

## Nuclear Maintenance Application Center

### Program Overview

#### Program Description

Maintenance practices at nuclear power plants play a critical role in a unit's ability to achieve or maintain high safety, reliability and capacity factor levels. To this end, maintenance practices must be continuously reviewed and updated based on industry operating experience and emerging issues. The Nuclear Maintenance Application Center conducts research to identify maintenance advances with the potential to produce substantial plant performance improvements. These activities require accurate assessment of plant needs and tend to be strategic, complex, and longer in duration.

The Nuclear Maintenance Application Center develops maintenance guides and coordinates worldwide technology transfer to drive improvements in nuclear maintenance activities. The program's technical guides, user groups, and workshops reflect best practices and engineering judgment gathered from nuclear plant experience, providing actionable maintenance activities that lead to improved safety, lower costs and higher reliability.

#### Research Value

Research results from the Nuclear Maintenance Application Center provide knowledge and guidance that enable nuclear plants to reduce operations and maintenance costs and improve equipment reliability.

Participants gain access to the following:

- Strategic roadmaps outlining research gaps confronting key issues – such as advanced preventive maintenance and emergency diesel generator systems – and the collaborative actions needed to address these gaps.
- More than 250 maintenance guides for nuclear equipment and systems, which provide source documents for improved procedures and training packages
- A worldwide network of maintenance professionals to help resolve nuclear plant maintenance issues
- Quicker identification of failure-related root causes through the use of a telephone hotline, program staff, and other program participants
- A broader range of maintenance solutions with reduced implementation risks due to collaboration with subject matter experts around the world
- Templates for establishing defensible preventive maintenance practices and intervals for key components and systems
- Industry data and best practices from more than 30 plant visits each year, providing lessons learned for implementing maintenance program improvements

#### Approach

The Nuclear Maintenance Application Center conducts near-term and long-term research to drive maintenance improvements at nuclear plants. Long-term research focuses on new methods and approaches that drive sustained improvements to plant equipment, processes, and practices. Near-term research focuses on maintenance methods and guidance that can help reduce operations and maintenance costs and improve equipment reliability.

There are both base and supplemental components of the Nuclear Maintenance Application Center Program.

Base research focuses on developing maintenance program improvements that can increase equipment reliability and plant performance and on developing and implementing new processes and technologies that can close the gaps between current issues and available solutions.

- **Equipment Issues and Maintenance Guides:** Maintenance strategies, fully informed by operating experience and technology advances, can result in improved equipment reliability, lower operating costs, and higher overall plant reliability. This program area identifies and addresses important maintenance and equipment issues by conducting more than 30 plant visits each year and compiling data from vendors, the Institute of Nuclear Plant Operations, and other industry sources. The maintenance guides aggregate relevant diagnostic and mitigating technical advice for addressing key maintenance issues, providing details on problem identification, troubleshooting, preventive and predictive maintenance, and maintenance tasks.
- **Operations and Maintenance Procedures:** Bringing essential information to the point of decision-making can drive safe and reliable plant and fleet performance. Access to equipment information and personnel knowledgeable in operations and maintenance practices from outside one's immediate plant or company can provide useful perspective and input. In this program area, Electric Power Research Institute (EPRI) expertise is applied to plant operation and maintenance concerns through direct phone and email interaction, routine plant visits, assistance with selected plant assessments, and specific field response when emergent issues arise. EPRI staff also use this expertise to develop reports and guidelines that address new or improved methods and processes to enhance nuclear plant performance.

The supplemental portion of the Nuclear Maintenance Application Center Program provides access to a larger population of maintenance and process guides, as well as a range of user groups targeting solutions to issues related to specific equipment, software, or regulations. The user groups provide a forum for exchanging information on topics such as circuit breakers, hoisting and rigging, electric motors, pumps, Terry Turbines, transformers, and switchgear.

Through separately funded supplemental projects, participants can receive expert EPRI support in implementing EPRI research results, including training, software implementation support, work package planning, and various maintenance assessments. Nuclear plants also can access targeted user groups on the Maintenance Rule, the Preventive Maintenance Basis Database, and EPRI's Motor-Operated Valve Performance Prediction Program.

### Accomplishments

EPRI's Nuclear Maintenance Application Center distills global operations and maintenance experience into actionable guidance for nuclear plant systems and components. Lessons learned from nuclear plants around the world are incorporated into industry- and vendor-specific technical guidance.

- Developed guidance for detecting cracked shaft failures in rotating equipment using torsional vibration signature analysis. Some of these failures have occurred where existing shaft crack detection monitoring systems were installed, but the cracks were not detected.
- Evaluated the detection of gas voids in pipe using guided wave ultrasonics. Initial research demonstrated the feasibility of guided wave techniques for gas entrapment detection, and follow-on research assessed performance on system mockups using various pitch-catch configurations. This research has provided a basis for instrument design and enhanced understanding of guided wave interactions with gas voids.
- Updated the crane maintenance application guide based on additional operating experience. This guide provides technical, maintenance, operational, training, inspection, and troubleshooting information for overhead bridge cranes used in nuclear power plants. Nuclear plant personnel use this guide as a reference document to review detailed component information, in-depth overhead bridge crane maintenance practices, and inspection programs.
- Issued a single-source reference guide for implementation of best practices in grease lubrication, guidance for proper lubricant selection, and evaluation of available and emerging technologies and techniques to optimize lubrication effectiveness.
- Evaluated alternatives to wire brushes for routine nuclear plant maintenance. The report recommends alternatives, with emphasis on tooling requirements, product speeds, temperature limitations, and brush applications.
- Updated EPRI guidance on nuclear plant fluid sealing programs to incorporate lessons learned from field experience. The update recommends a philosophical shift away from "fluid leakage" and toward "fluid sealing" that would integrate procedures, materials, training, and management support.

- Updated the Preventive Maintenance Basis Database (Version 2.1). This product enables utility engineers to readily access technically applicable and cost-effective preventive tasks.

**Current Year Activities**

Nuclear Maintenance Application Center Program research and development for 2013 will focus on updates to key equipment maintenance guides, greater outreach to domestic and international participants, and focused attention to emerging industry maintenance issues. Specific efforts will include the following:

- Develop Terry Turbine Training Modules to replace the once every two year training sponsored by EPRI.
- Upgrade the Preventive Maintenance Basis Database software to facilitate interactions with other information sources, define optimum replacement and refurbishment times, develop refurbishment/replacement considerations, and supply plug-ins for interfaces with other software,
- Determine basic seal design parameters and commercial viability of a seal using piezoelectric technology to improve seal performance and reduce maintenance.

**Estimated 2013 Program Funding**

\$8.1 million

**Program Manager**

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**Summary of Projects**

Project Number	Project Title	Description
P41.05.01.04c	Motor-Operated Valve Performance Prediction Methodology User Group (QA) (supplemental)	The EPRI MOV PPM User Group (EMPUG) provides ongoing code maintenance, user technical support, and training. EMPUG supports users of the EPRI MOV Performance Prediction Methodology and the EPRI MOV Performance Prediction Program.
P41.05.01.05	Preventive Maintenance Basis Database (PMBD) User Group (supplemental)	The Preventive Maintenance Basis Database (PMBD) User Group serves as the primary source for input to guide new and revised functionality for the database. Members share experience with the database and suggest new component types that may need to be developed.
P41.05.01.20a a	Member Requested Support (supplemental) (QA)	NMAC offers assistance to members in evaluating the extent to which various NMAC products can provide value to their organization. Such assistance may include training, software implementation support, work package planning, and on-line maintenance assessment.

## **Motor-Operated Valve Performance Prediction Methodology User Group (QA) (supplemental) (004433)**

### **Key Research Question**

EPRI's Motor-Operated Valve Performance Prediction Methodology (MOVPPM) provides a low-cost alternative to prototype (or in situ) design basis differential pressure testing of motor or air-operated valves. MOVPPM software (QA) validates the thrust/torque requirements under design basis flow and differential conditions of gate, globe, and butterfly valve designs commonly found in both motor and air-operated valve service. In addition to the code, several hand calculation methods have been developed to address specific designs not covered by the code. The methodology has been approved by the U.S. Nuclear Regulatory Commission. Feedback and dialogue among software users can lead to functional improvements and more effective application.

### **Approach**

The EPRI MOV PPM User Group (EMPUG) provides ongoing code maintenance, user technical support, and training for the MOV Performance Prediction Methodology (MOVPPM) and the MOV Performance Prediction Program (MOVPPP). The users forum enables exchange of information pertaining to utilization of the methodology and a vehicle for maintaining and modifying the MOVPPM code.

### **Impact**

Use of this methodology obviates the need for differential pressure testing either as an initial demonstration of or periodic verification of design basis capability. Not only does MOVPPM greatly decrease downtime for valve testing in general, it can significantly reduce valve failures due to insufficient torque or thrust.

### **How to Apply Results**

MOVPPM is Windows™-based and runs on personal computers and comes with support documentation. Use of the method requires the utility to obtain valve internal design information from valve vendors, which requires about one man-week per valve.

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified.

## **Preventive Maintenance Basis Database (PMBD) User Group (supplemental) (068039)**

### **Key Research Question**

Effective industry use of preventive maintenance strategies relies on widespread availability of component-specific maintenance data and information. A comprehensive repository of preventive maintenance basis information for power plant equipment can support effective maintenance. Feedback and dialogue among database users leads to functional improvements and more effective application.

### **Approach**

The Preventive Maintenance Basis Database (PMBD) collects data from worldwide industry sources to develop a comprehensive repository of PM basis information for power plant equipment. The PMBD contains the data related to PM tasks, task intervals, and the technical bases of these tasks for all defined failure and degradation mechanisms. The foundation of this repository was the EPRI 38-volume *PM Basis Reports and Handbook* (TR-112500) and, subsequently, PM Basis Database Client /Server Version 2.0 and subsequent versions.

### **Impact**

The PMBD User Group serves as the primary source for new or revised functionality of the database. User group participants serve as the beta testers for new versions of the database. The group also will suggest new component types that may need to be developed, and the group will provide input on what interfaces should be developed for the database.

### **How to Apply Results**

Participants in the PMBD User Group receive copies of the current version of EPRI PM Basis Database containing information on the preventive maintenance programs recommended for 130+ component types. Updates to the existing component data tables and the addition of data tables for new component types will be communicated to participants so they can download the new data as desired.

## **Member Requested Support (supplemental) (QA)**

### **Key Research Question**

Members are often challenged in applying NMAC products. Therefore, NMAC offers assistance to members in evaluating the extent to which these products can provide value to their organization.

### **Approach**

Support services can include the following:

- Training
- Implementation of the Preventive Maintenance Basis Database
- Work package planning and preparation
- Foreign Material Exclusion (FME) program support
- Sealing technology and bolting techniques
- Implementation support in the area of on-line maintenance
- Specific component maintenance strategy support
- Expert assistance via evaluations and audits, or as consultants for resolving problems

NMAC provides on-site member-requested support to participating utilities on a cost recovery basis. The scope of member-requested support activities should be consistent with the overall objectives of the NMAC program. Examples of typical activities include programmatic and technical review of specific engineering programs, implementation of NMAC products, and response to a plant's technical issues. The costs of these services vary, depending on the level of support requested.

### **Impact**

Reduced engineering staffs, aging plants, and dwindling vendor and architect/engineer (A/E) support make solving engineering system and component problems more difficult for operating nuclear plants. In this environment, utility engineers need a variety of tools available to assist them with problem resolution. This program provides utility personnel with information and technology solutions that decrease the time and cost needed to resolve specific technical issues or implement specific programs or products. Improved decision-making is the greatest utility benefit delivered by this program.

### **How to Apply Results**

This program will be delivered through on-site technical assistance. This program is offered in one-week increments of a full-time equivalent NMAC representative.

Selected reports and products may be prepared in whole or in part in accordance with the EPRI Quality Program Manual that fulfills the requirements of 10CFR50 Appendix B and 10CFR21. The QA status of reports and products will be marked and identified