

69 Maintenance Management & Technology

Program Overview

Program Description

This program helps plant operators improve maintenance processes and technologies within today's cost constraints to increase plant availability. All major process elements are covered, including maintenance basis, work management, continuous improvement, corrective action, and outage management. The technology focus is to develop and deliver an integrated approach that combines condition-based maintenance with risk-informed maintenance decision support. The program supports self-assessments by collaborating with members to develop a maintenance excellence matrix supported by ongoing analyses of performance metrics. The Plant Reliability Optimization User Group provides key technical guidance.

Industry Needs and Issues Addressed

- Due to decreasing reserve margins, the fossil electricity generation industry needs to sustain high plant availability despite increasingly constrained maintenance resources.
- Plants expect to lose staff members with valuable experience in planning, performing, and managing maintenance tasks.
- Plants seeking to optimize maintenance at reduced cost by implementing condition-based maintenance programs need effective methods to assess equipment condition.
- To achieve cost and reliability goals, plants require a risk-informed basis for prioritizing the use of scarce maintenance resources.

Impact

- Operation and maintenance excellence through an integrated approach that includes process improvements, technologies, and staff training
- Increased maintenance effectiveness, yielding less rework and higher plant availability
- Optimized use of limited maintenance resources through processes and strategic technologies
- Increased plant availability through improved outage management and performance

Key Accomplishments

- Development and application of Plant Reliability Optimization (PRO) processes at members' facilities
- Development of a widely used enterprise software tool, PlantView, which facilitates sustained high performance derived from processes such as PRO
- More than 100 technical reports, technical updates, and software products produced over the past decade that cover all aspects of maintenance planning and execution
- Development of technical basis for a risk-informed approach to production optimization and resource allocation

Current Year Objectives

- Integrate results of EPRI research into major component damage mechanisms with mature maintenance processes such as Plant Reliability Optimization (PRO)
- Complete revisions of EPRI's Maintenance Excellence Matrix
- Document effective corrective action program for fossil power generation plants
- Document continuous improvement techniques applicable to fossil power generation
- Create database of component failure probabilities that supports new risk-informed approaches to maintenance resource prioritization

- Collect industry case studies, in which on-line monitoring systems facilitated early detection of component degradation, for use as a failure signature database
- Launch industry data repository on metrics relating to fossil operations and maintenance

Industry Involvement

- Estimated 2009 funding: \$1.8M

Program Technical Lead

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Summary of Projects

Project Number	Project Title	Value
P69.001	User Groups, Training, and Industry Data	This project supports EPRI's Plant Reliability Optimization User Group (PROUG). Other activities include sponsorship of the annual EPRI Predictive Maintenance Workshop, workshops and webcasts on current maintenance topics, and collaborative development of key industry metrics relating to fossil plant operations and maintenance.
P69.002	Fossil Plant Maintenance Processes	This project focuses on maintenance process development and improvement. Reports cover work management, outage planning/execution, corrective action, continuous improvement, maintenance basis, predictive maintenance, and vendor management. This project also explores improved integration of major component reliability in existing maintenance processes.
P69.003	Fossil Plant Maintenance Technology	This project supports research on a range of technologies that facilitate deployment of optimum maintenance processes for fossil power generation. Those technologies include equipment monitoring and diagnostics for improved condition-based maintenance and a risk-informed approach to maintenance resource allocation.

Project Descriptions

P69.001 User Groups, Training, and Industry Data (062022)

Issue

Maintenance engineers, planners, and system owners need information on current technology and processes to achieve high performance in plant availability and production costs. This requires workshops, conferences, and user groups that enable peer information exchange and technology gap identification. Member collaboration to share best practices is essential to improving plant reliability. Industry data on metrics is needed to support ongoing self-assessments by members.

Description

The Plant Reliability Optimization User Group (PROUG) provides a structure for sharing peer information about, and experience with, fossil plant maintenance. That structure includes technical workshops, conferences, and webcasts on current topics. Examples include the new combined annual Predictive Maintenance, Infrared, and Vibration Technology Conference held each summer; training in new

technologies, such as the use of risk-informed maintenance; and a database of leading metrics pertaining to plant operations and maintenance.

Value

- Proven methods for employing existing maintenance processes and supporting new technologies to improve plant reliability
- Assistance in self-assessment through the use of effective leading metrics
- Access to peer-reviewed procedures and practices through participation in workshops, conferences, and webcasts

How to Apply Results

Members will receive the most value by participating in the Plant Reliability Optimization User Group, annual Predictive Maintenance Workshop, topical webcasts, and training sessions. The database of industry metrics will enhance EPRI's Maintenance Excellence Matrix to assist self-assessments. By adding key leading metrics with ranges of values, future users of EPRI's Maintenance Excellence Matrix can associate key process elements with these metrics. The enhanced Maintenance Excellence Matrix will be a "living document," updated periodically and distributed as a user-friendly Excel database.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Plant Reliability Optimization User Group: Participation in the annual Plant Reliability Optimization User Group Meeting and periodic webcasts. Participants also will have access to the PROUG web forum.	12/31/2009	Technical Resource
Annual Conference on Predictive Maintenance Technology: Participants in this project can register for a reduced fee for EPRI's annual Predictive Maintenance Technology Conference. Starting in 2008, this conference combines the Infrared User Group, the Vibration Technology User Group, and the Predictive Maintenance User Group in a single annual meeting.	12/31/2009	Technical Resource
Annual Workshop on Selected Maintenance Topic: A two-day workshop will be conducted at EPRI's Charlotte office in 2009 on a member-selected topic relevant to fossil power plant maintenance. Topics will be limited to those not covered by the PROUG and the annual Predictive Maintenance Conference.	12/31/2009	Technical Resource
Industry Data Repository on Maintenance Metrics: To enhance the use of EPRI's Maintenance Excellence Matrix, an initial technical update will identify key leading metrics with ranges of values derived from industry research and various user group meetings. Ultimately, the data repository will be incorporated into the Maintenance Excellence Matrix software to be developed under Project 69.002.	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Plant Reliability Optimization User Group: Participation in the annual Plant Reliability Optimization User Group Meeting and periodic webcasts. Participants also will have access to the PROUG web forum.	2010	Technical Resource
Annual Conference on Predictive Maintenance Technology: Participants in this project can register for a reduced fee for EPRI's annual Predictive Maintenance Technology Conference in 2010. Starting in 2008, this conference combines the Infrared User Group, the Vibration Technology User Group, and the Predictive Maintenance User Group in a single annual meeting.	2010	Technical Resource
Equipment Risk Management Workshop and Training: A two-day workshop will be provided on risk-informed approaches to maintenance task prioritization, capital utilization, and outage task optimization. Training on new EPRI technology related to risk-informed maintenance also will be provided.	2010	Technical Resource
Webcasts on Fossil Plant Maintenance Topics: EPRI will arrange for industry experts to provide two 90-minute webcasts during 2010 on emerging topics of interest to fossil power plant maintenance staff. Advisors will assist in the selection of topics.	2010	Technical Resource
Plant Reliability Optimization User Group: Participation in the annual Plant Reliability Optimization User Group Meeting and periodic webcasts. Participants also will have access to the PROUG web forum	2011	Technical Resource
Annual Conference on Predictive Maintenance Technology: Participants in this project can register for a reduced fee for EPRI's annual Predictive Maintenance Technology Conference in 2011. Starting in 2008, this conference combines the Infrared User Group, the Vibration Technology User Group, and the Predictive Maintenance User Group in a single annual meeting.	2011	Technical Resource
Annual Workshop on Selected Maintenance Topic: A two-day workshop will be conducted at EPRI's Charlotte office in 2011 on a member-selected topic relevant to fossil power plant maintenance. Topics will be limited to those not covered by the PROUG and the annual Predictive Maintenance Conference.	2011	Technical Resource
Industry Data Repository on Maintenance Metrics: To assist in the use of EPRI's Maintenance Excellence Matrix, this repository will update and reissue a 2009 technical update identifying key leading metrics, with ranges of values for these metrics as derived from research and various user group meetings.	2011	Technical Update

P69.002 Fossil Plant Maintenance Processes (062023)

Issue

Many fossil plants operators lack knowledge of fundamental processes needed to achieve top performance in reducing maintenance costs, improving the quality of maintenance, reducing outage durations, avoiding unplanned downtime, and enhancing safety. They need guidance in outage planning/execution, preventive maintenance, backlog management, work close-out, inventory management, and human error reduction. A collaborative approach to applied research ensures the results are readily useable by member organizations. The need to sustain a high level of fossil plant performance will increase in the future as generation reserve margins decrease, replacement power costs increase, and investors demand continued reductions in operating costs.

Description

This project focuses on maintenance process development and improvement. Technical reports cover detailed aspects of the primary process elements such as work management, maintenance basis, outage planning/execution, corrective action, and continuous improvement. Additional process work will improve the EPRI Maintenance Excellence Matrix used to assist in member self-assessments. A new initiative starting in 2008 will examine the need for tighter integration between major component reliability research and maintenance processes. Subsequent work in 2009-2011 will address specific gaps in this integration.

Value

- Significant benefits are achieved by implementing comprehensive maintenance process improvements in a systematic and proven manner. This is the first step for any organization seeking top-tier performance.
- Technical reports covering specific maintenance topics are valuable reference documents used by new staff members in planning and executing maintenance activities.
- Worker safety improves through the use of standard maintenance procedures, effective job planning, and management oversight.
- Plant availability increases by reducing outage duration through better planning and reduced rework due to improved execution of maintenance tasks.
- Adding proven research in improving major component reliability to existing maintenance processes provides maximum value.

How to Apply Results

The updated Maintenance Excellence Matrix is the springboard to improving fundamental processes, which in turn improve operational performance and reduce maintenance costs. Members can conduct maintenance self-assessments using this MS-Excel database. To fully understand technical results and enhance their application, advisors are encouraged to participate in the technical advisory groups formed to guide the development of specific products. Through their involvement, members become more familiar with the reports, which allows easier implementation. The information contained in the technical reports can be integrated into new employee and continuous improvement training. Technical content can be used to update old or develop new maintenance procedures. Members also benefit from topical webcasts conducted after the release of selected reports. In addition, EPRI's PlantView software will be enhanced through a separate collaborative effort to include the latest findings from research on maintenance process improvements.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
<p>Update of EPRI Maintenance Excellence Matrix: The redesign of EPRI's Maintenance Excellence Matrix was initiated in 2008. In 2009, this work will be completed and result in a MS-Excel database that provides the ability to navigate through and apply the updated matrix to self-assessment processes.</p>	12/31/2009	Software
<p>Integration of Major Component Reliability with Maintenance Processes: In 2008, a technical report identified gaps in current maintenance processes that could be filled through tighter integration of Major Component Reliability research results with processes such as Plant Reliability Optimization. In 2009, a second report will be produced that focuses on one of the major gaps identified in the 2008 report. The specific topic will be selected in late 2008 and likely will involve boiler, turbine, or generator components.</p>	12/31/2009	Technical Report
<p>Instituting an Effective Corrective Action Program: The Corrective Action Program (CAP) guideline will describe deficiency identification, screening processes, prioritization, circumstances that require root-cause investigation, and trends that suggest a need for investigation. Various root-cause techniques from the literature will be described, as well as techniques to improve human performance.</p>	12/31/2009	Technical Report
<p>Integrating Continuous Improvement Practices in Maintenance Processes: This report will investigate and document methods to resolve deficiencies in maintenance processes related to program issues, design concerns, or other issues that exceed the normal limits of commercial maintenance management systems.</p>	12/31/2009	Technical Report

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
<p>Outage Management Guidelines – Selected Topic: The series of Technical Update reports that began in 2004 on specific topics related to outage management will be continued in 2010 on a specific outage-related topic to be selected by advisors in late 2009.</p>	2010	Technical Update
<p>Work Management Guidelines: This report will expand the previous research under Program 69 on work management by focusing on a specific topic selected by advisors in late 2009.</p>	2010	Technical Report
<p>Vendor/Contractor Management: This report will compile industry best practices and methods for managing supplemental workforces, focusing on contractual considerations relating to scope and oversight. Guidance on metric development to ensure that work is measurable also will be included. Methods will be proposed for providing feedback on work quality and ensuring proper work closure.</p>	2010	Technical Report

Product Title & Description	Planned Completion Date	Product Type
Human Error Reduction Techniques: This report will expand related research on reducing human error conducted previously in Program 108 (Operations Management and Technology). The report will expand beyond operations to include field applications in the maintenance domain and will provide real plant examples of successes and failures.	2011	Technical Report
Work Close-Out Guidelines: This report will help members summarize completed maintenance activities, parts use, measurements of importance, and capture of as-found and as-left conditions. Field activities important to work close-out include final inspections, management observations, safety inspections, housekeeping, loop testing, clearance removal, post maintenance testing. Methods for baselining post-maintenance equipment performance will also be addressed.	2011	Technical Report
Best Practice Study: Wrench Time Metrics: This study will review typical maintenance metrics to identify leading causes of reduced wrench time. A description of time-motion studies, and investigations of related industry use of wrench-time metrics including industry examples of successes and failures in application, will be included.	2011	Technical Report

P69.003 Fossil Plant Maintenance Technology (062024)

Issue

Technologies to facilitate deployment of advanced maintenance processes are essential to achieving desired performance. These include technologies to support advanced predictive maintenance (PdM), tools, diagnostics, risk, and craft work execution. Many fossil plants lack the fundamental technology needed to achieve top performance. The most important current need is for continued refinement of risk-informed planning and prioritization tools, supported by integrated condition assessment techniques. This will allow plants to optimize the use of scarce resources and maximize availability. The need to sustain a high level of fossil plant performance will increase as reserve margins decrease, replacement power costs increase, and investors demand continued reductions in operating costs.

Description

During 2009-2011, this project will primarily support research in two key emerging areas of maintenance optimization. New methods and supporting databases for applying component and system knowledge to fault diagnostics will be developed and demonstrated. A risk-informed basis for maintenance interval optimization, task prioritization, and cost reduction will be developed. To assist users of the risk analysis tools, development will be coupled with production of supporting databases on component failure probabilities. Other technology topics will support work execution, predictive maintenance, scheduling, and configuration management.

Value

- Members derive more value and can apply EPRI research results more easily through an enterprise-wide platform, such as PlantView.
- Condition-based maintenance -- essential to achieving further reductions in maintenance costs without impacting availability -- needs to extend beyond traditional PdM to major components.

- Risk-informed approaches to maintenance planning improve plant availability by providing a basis for doing the right maintenance at the right time.

How to Apply Results

The software products in this project will provide MS Excel databases that members can use to apply component and system knowledge and perform effective risk analysis. EPRI will facilitate member application of these databases through training courses.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Risk-Based Fossil Component Reliability Database: Effective risk analysis requires valid input data on component failure probability. An MS-Excel database will be developed that contains failure probabilities for common fossil plant equipment. This product will serve as a valuable guide to users of EPRI's new risk analysis software modules, development of which began in 2008.	12/31/2009	Software
Asset Failure Signature Database Development: An MS-Excel database of asset fault signatures will be developed with the format and content specifications defined in the 2008 project on Diagnostic Advisor development. This product will be used as input to EPRI's Case-Based Reasoning process for equipment fault diagnostics.	12/31/2009	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Technology to Assist Fossil Plant Maintenance Craft – Survey of Recent Developments: Advances in technology that help craft laborers save time and improve the quality of their work will be investigated, reviewed and documented. This report will focus on technology rather than process and will cover developments and proven applications in the last five years.	2010	Technical Report
Scrubber Systems Predictive Maintenance – Current Technology and Gaps: This report will document emerging predictive maintenance capabilities that can be applied to new environmental control systems, specifically scrubbers. The capabilities of new technologies and produce benchmarking opportunities will be evaluated. Technology gaps and opportunities for improved predictive maintenance equipment will be analyzed.	2010	Technical Report
Effective Integration and Utilization of Planning and Scheduling Tools: This report will document approaches and methods to better integrate and utilize planning and scheduling tools. These two functions often are carried out using independent tools and processes. This project will focus on ways to integrate the information produced in planning and scheduling.	2011	Technical Report

Product Title & Description	Planned Completion Date	Product Type
Technology to Assist Fossil Plant Configuration Control: This report will evaluate the potential benefits of emerging technologies pertaining to plant/system/equipment configuration. Research will identify current practices and processes and their shortcomings. Work will focus on emerging technologies that can help improve configuration management.	2011	Technical Report
