with outside contractors, and that the post-maintenance testing is done properly.

- The system owner will be part of the outage management team.
- Planned/unplanned outage type work to be performed will be planned or reviewed by the system owner.
- The system owner ensures that all jobs are ready for both planned and unplanned outages.

2.2.7 Continuous Improvement Responsibilities

The specific responsibilities of the system owner in this process include reviewing work closeout documentation, event reports, outage reports, and engineering assessments. Based on the results of these reviews, analyses should be conducted and recommendations made to support the necessary adjustments to the PMO program.

After the PMO process has been implemented, the activities are not over. To maintain and enhance the maintenance improvement process, it is important to track progress, to find out what is and is not working, and to develop an action plan to improve the process. This is an ongoing effort; in fact, it will be part of the everyday activity of the system owner.

2.2.8 Implementing a System Living Program

To ensure that the living program is updated on a regular basis, the system owner should

- Monitor O&M costs and how they relate to the reliability of system.
- Track and publish appropriate performance indicators for the system. The data will come from different sources, such as engineering and accounting, but the owner is responsible for pulling the metrics together for trending, analysis, and communication. The metrics should include such areas as EFOR, mean time between failure, system cost, equipment cost, and CM/PM.

2.2.9 Work Order Closeout Review

Work closeout is the completion of a work activity (order). This process includes a description of the work accomplished and a post-job critique that covers the adequacy of the work packages, equipment condition codes, and the availability of parts. This information is housed in the CMMS. The work closeout documentation needs to be approved for its content, and the quality of the documentation is important for use in the continuous improvement process.

The work closeout process also includes post-maintenance testing and the appropriate information on the work performed, such as the as-found and as-left condition of equipment, the maintenance history, and appropriate feedback to the workforce regarding the conditions found.

The system owner should review work closeout for improvement opportunity information.

2.2.10 State of the System Annual Presentation

The system owner is required to make presentations regarding the status of the program, and typically, these include the following:

- Present budgeted items to the senior staff for review and approval.
- Make a presentation to the plant senior staff on the status of his/her system, which should contain the following items:
 - Number of forced outages or de-rates caused by equipment failure
 - PM work order backlog for the equipment
 - CM work order backlog for the equipment
 - PM to CM work order ratio for the equipment
 - Number of RCAs performed for the equipment
 - Proactive work orders and projects performed on the equipment

3

CRITICAL EQUIPMENT OWNER FUNCTIONS

3.1 Functional Overview and Mission Statement

3.1.1 Functional Overview

The role of the critical equipment owner can be analogous to that of a specialized medical practitioner. In contrast, the system owner can be thought of as the general practitioner: whereas a doctor or medical specialist is asked to help us keep our bodies healthy, the critical equipment owner is often asked to help keep certain components healthy. For some time, many plant sites have not recognized or appreciated the need for critical equipment owners. But as plant components age, just as our bodies age, things tend to go wrong, wear out, and break down, and thus the need arises for the kind of attention a doctor, or the critical equipment owner, can offer.

Table 3-1 attempts to provide a functional overview of the critical equipment owner analogous to a medical specialist. As the table illustrates, the overall goal centers on the health of the components within a given system, both in the short and long terms.

Table 3-1
Functional Overview of the Critical Equipment Owner

Functional Overview of the Critical Equipment Owner	Comparative Analogy with the Functions of a Medical Practitioner
Develop and facilitate execution of long-range component maintenance strategies. (Section 3.2.1)	Recommend activities to maintain good health and what activities to avoid that may cause long-term illnesses such as cancer, heart attack, or stroke.
Provide component expertise/oversight during troubleshooting, root cause analysis, and corrective action. (Section 3.2.2)	Diagnose illnesses and prescribe treatment or medication to cure the illness.
Monitor and improve component health. (Section 3.2.3)	Administer routine check-ups.
Provide technical oversight to off-site vendors refurbishing component. (Section 3.2.4)	Conduct or assist with surgery to correct a problem not curable with medication.
Develop and implement component-focused initiatives. (Section 3.2.5)	Recommend diets, exercise regimens, and activities to improve health of the patient.

3.1.2 Mission Statement

During the development of this report a number of owners suggested that as a means for maintaining focus on the critical equipment owner function(s), a mission statement should be developed. As such, the following general statement summarizes the primary mission of the critical equipment owner at a fossil power plant:

To have engaged, professional, well-trained component specialists who take proactive and effective measures to improve equipment reliability, reduce costs, and prevent plant challenges due to component failures.

3.2 Key Critical Equipment Owner Functions That Add Value

As noted in Table 2-1, this report categorizes five key functions of the critical equipment owner that can add value to an organization either at the corporate or site levels. A description of each major function is provided in the following sections.

3.2.1 Develop and Facilitate Execution of Long-Range Component Maintenance Strategies



Key Human Performance Point

One of the key functions of a critical equipment owner is to assist with the development and execution of long-range maintenance strategies for various components within their scope of responsibility.

Of these maintenance strategies, some are based directly on the criticality of the equipment with regard to generation of power:

- Preventive maintenance – Assist with the identification of preventive maintenance activities and their recommended frequencies.
- Condition-based maintenance – Assist in developing condition-based maintenance plans using current technologies and industry-wide guidance for periodicity.
- Obsolescence – Provide input regarding anticipated obsolescence, recommended actions, and potential sources of suitable alternative components or assemblies.
- Aging management – Provide life-cycle management input regarding the anticipated life expectancy of the component, as well as input to repair versus replacement analyses.
- Condition monitoring – Assist maintenance and system owners with component-specific monitoring requirements to optimize component reliability and performance.
- Equipment surveillance – Review operator-round data to identify condition-directed maintenance requirements compiled during operator surveillance.

However, the critical equipment owner can also play an important role in suggesting and developing improvement initiatives for various components because of their technical expertise and knowledge of component performance issues.

Another long-range strategic area where the critical equipment owner can contribute is in the development of critical spares. In particular, the critical equipment owner can identify and recommend replacement items, assist in developing bills of materials (BOMs), and help identify potential sources of the spare/replacement items in the supply chain.

One of the difficulties of accomplishing this function is the ability to maintain both a long-term and short-term focus relating to their line of equipment. Many times, the critical equipment owner is forced to spend far too much time on emergent issues and is unable to devote time for the long-term, strategic planning that is also necessary. The guidance provided in Section 4 of this report regarding how the critical equipment owner interfaces with the maintenance and system owners can assist in enabling the critical equipment owner to maintain both the short-term and long-range focus.

3.2.2 Provide Component Expertise/Oversight

Inevitably, as plants and their components age, problems are going to arise.



Key Human Performance Point

The critical equipment owner can provide valuable assistance both proactively and reactively to address emergent and immediate component performance issues.

Proactively, the critical equipment owner should provide technical expertise and support to the maintenance and operations organizations. This support may include the following:

- Coordinating with the equipment manufacturer to establish appropriate preventive maintenance activities and their frequency
- Coordinating with operations and condition-based surveillance personnel as they provide feedback to the system owner to initiate condition-directed maintenance activities
- Working with maintenance personnel to assist in the performance of preventive and condition-directed maintenance work
- Assisting operations personnel with technical input regarding the component's design and performance parameters

If and when performance problems occur with a given component, the critical equipment owner can provide assistance leading or supporting the following activities:

- Troubleshooting the component performance problem, identifying probable causes, and recommending actions to return the component to service
- Performing root cause analyses of component performance problems
- Recommending corrective action for components not performing as designed

Similarly, the critical equipment owner should provide technical expertise to other engineering organizations. This support may include the following:

- Recommending design modifications, component refurbishment or replacement
- Preparing or reviewing design modification packages
- Preparing or reviewing refurbishment specifications
- Providing input and evaluating bids for replacement components
- Providing input to purchase requisitions and/or specifications

3.2.3 Monitor and Improve Component Health



Key Human Performance Point

An ongoing function of the critical equipment owner is to monitor and improve component health.

The critical equipment owner, in concert with the equipment manufacturer and the system owner, should perform the following activities in this ongoing role:

- Coordinate with the equipment manufacturer to establish appropriate preventive maintenance activities and their frequency.
- Review equipment condition-monitoring results for each particular component to initiate repairs and/or condition-directed maintenance activities.
- Evaluate maintenance history and work requests.
- Review, compile, and input operator-rounds/surveillance data to enhance maintenance activities.
- Assess equipment reliability.

3.2.4 Provide Technical Oversight to Off-Site Vendors Refurbishing Components

Cases inevitably will arise with aged components where refurbishment is necessary and it is most cost-effective to have it performed by an off-site vendor. When this scenario arises, the critical equipment owner should perform the following functions:

- Assist with vendor selection, qualification, procurement of services, and supply chain management.
- Prepare and/or provide input to technical refurbishment specifications.
- Establish unique critical refurbishment activities.
- Provide oversight of quality control activities (vendor surveillance, witness/hold points).



Key Human Performance Point

Care should be taken to use established processes for conducting vendor oversight activities, to ensure that personnel visiting the manufacturer's facility are adequately trained on how to perform these activities, and to ensure that appropriate briefings are performed prior to overseeing vendor activities.

3.2.5 Develop and Implement Component-Focused Initiatives

Because of regulations, industry-operating guidance, or economy of scale, there are some component groups that are typically managed through separate technical initiatives either at the plant or corporate level. The critical equipment owner may in fact be designated as the owner for one or more of these initiatives, depending on the organizational structure at the plant site. As discussed in more detail in Section 3.3, the general types of components most often managed by the critical equipment owner may include but are not limited to the following:

- Valves
- Pumps
- Motors
- Breakers and switchgear
- Fans

3.3 Components Most Often Assigned a Critical Equipment Owner

During the development of this report, owners indicated that a very wide range of components either had at one time or currently have a critical equipment owner assigned to assume certain component-related responsibilities. Tables 3-2 and 3-3 list various components that may have a critical equipment owner assigned to them. Each table also indicates whether there is a high, medium, or low likelihood of having a critical equipment owner for each particular type or group of equipment.

3.3.1 Mechanical Components

Table 3-2 lists typical mechanical components and the likelihood that owners have typically assigned a critical equipment owner for that particular item.

Table 3-2
Typical Mechanical Components

High Likelihood of Critical Equipment Owner for These Components	Medium Likelihood of Critical Equipment Owner for These Components	Low Likelihood of Critical Equipment Owner for These Components
Valves and operators	Cranes and hoists	Boiler
Pumps	High-energy piping	Pulverizer
Fans	Condenser	Feedwater heaters
		Hoppers
		Bottom ash dewatering bins
		Air compressors
		Turbine

3.3.2 Electrical Components

Table 3-3 lists typical electrical components and the likelihood that owners have typically assigned a critical equipment owner for that particular item.

**Table 3-3
Typical Electrical Components**

High Likelihood of Critical Equipment Owner for These Components	Medium Likelihood of Critical Equipment Owner for These Components	Low Likelihood of Critical Equipment Owner for These Components
Electric motors	Cables	Generator
Breakers and switchgear	Relays	Lighting
	Transmitters	Connectors
	Motor control centers	
	Precipitators	

3.3.3 Instruments and Controls

At most fossil plants, there are not critical I&C equipment owners because most systems have a dedicated team of I&C personnel associated with the majority of the 11 primary systems illustrated in Figure 1-4.

4

CRITICAL EQUIPMENT OWNER SKILLS, ATTRIBUTES, AND STAFFING

The following section attempts to characterize the skills, experience, and performance attributes of the critical equipment owner at a fossil power plant. Care should be taken not to interpret these as minimum requirements for qualification or certification purposes, but rather as a benchmark for use within each owner's plant-specific program. This report recognizes that it is rare that any one individual will exemplify all of the characteristics described below.

4.1 Typical Position Summary

As noted in Section 3, the primary roles of the critical equipment owner can be summarized in the following five areas of responsibility:

- Develop and facilitate execution of long-range component maintenance strategies. (Section 3.2.1)
- Provide component expertise and oversight during troubleshooting, root cause analysis, and corrective action. (Section 3.2.2)
- Monitor and improve component health. (Section 3.2.3)
- Provide technical oversight to off-site vendors refurbishing components. (Section 3.2.4)
- Develop and implement component-focused initiatives. (Section 3.2.5)

4.2 Typical Expertise and Experience Level

Table 4-1 describes typical expertise and experience levels for a critical equipment owner. At a fossil power plant, however, the critical equipment owner tends to be the individual with significant years of plant experience and not necessarily a relatively inexperienced degreed engineer.

Table 4-1
Typical Expertise and Experience Levels

Critical Equipment Owner
Completion of applicable apprenticeship program or 10 years applicable trade experience, and a high school diploma or equivalent; or
Five years of experience in maintenance, engineering, or fossil plant operations with AAS degree in engineering or related physical science; or
Three years of experience in maintenance, engineering, or fossil plant operations with a BS degree in engineering or related physical science.

The research conducted during the development of this report suggests that the critical equipment owner, because of experience and expertise, tends to retain the assignment for a long period of time. However, the research also suggested that the critical equipment owner may have ancillary responsibilities, depending on the organizational structure of the utility/site. This report does not imply or recommend the amount of time each critical equipment owner devotes on a weekly or monthly basis to performing the functions described herein. As such, it remains the responsibility of the utility, site, or plant management to determine the appropriate percentage of time devoted to critical equipment owner functions.

4.3 Typical Competencies and Skills

The following describes skills and competencies common among many individuals performing the critical equipment owner functions described in the previous sections. Care should be taken not to interpret these as minimum requirements for qualification or certification purposes, but rather as a benchmark for use within each owner’s plant-specific program.

- Communication skills
 - Good verbal skills for communicating component conditions and work activities
 - Good rapport with OEMs and for interfacing with component refurbishment vendors
 - Ability to collaborate and coordinate with numerous organizations within and outside the utility
- Technical competencies and skills
 - Has knowledge of component design parameters, design characteristics and margins, equipment manufacturing capabilities, component operations and maintenance, and equipment reliability
 - Uses condition monitoring/operator rounds/surveillance data effectively
 - Supports industry initiatives regarding components
 - Is skilled at troubleshooting component problems

- Is recognized as subject matter expert (SME) and as the single point of contact for assigned component/line of components
- Has good problem solving skills
- Provides effective equipment root cause analysis
- Human performance competencies and skills
 - Is engaged, professional, knowledgeable, specialized
 - Has the ability to interface with numerous organizations within the utility and to ensure that roles and responsibilities are respected and understood
 - Maintains good business acumen
 - Is trusted by maintenance and operations
- Planning/organization competencies and skills
 - Takes strong ownership of area of expertise
 - Has ability to maintain focus on long-range equipment reliability goals while simultaneously addressing emergent component performance issues
 - Retains a long-term focus for the health of the component/equipment

4.4 Typical Staffing and Placement

4.4.1 Corporate or Fleet-Wide Staffing



Key O&M Cost Point

Experience suggests that the critical equipment owner function performed at the corporate or fleet level is mostly concerned with standardizing engineering processes associated with specific components, lending support to sites as needed, and developing long-range component health plans.

The staffing of critical equipment owners, by discipline, at the corporate or fleet level, on average is shown in Table 4-2.

Table 4-2
Typical Corporate/Fleet Level Staffing of Critical Equipment Owners

	Approximate Average Staffing Level	Range of Staffing Levels
Mechanical critical equipment owners	Pumps (3) Pulverizers/fans (1) Valves (1) Boilers (3) Turbines (2) High energy piping (1)	Pumps (1-4) Pulverizers/fans (1) Valves (0-1) Boilers (1-4) Turbines (1-2) High energy piping (0-1)
Electrical critical equipment owners	Motors (3) Breakers/switchgear (1) Batteries (1) Relays (1) Generators (1)	Motors (2-4) Breakers/switchgear (1-2) Batteries (0-1) Relays (0-1) Generators (0-1)

4.4.2 Plant-Level Staffing



Key O&M Cost Point

Experience suggests that the critical equipment owner function performed at a particular site tends to focus primarily on the short-range or emergent health of respective components in support of equipment reliability and preventive maintenance activities.

The staffing of critical equipment owners on site, by discipline and on a per-unit basis, is shown in Table 4-3.

Table 4-3
Typical Plant Staffing of Critical Equipment Owners

	Approximate Average Staffing Level
Mechanical critical equipment owners	Pumps (1) Fans (1) Valves (1)
Electrical critical equipment owners	Motors (1) Breakers/switchgear (1)

5

ORGANIZATIONAL INTERFACES AND OUTPUTS

5.1 Operations and Maintenance Interfaces

Figure 5-1 illustrates key interfaces between the critical equipment owner and field personnel from the operations and maintenance organizations. Because these two organizations have frequent contact with the components, the critical equipment owner should seek feedback regarding component performance problems on a regular basis. The figure shows the need for two-way information exchanges between each of these groups with the critical equipment owner. In some plants, the interfaces with these field personnel are viewed as being more important than those interfaces the critical equipment owner has with engineering organizations. As such, in these cases, the critical equipment owner is often assigned to the maintenance organization rather than engineering.

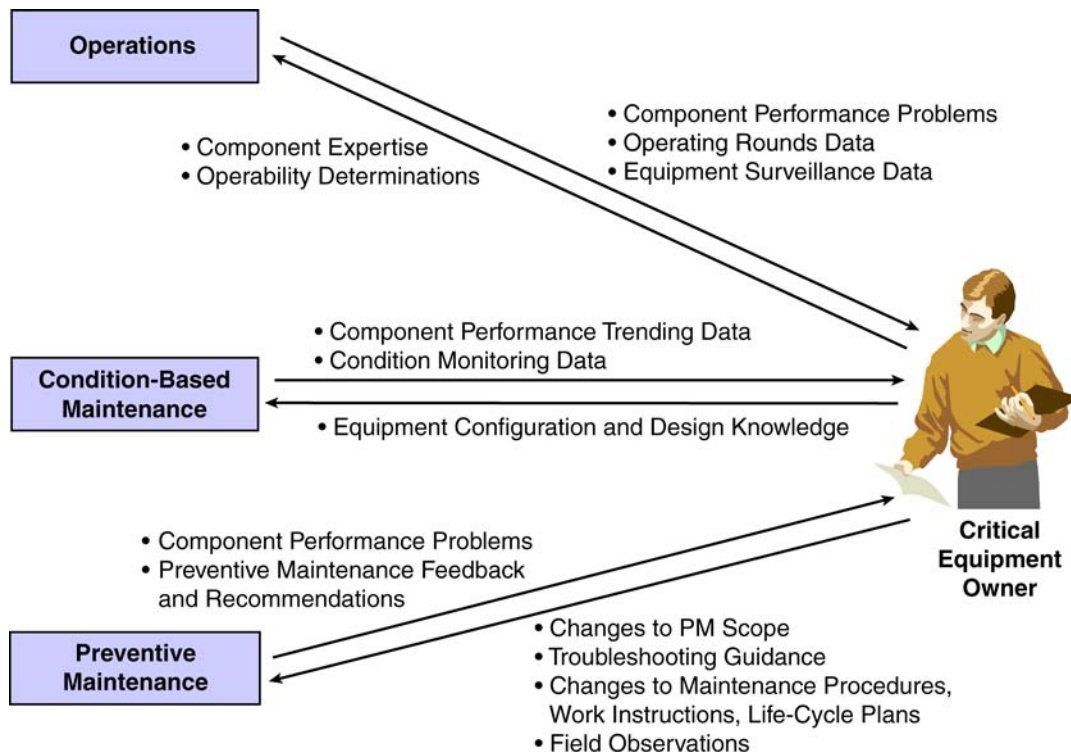


Figure 5-1
Operations and Maintenance Interfaces for the Critical Equipment Owner

Owners should ensure that procedures clearly identify these roles and responsibilities to ensure the most effective use of critical equipment owner personnel.

5.1.1 Coordinating to Optimize Plant Maintenance

Critical equipment ownership is one of the most important parts of a plant maintenance optimization (PMO) process. Therefore, owners of fossil power stations should establish a consistent way of providing critical equipment ownership activities and responsibilities at each plant. Comprehensive guidance regarding the role of the system owner and ways in which that individual can enhance plant maintenance optimization process is provided in *Plant Maintenance Optimization (PMO) – System Owner Handbook* (EPRI Solutions, Inc. Knoxville, TN: 2005, Draft Report). The means by which the critical equipment owners can enhance plant maintenance optimization are provided in the following sections.

5.1.1.1 Preventive Maintenance Organizations



Key Technical Point

Interface with the preventive maintenance organization is an ongoing relationship that directly affects equipment reliability through consistent and effective maintenance activities.

The critical equipment owner should be seen as a valuable source of information to make preventive maintenance instructions more effective, timely, and current based on their knowledge of the component design, functionality, and failure mechanisms. The critical equipment owner should also be the lead interface when a component performance problem has been identified and troubleshooting or corrective maintenance is needed.

The critical equipment owner can offer technical expertise to maintenance personnel about the troubleshooting and repair of the component, which should lead to more effective resolution (elimination of rework) for component problems. Operating experience from the field should be factored by the critical equipment owner into revising maintenance procedures, work instructions, and life-cycle plans. In many cases, field observations of actual conditions are important to making feedback processes most effective.

The critical equipment owner should be receptive to learning about component performance problems from the preventive maintenance organization as input for changing maintenance activities, their frequencies, and the scope of postmaintenance testing. The critical equipment owner should also seek feedback regarding the overall effectiveness of the maintenance performed and its impact on the reliability of the equipment.

5.1.1.2 Condition-Based Maintenance Organizations



Key Human Performance Point

The critical equipment owner should provide equipment configuration and design knowledge to the condition-based maintenance organization as a means of promoting and assessing component health.

The critical equipment owner should obtain condition monitoring data (short term) and component performance trending data (long term) from the condition-based maintenance organization as input for equipment reliability assessments. These data are valuable because they assess component health based on the age of the equipment and can be a valuable tool for predicting the remaining life of the component and for life-cycle planning.

5.1.2 Plant Operations



Key Human Performance Point

The plant operations organization should have a close working relationship with the critical equipment owner because they form an important channel for sharing equipment surveillance data, performance problems, and operating-rounds data.

The critical equipment owner can offer technical expertise to the operators about the design and functionality of the component, which should lead to more effective operation of the equipment. Operating experience from the field should be factored by the critical equipment owner into revising maintenance procedures, work instructions, and life-cycle plans.

5.2 Engineering Interfaces

Figure 5-2 illustrates a number of key interfaces with engineering organizations at a typical plant site.

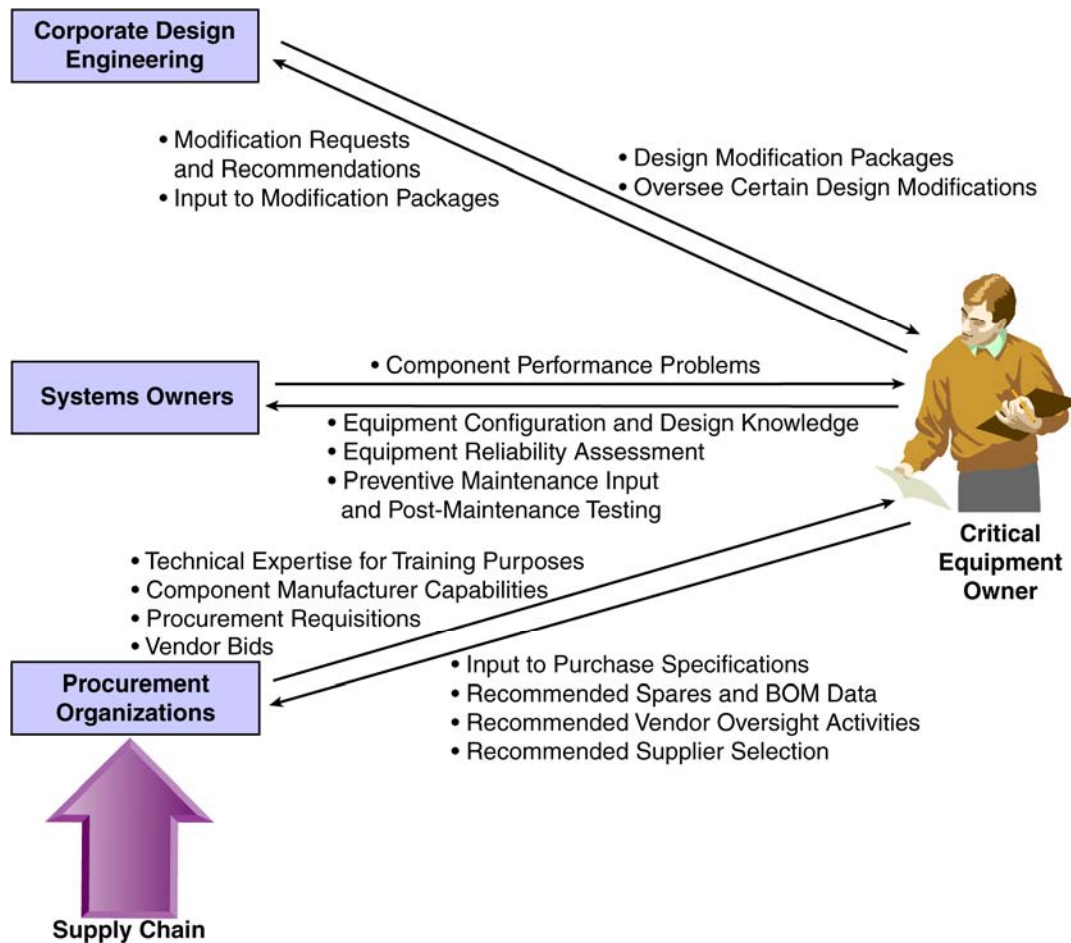


Figure 5-2
Engineering Interfaces for the Critical Equipment Owner

5.2.1 System Owners



Key Technical Point

The interface between the critical equipment owner and the system owner can be made more effective given the understanding that the system owner has a more vertical view of the plant (that is, one particular operating system); whereas the critical equipment owner has a more horizontal view (that is, one group of components, such as a pump, installed in many different operating systems).

The critical equipment owner should seek feedback regarding component performance from all system owners responsible for systems containing their particular component. In the ideal scenario, the component performance feedback obtained from various system owners should be consistent with the feedback received from the operations and/or maintenance organizations.

Critical equipment owners, after compiling equipment reliability assessment data across various plant systems, should prepare the necessary reports and share the trends and issues with the appropriate system owners. They should also be a source for obtaining component-specific configuration and design knowledge, as well as for providing input for preparing equipment reliability assessments.

The critical equipment owners, as already noted in the previous section, should provide input to system owners regarding component PM instructions and testing.

5.2.2 Corporate Design Engineering



Key O&M Cost Point

Given the broad component performance data available to them, the critical equipment owner should provide recommendations regarding possible design modifications and enhancements to improve equipment reliability or extend component life.

Once a design modification has been approved, the critical equipment owner should work closely with the design engineering group, with input from component manufacturers, regarding the scope and application of the proposed design modifications. In some cases, the critical equipment owner may be required to seek potential component manufacturers if the decision has been made to replace the existing component with a suitable alternative. The critical equipment owner may be asked to recommend a particular type or model component in these cases as well (for example, gate valve vs. globe valve). They should also provide input to the modification package to ensure the replacement component is suitable for the intended application(s) and that the replacement component will not adversely affect any design margins.

Once a design modification package has been developed, the critical equipment owner may be required to oversee the implementation of the modification, or as a minimum, review the design modification package to ensure technical accuracy.

5.2.3 Procurement Organizations and the Supply Chain

The critical equipment owner's interface with the procurement organizations is similar in scope to that of design engineering except that in most cases the issues will apply to replacement parts and assemblies rather than the entire component.



Key O&M Cost Point

The critical equipment owner should be a key contributor to establishing recommended spares and completing bill of materials for their scope of components. They should also play a role in recommending qualified vendors for refurbishing existing components and potential suppliers of new replacement components.

The critical equipment owner should work closely with the procurement organization in developing the necessary procurement documents (for example, purchase requisitions, specifications) as well as recommending vendor oversight activities (for example, manufacturing surveillance plans, receiving inspection plans, witness/hold point test and inspection plans, and acceptance criteria). The critical equipment owner may also solicit vendor bids for technical evaluation and selection.

The critical equipment owner should also seek feedback from the procurement organization, and possibly through the vendor audit/qualification group, regarding the current capabilities of a given refurbishment vendor or equipment manufacturer. This interaction should ensure that only qualified suppliers are considered for bidding and are subsequently asked to furnish replacement items or refurbishment services.

5.3 Other Plant Interfaces

Figure 5-3 shows two other key interfaces with organizations at the plant site—training and work planning.

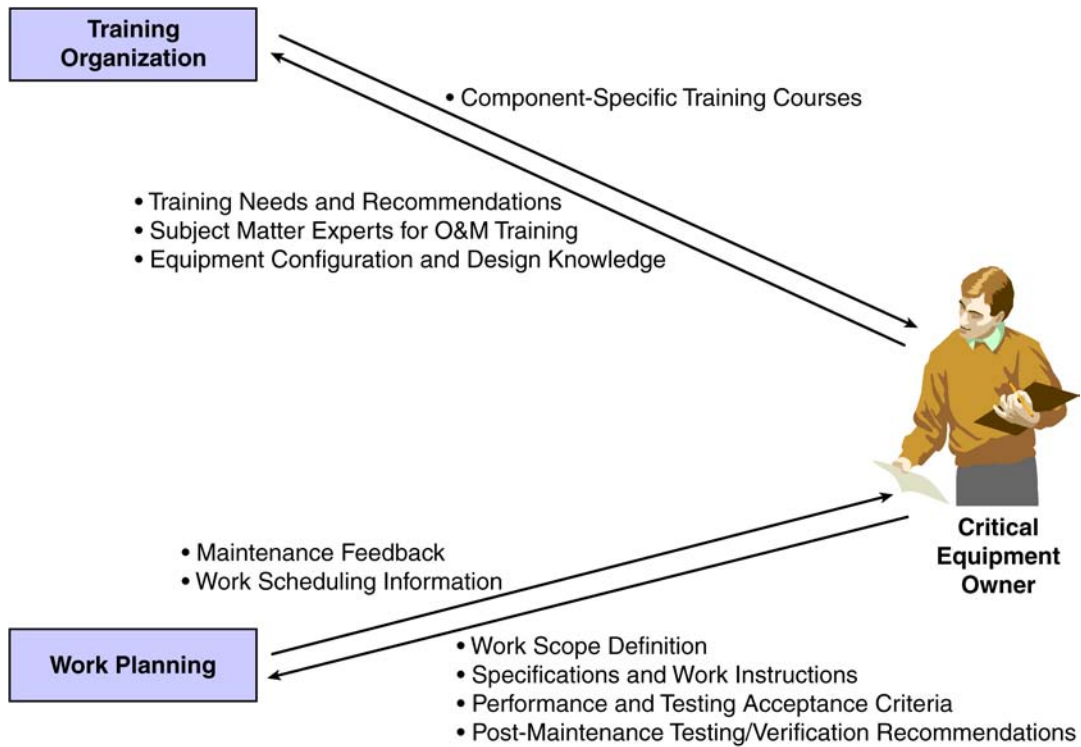



Figure 5-3
Training and Work Planning Interfaces for the Critical Equipment Owner

5.3.1 Training Organization

Key O&M Cost Point

 To support the plant’s ongoing training of maintenance and operations personnel, the critical equipment owner should be sought as the subject matter expert regarding the component design and functionality and as a primary source for recommending the type and scope of component-related training relevant to operations and maintenance personnel.

Through continuous training, the critical equipment owner has an excellent way to share equipment configuration and design knowledge and knowledge of related maintenance activities needed to improve equipment reliability and extend component life.

At many sites, the critical equipment owner is the individual who develops the training and conducts it, although they may also consider the use of equipment manufacturers or maintenance/troubleshooting specialists to assist with training when it is appropriate.

5.3.2 Work Planning



Key O&M Cost Point

Once maintenance has been approved, either through standing procedures or for execution during an outage, the critical equipment owner should work closely with the maintenance planning organization to assist in preparing the necessary work packages and maintenance work instructions.

The critical equipment owner is often the most appropriate individual to establish, define, or revise the work scope and to recommend the postmaintenance testing and verification activities. They may also provide performance testing and acceptance criteria because of their level of technical expertise with the component group.

In cases where it is more appropriate than getting feedback directly from the maintenance organization, the critical equipment owner should also seek feedback regarding the effectiveness of the maintenance through the work planning organization. They should also be aware of work scheduling issues as they arise regarding their particular line of equipment.

5.4 Interfacing with Organizations External to the Utility

Figure 5-4 describes key interfaces the critical equipment owner should develop with organizations external to the utility, including industry users groups, refurbishment service suppliers, and component manufacturers.

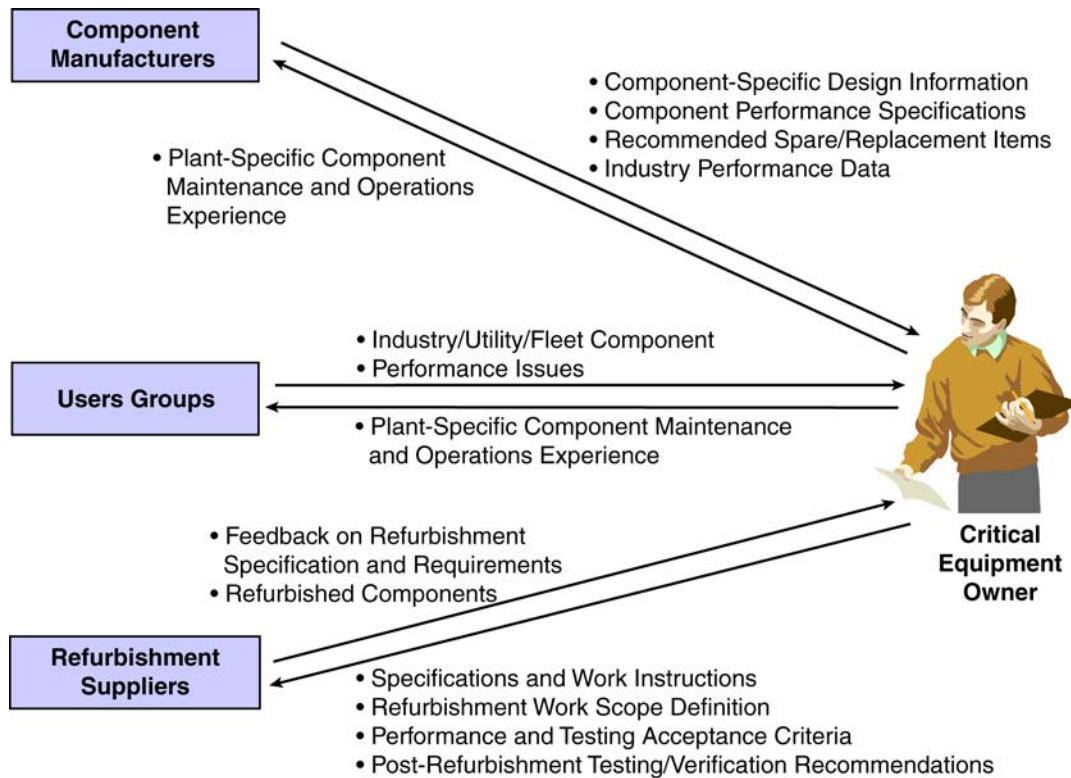



Figure 5-4
External Interfaces for the Critical Equipment Owner

5.4.1 Refurbishment Service Suppliers

As components age, it often becomes necessary to refurbish them, either to extend their life or as an alternative to wholesale replacement with another component.

Key O&M Cost Point

 The critical equipment owner should be the key contributor to defining the refurbishment work scope, preparing the specification and work instructions for the vendor, recommending post-refurbishment testing and verification activities to ensure that the refurbishment was performed correctly, and establishing the appropriate performance and testing acceptance criteria that the vendor must achieve.

The critical equipment owner should develop a means to capture refurbishment information so it can be applied generically, as appropriate, for the broadest application through the equipment line as possible. The critical equipment owner should seek feedback from the refurbishment vendor regarding the accuracy, effectiveness, and workability of the specification and work instructions so improvements can be made to future refurbishment activities. They should also be involved with the receipt and inspection of the refurbished equipment when it is received on site.

5.4.2 Component Manufacturers

As noted in the preceding section, the critical equipment owner should be the primary point of contact between the manufacturer of a replacement component and the plant.



Key O&M Cost Point

The critical equipment owner should provide plant-specific component maintenance and operations experience to the corporate design and procurement organizations. As soon after the decision has been made to replace an existing component that is no longer performing in accordance with design requirements, this information should be forwarded from the design group to the potential component manufacturers.

The critical equipment owner in concert with the design engineering organization should review the bid specification and the request for proposal and should also assist in evaluating the bids for technical merit and suitability. Through these activities, potential equipment manufacturers should be provided with plant-specific design parameters. In those cases where the component manufacturer is also required to install the equipment, the critical equipment owner should work closely with design engineering and maintenance planning to develop the necessary demolition/installation specifications.



Key Technical Point

Once a component manufacturer has been selected and has furnished the equipment, the critical equipment owner should ensure that all necessary technical information accompanying the hardware is provided, the technical information is accurate and current, and it is incorporated into appropriate plant procedures.

This may include recommendations of spare/replacement items and replacement component/part design information. Over the long term, the component manufacturer should be sought for industry-wide component performance data, preventive maintenance enhancements, and obsolescence issues.

5.4.3 Users Groups

Industry/utility users groups can be another valuable source of operating experience for a given line of components that the critical equipment owner should consider. Typically, these users groups are a way to keep abreast of fleet-wide or industry developments that may include any of the following:

- New technologies associated with the component
- Common failure mechanisms and their causes

- New or enhanced preventive maintenance techniques
- Suitable replacement items (subcomponents, parts, and components) due to obsolescence
- New or enhanced equipment operational techniques
- Modification experiences and lessons learned
- Early warning of component degradation

5.5 Equipment Reliability Improvement Initiatives

As noted in Section 3 of this report, because of industry operating guidance or economy of scale, there are some component groups that are best addressed through a broad-based equipment reliability improvement initiative usually managed at the fleet or corporate level. Examples of such initiatives may include the following:

- Benchmarking for pulverizer performance
- Valve motor operator safety enhancements
- High-energy piping inspection intervals
- Boiler efficiency enhancement studies

The critical equipment owner may in fact be designated as the key contact at the plant level for one or more of these initiatives, depending on the organizational structure at the plant site. If this is not the case, however, the critical equipment owner should ensure that there are sufficient means for communicating component information to the manager of the fleet-wide initiative.

5.6 Critical Equipment Owner Outputs and Deliverables

As shown in Figures 5-1 through 5-4, there are number of outputs that the critical equipment owner may be required to deliver to a wide range of recipients. Table 5-1 summarizes these output documents and identifies those organizations most likely to contribute information and to receive the final product.

**Table 5-1
Summary of Critical Equipment Owner Outputs and Deliverables**

Critical Equipment Owner Output/Deliverable	Organizations Contributing Information to Generate the Output Document	Organizations Typically Receiving and Using the Output Document
Condition monitoring plans and guidance	Condition-based maintenance, operator round/surveillance organization Component manufacturer	Condition-based maintenance
Revisions to preventive maintenance procedures	Maintenance Operations System owner Design engineering	Preventive maintenance
Equipment reliability assessment	Maintenance Operations System owners	System owners Fleet component owners/SMEs
Root cause Analyses	Maintenance Operations System owners Fleet component owners/SMEs Component manufacturer	Maintenance Operations System owners Fleet component owners/SMEs Component manufacturer
Input to the system owner's life-cycle management plan	Maintenance Operations System owner Fleet design engineering	Systems owners Fleet component owners/SMEs
Component purchase/repair/refurbishment specifications	Maintenance System owners Fleet design engineering Component manufacturer	Refurbishment vendor Procurement organization
On-line work schedule review	Maintenance System owners Planning/scheduling organization Operations	Work planning Maintenance
Troubleshooting instructions/guides/plans	Maintenance Operations Fleet component owners/SMEs Component manufacturer	Maintenance
Maintenance work instructions and procedures	Maintenance Work planning	Maintenance Work planning
Training material	Maintenance Operations System owners Component manufacturer	Training organization

6

EQUIPMENT RELIABILITY ASSESSMENTS

6.1 Introduction

The critical equipment owner has a responsibility to ensure that the equipment remains reliable and available. Equipment reliability assessments should be made available to system owners so they can compile and determine the overall health of a given system.



Key Technical Point

Equipment reliability assessments may be acceptable for now, but system level health may be on the verge of going bad.

6.1.1 *Integration of Equipment Reliability Assessment Reports*

Equipment reliability assessment reports should be integrated into the overall plant improvement initiatives, equipment reliability efforts, and the budgeting process. The critical equipment owner, who is most likely the individual preparing the reports or compiling the equipment data, should recommend that the reports be used as input to these processes through the interfaces described in Section 4 of this report. In some cases, plant procedures may need to be revised in order to use equipment reliability assessment reporting to its fullest advantage, and the critical equipment owner may not be able to facilitate those changes by themselves.

Equipment reliability assessment reports should target the most appropriate components that add value to the site's equipment reliability and life-cycle management processes. Again, the critical equipment owner should provide input and recommendations regarding the scope of components for which health reports are prepared and used.

6.1.2 *Key Attributes/Content of an Equipment Reliability Assessment*

The content of an equipment reliability assessment report will vary from one utility to the next and is often dictated by the capability of each utility's information technology and related processes. In general, however, an equipment reliability assessment report should include the following information:

- Component identification
- As found, current component condition, by measuring selected component degradation mechanism indicators (See Section 6.2.3.)

- Current component operating status
- Plant-specific and industry operating/maintenance history and experience
- Subjective types of input (for example, anticipated failures based on age and/or critical equipment owner experience)
- Grading criteria and metrics (See Section 5.3 for examples.)
- Recommendations for improving critical equipment conditions (corrective actions)

6.1.3 Data for Equipment Reliability Assessment Reports

EPRI report *System, Component, and Program Health Reporting* (1009745) provides the following guidance regarding data requirements, data sources, and data capture requirements.

6.1.3.1 Data Requirements

After functions, failure modes, and degradation mechanisms are identified, a plan should address development of the required data and their acquisition.

The failure modes, degradation mechanisms, and indicator analysis determine data requirements. Importance determination, greatly affects the identification of failure modes. When the failure modes that need to be detected or monitored have been identified, the listing of required data should be compared to the list of available data. This process determines which failure modes can actually be monitored. It is highly unlikely that all the required data will be available for the monitoring tasks specified. As such, adjustments to the plan may be necessary later based on the probability of the failure modes that cannot be detected at this time. Plan adjustments may include replacement of optimum monitoring tasks with less effective monitoring methods.

The EPRI PM Basis Database is a good source for identifying component failure mode probabilities. Calculations can be performed in the PM Basis Database that can help in making the final maintenance strategy determination.

6.1.3.2 Data Sources

There are two categories of data that can be used in monitoring programs: direct and indirect. The following paragraphs discuss these two categories.

Direct Data – Direct data are typically live plant data with a measurable mechanical or electrical property. Data can come from many sources, including on-line systems, operator rounds, or routine collection. Examples of data are pressures, temperatures, and vibration. Data can be obtained from many sources, including the following:

- Plant computer
- Predictive maintenance routines
- In-service test (IST) program
- Thermal performance program
- System walkdowns

Indirect Data Sources – In contrast to direct data, indirect data sources are typically programmatic. The following sources may provide indirect data:

- Operating experience
- Maintenance feedback
- Historical review of logs
- Work order review
- Condition reports
- Refurbishment reports from vendors

While not as real-time as direct data sources, indirect data can often be a valuable part of effective monitoring and reporting.

6.1.3.3 Data Capture Requirements

A standard procedure that defines the purpose and requirements for data capture, including the collection of direct and indirect sources, should be established. Identify the organizational requirements necessary to support the data collection requirements and define the scope of the data collection activities.

In addition, determine the hardware and software tools necessary to support direct and indirect data collection activities, including identification of required qualifications, skill sets, and subject-matter expertise needed to execute and support the data collection activities. The training requirements necessary to execute the data collection activities should include all organizations involved with any aspect of data collection, whether these are direct or indirect data sources.

6.1.4 Data Trending and Analysis for Equipment Reliability Assessment Reports

EPRI report *System, Component and Program Health Reporting* (1009745) provides the following guidance regarding data trending and analysis.

After data are acquired, a competent staff for trending and analysis must be in place. The data cannot provide benefit without trending and analysis. Establish standard protocols and formats for trending and to ensure that data are acquired, trended, and analyzed at the appropriate frequency to identify degradation early.

The areas of trending and analysis are typically determined by the recommended frequencies and scope of monitoring derived within the maintenance basis or other maintenance optimization effort. The EPRI PM Basis Database is a good source for identifying monitoring tasks and frequency at the component level.

It is vital that those engaged in trending and analysis are trained in the functions they are undertaking and have detailed guidance on actions to take when adverse trends are identified.

6.2 Determining Appropriate Component Attributes

EPRI Report *System, Component, and Program Health Reporting* (1009745) states in part:

As with system issues, the structured development of a monitoring program requires a full understanding of component functions, the potential degradation mechanisms, and the precursor indicators of those mechanisms.

When implementing a system or component health program, the first step is to understand the required function of the equipment being considered. Once function is understood, the impact of degradation or loss can be recognized and a plan to monitor for such degradation can be developed.

6.2.1 Critical Equipment Failure Modes

Critical equipment failure modes affect components such as pumps, motors, breakers, and valves. These failure modes are typically failures of the parts/assemblies within the components. Examples of failure modes of subcomponents include bearings, seals, shafts, valve stems, valve disks, rotors, and insulation. The EPRI PM Basis Database should assist in proactively identifying component failure modes, degradation mechanisms, indicators, and failure probabilities.

6.2.2 Equipment Degradation Mechanisms

Most degradation mechanisms can be detected using one of many technologies. Detection may be direct or indirect (for example, by monitoring a second-level parameter). Monitoring for identified degradation mechanisms is possible, in most cases.

The degradation mechanism for component failure modes can often appear similar to the system degradation mechanisms primarily because it can be argued that all systems are made up of components. However, the monitoring plan should be built with a specific hierarchy—system functions at the top, working down to the subcomponent level. The top-level view will keep the overall objective of the system in mind without being clouded by the subcomponent problems; therefore, the plan does not lose sight of the important system function.

6.2.3 Equipment Degradation Mechanism Indicators

Component degradation mechanism indicators are often quantifiable and dynamic, that is, they have some measurable mechanical or electrical property. By measuring these indicators, the analyst may begin to identify a degradation mechanism, which then may indicate the onset of a failure mode within the component. Some examples of indicators may include any of the following:

- Vibration signature
- Lubricating oil analysis
- Infrared signature
- NDE techniques (ultrasonic, eddy current)
- Acoustics
- *In situ* inspection (unusual noise, smell, or motion)
- Pressure readings
- Electrical testing
- Current signature analysis

6.3 Equipment Reliability Assessment Report Content and Format Examples

The CBM/PdM is a process that requires technologies and people skills, while combining and using all available diagnostic and process data, maintenance histories, operator logs, and design data, to make timely decisions about the maintenance requirements of major/critical equipment.

The system owner relies on all of these data to determine and manage a component's condition, and as noted on Table 6-1, the system owner relies on input provided by each of the critical equipment owners having equipment in that particular system. A recommended method for this

function is for the system owner to develop an Equipment and Condition Indicator (E&CI) Matrix, which is illustrated in Table 6-1. This is a spreadsheet that identifies the equipment, technology, and the frequency of the tasks that are to be performed on the equipment. The system owner also utilizes the system team during this process. It is the responsibility of the system owner to convert the data to information and then take action.

**Table 6-1
Equipment and Condition Indicator (E&CI) Matrix Example**

Base Equipment Test Requirements and Frequency																									
revised 12/8/00 : minor changes to technology frequencies																									
revised 11/27/00 : system names & numbers																									
System Number	Component Description	UNID	Equip. Owner	Critical Y=Yes	Run to Failure Y=Yes	Periodic Surveys								Process Indicators		Continuous		Other							
						Functional Testing	Vibration Analysis	Performance Testing	Infrd Thermography	Lubricant/Fluid Ana	Acosics/Ultrasonics	Motor/Gen Testing	Misc. Elect Testing	Temperature	Pressure	Level Flow	Run Amps/Line Volt	Load/Speed	Starts	Running Hrs/Vol	Online Vibration Moni	Process Chem Para	NDE Testing	Routine Tasks	Operator Rounds
14	Precipitators		Inklebarger	Y																					
14	Precipitator Hoppers	BRF-01-f	Inklebarger																						
14	Dry Fly Ash		Inklebarger																						
153	CEMS		Inklebarger	Y																					
307	Elevators and Cranes		Inklebarger																						
31	HVAC		Inklebarger																						
14	Ash Sluice Water Pump A	BRF-01-f	Leach	N		M						X												D	
14	Ash Sluice Water Pump B	BRF-01-f	Leach	N		M						X												D	
14	Ash Sluice Water Pump C	BRF-01-f	Leach	N		M						X												D	
14	Ash Sluice Water Pump D	BRF-01-f	Leach	N		M						X												D	
14	Fly Ash Sluice Water Pump E	BRF-01-f	Leach	N		M						X												D	
14	Fly Ash Sluice Water Pump F	BRF-01-f	Leach	N		M						X												D	
14	Fly Ash Sluice Water Pump G	BRF-01-f	Leach	N		M						X												D	
14	Clinker Grinders A1	BRF-01-f	Leach	N																					
14	Clinker Grinders A2	BRF-01-f	Leach	N																					
14	Clinker Grinders B1	BRF-01-f	Leach	N																					
14	Clinker Grinders B2	BRF-01-f	Leach	N																					
14	Bilge Sump Pump A	BRF-01-f	Leach	N		M																			
14	Bilge Sump Pump B	BRF-01-f	Leach	N		M																			
47	High Pressure Turbine	BRF-01-f	Leach	Y		W	A		Q			X	X		X			X							
47	Intermediate Pressure Turbine	BRF-01-f	Leach	Y		W	A		Q			X	X		X			X							
47	Low Pressure Turbine A	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
47	Low Pressure Turbine B	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
3	Boiler Feed Pump Turbine A	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
3	Boiler Feed Pump TurbineB	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
119	High Pressure Turbine Generator	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
119	Low Pressure Turbine Generator	BRF-01-f	Leach	Y		W			Q			X	X		X			X							
118	HP Exciter	BRF-01-f	Leach	Y		W			Q									X							
118	LP Exciter	BRF-01-f	Leach	Y		W			Q									X							
35	Stator Cooling Water Pump A	BRF-01-f	Leach	N		BW						X													
35	Stator Cooling Water Pump B	BRF-01-f	Leach	N		BW						X													

7

BENEFITS AND LESSONS LEARNED

7.1 Benefits of Maintaining Critical Equipment Owners

The purpose of this section is to provide an overview of the actual and perceived benefits of maintaining integrated and involved critical equipment owners. Depending on the organizational structure of the utility, the benefits are grouped for corporate level and at the plant site.

7.1.1 *Corporate Level*

The primary benefits of the critical equipment owner function at the corporate or fleet level are as follows:

- Fleet overview provides for:
 - Establishing consistent processes
 - Applying consistent evaluation and resolution of component-specific issues
 - Developing consistent long-range strategy for component reliability
- Standardization of responsibilities and improved efficiency
- Reduced costs by adopting a fleet approach to component purchases and repairs

7.1.2 *Plant Level*

The primary benefits of the critical equipment owner function at the plant level are as follows:

- Work with craft labor to resolve in-progress issues.
- Work with planning to resolve issues that are coming up or in the schedule.
- Protect system owners so they can focus on performance monitoring and system long-term planning.
- Be a single point of contact for component issues including troubleshooting of failures and root cause/failure analysis.
- Focus on component long-range planning.
- Develop on-site subject matter expert at the level of the component-specific vendor.
- Develop consistent vendor contacts through the component owner.

- Implement consistent PM for like or similar lines of components.
- Interface with vendors as a primary contact.
- Consistently interface with the maintenance organization.
- Offer procurement support.
- Reduce costs by predicting equipment performance.
- Provide component expertise at the site level, in addition to expertise at corporate, which facilitates better response to critical component issues.
- Have specialized technical expertise in each major critical component.
- Focus on common components across all systems.
- Have better knowledge of the component group.
- Offer more uniform treatment for maintenance and repair.
- Provide for long-term vision of component's health.
- Maintain centralized information and expertise on components.
- Have a component focus to improve reliability versus just a system focus by system owners.
- Focus on proactive improvement of component reliability to reduce O&M costs.

7.2 Lessons Learned

Utilities maintaining the critical equipment owner function have not done so without problems along the way. Listed below are some lessons learned regarding the use of the critical equipment owner at a fossil power plant that should be helpful to those utilities considering adopting this type of organizational structure:

- The plant critical equipment owner should be the go-to person when there are questions or issues with the component.
- Fleet/corporate critical equipment owners in concert with system owners should retain focus on long-range issues and should not get bogged down in day-to-day plant issues.
- Critical equipment owners should be proactive to look for ways to improve equipment reliability.
- Critical equipment owners are effective when they are knowledgeable of industry initiatives, operating experience, and current technologies.
- Critical equipment owners should remain the primary interface with OEMs and third-party organizations.
- Communication is the key to ensuring that all interfaces are effective.

- Critical equipment owners must be knowledgeable of component health (current and future, and integrated vertically into the plant decision-making process, corrective actions, pending modifications, improvement corrective actions, and status improvement).
- Critical equipment owners should be rewarded for being proactive and preventing component problems, not solely for fixing problems reactively.

8

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A

COMPILATION OF KEY POINTS

A.1 Key O&M Cost Points



Key O&M Cost Point

Emphasizes information that will result in reduced purchase, operating, or maintenance costs.

Section	Page	Key O&M Cost Point
4.4.1	4-3	Experience suggests that the critical equipment owner function performed at the corporate or fleet level is mostly concerned with standardizing engineering processes associated with specific components, lending support to sites as needed, and developing long-range component health plans.
4.4.2	4-4	Experience suggests that the critical equipment owner function performed at a particular site tends to focus primarily on the short-range or emergent health of respective components in support of equipment reliability and preventive maintenance activities.
5.2.2	5-5	Given the broad component performance data available to them, the critical equipment owner should provide recommendations regarding possible design modifications and enhancements to improve equipment reliability or extend component life.
5.2.3	5-5	The critical equipment owner should be a key contributor to establishing recommended spares and completing bill of materials for their scope of components. They should also play a role in recommending qualified vendors for refurbishing existing components and potential suppliers of new replacement components.
5.3.1	5-7	To support the plant's ongoing training of maintenance and operations personnel, the critical equipment owner should be sought as the subject matter expert regarding the component design and functionality and as a primary source for recommending the type and scope of component-related training relevant to operations and maintenance personnel.
5.3.2	5-7	Once maintenance has been approved, either through standing procedures or for execution during an outage, the critical equipment owner should work closely with the maintenance planning organization to assist in preparing the necessary work packages and maintenance work instructions.

Section	Page	Key O&M Cost Point
5.4.1	5-8	The critical equipment owner should be the key contributor to defining the refurbishment work scope, preparing the specification and work instructions for the vendor, recommending post-refurbishment testing and verification activities to ensure that the refurbishment was performed correctly, and establishing the appropriate performance and testing acceptance criteria that the vendor must achieve.
5.4.2	5-9	The critical equipment owner should provide plant-specific component maintenance and operations experience to the corporate design and procurement organizations. As soon after the decision has been made to replace an existing component that is no longer performing in accordance with design requirements, this information should be forwarded from the design group to the potential component manufacturers.

A.2 Key Technical Points



Key Technical Point

Targets information that will lead to improved equipment reliability.

Section	Page	Key Technical Point
5.1.1.1	5-2	Interface with the preventive maintenance organization is an ongoing relationship that directly affects equipment reliability through consistent and effective maintenance activities.
5.2.1	5-4	The interface between the critical equipment owner and the system owner can be made more effective given the understanding that the system owner has a more vertical view of the plant (that is, one particular operating system); whereas the critical equipment owner has a more horizontal view (that is, one group of components, such as a pump, installed in many different operating systems).
5.4.2	5-9	Once a component manufacturer has been selected and has furnished the equipment, the critical equipment owner should ensure that all necessary technical information accompanying the hardware is provided, the technical information is accurate and current, and it is incorporated into appropriate plant procedures.
6.1	6-1	Equipment reliability assessments may be acceptable for now, but system level health may be on the verge of going bad.

A.3 Key Human Performance Points



Key Human Performance Point


Denotes information that requires personnel action or consideration in order to prevent injury or damage or to ease completion of the task.

Section	Page	Key Human Performance Point
3.2.1	3-2	One of the key functions of a critical equipment owner is to assist with the development and execution of long-range maintenance strategies for various components within their scope of responsibility.
3.2.2	3-3	The critical equipment owner can provide valuable assistance both proactively and reactively to address emergent and immediate component performance issues.
3.2.3	3-4	An ongoing function of the critical equipment owner is to monitor and improve component health.
3.2.4	3-5	Care should be taken to use established processes for conducting vendor oversight activities, to ensure that personnel visiting the manufacturer’s facility are adequately trained on how to perform these activities, and to ensure that appropriate briefings are performed prior to overseeing vendor activities.
5.1.1.2	5-3	The critical equipment owner should provide equipment configuration and design knowledge to the condition-based maintenance organization as a means of promoting and assessing component health.
5.1.2	5-3	The plant operations organization should have a close working relationship with the critical equipment owner because they form an important channel for sharing equipment surveillance data, performance problems, and operating-rounds data.

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