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DOE STANDARD

GUIDELINE TO GOOD PRACTICES FOR MAINTENANCE MANAGEMENT INVOLVEMENT AT DOE NUCLEAR FACILITIES



**U.S. Department of Energy
Washington, D.C. 20585**

AREA MNTY

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FOREWORD

The purpose of the *Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities* is to provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing maintenance management programs, or to develop new programs. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, *Maintenance Management Program*, Chapter II, Elements 14 and 16. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing maintenance management programs that are applicable to their facility.

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1. INTRODUCTION

1.1 Purpose

This guide is intended to assist facility maintenance management in the review of existing and in developing new maintenance management programs. It is expected that each DOE facility may use different approaches or methods than those defined in this guide. Explanation of the intent of this guide is provided in the Discussion section, and the specific guidelines that follow reflect generally accepted industry practices. Therefore, deviation from any particular guideline would not, in itself, indicate a problem. If substantive differences exist between the intent of the Guideline and actual practice, management should evaluate current practice to determine the need to include/exclude proposed features. A change to maintenance practice would be appropriate if a performance weakness was determined to exist. Development, documentation, and implementation of other features which further enhance these guidelines for specific applications, is encouraged.

This guide describes key features of programs that support maintenance management. Their implementation should enhance safe, reliable, and efficient maintenance operations. Included in these key features is guidance for the following management functions:

- a) Management Involvement
- b) Performance Indicators, Goals, and Objectives Results
- c) Problem Analysis
- d) Feedback
- e) Program Reviews

The **Discussion Section**, of this guideline, concisely describes actions which support the development of a maintenance management program and includes a brief explanation of it's relevance. The **Guidelines** section provides typical industry guidance relative to each of the four features listed above. In some cases, example situations accompany the guidelines. These examples have been provided only as an aid in clear understanding of the guidelines and should not be construed as the only method for meeting the intent of the guidelines.

Persons wishing to obtain an overview of this document need only read the Introduction and Discussion section.

Additional information pertinent to the implementation of this guideline may be found in the following DOE Guidelines:

- 1) DOE-STD-1004-92 *"Root Cause Analysis Guidance Document."*
- 2) DOE STD-XXXX-XX *"Guidelines to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities."*
- 3) DOE-STD-XXXX-XX *"Guidelines to Good Practices for Maintenance History at DOE Nuclear Facilities."*
- 4) DOE-NE-STD-XXXX-XX *"Guidelines to Good Practices for Planning, Scheduling, and Coordination of Maintenance Activities at DOE Nuclear Facilities."*
- 5) DOE-STD-XXXX-XX *"Writer's Guide for Technical Procedures."*
- 6) DOE-STD-XXXX-XX *"Guidelines to Good Practices for Types of Maintenance at DOE Nuclear Facilities."*
- 7) DOE-STD-XXXX-XX *"Guidelines to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities."*

Appendix A is provided for use by facility trainers who intend to provide training regarding this element.

1.2 Background

The information in this guide was developed from commercial and DOE sources. Each facility should select those details that are applicable, add any unlisted knowledge or experience that are applicable, and develop and implement facility-specific maintenance management programs. Facilities that have existing maintenance management programs should review this guide to identify details that may enhance their existing programs.

1.3 Application

The content of this guide is generally applicable to all DOE nuclear facilities. Portions of the programs outlined may not be applicable to all facilities because maintenance organizations, disciplines, titles, and responsibilities may vary among DOE nuclear facilities. Facility maintenance personnel may verify the adequacy or improve existing maintenance management programs by adapting this guide to their specific facility and individual maintenance disciplines.

2. MAINTENANCE MANAGEMENT INVOLVEMENT

2.1 Discussion

Maintenance managers should demonstrate their commitment to excellence through direct involvement in activities which encourage a high level of individual performance. Management should set an example which supports the first-line supervisors by taking the lead in direct observation of craft activities in the field.

This high profile by management during frequent non-scheduled individual tours of work areas both on- and off-shift provides:

- First-hand observation of actual conditions
- An opportunity to communicate expected performance standards through appropriate and timely recognition/feedback directly to individuals regarding either positive or negative observations
- An opportunity to seek involvement in and to establish ownership of approved actions at the level closest to and directly involved in performance improvement
- Incentive for individuals at all levels to take pride in their accomplishments
- Motivation for first-line supervisors and craftspersons to accept responsibility for the early detection of opportunities for improvement
- The means for timely escalation of significant problems/concerns to the level of management having resolution authority

In addition to first-hand observations, maintenance managers ensure effective knowledge-based decisions using factual information derived from and substantiated by a variety of sources, including:

- Key performance indicator trend review
- Critical self-assessments
- Exception reports
- Problem and corrective action status tracking
- Lessons Learned and Alert System reviews
- Daily and weekly review of staff activities
- Customer feedback
- Craftsperson input
- Historical data
- Regulatory (ESH) requirements

Follow-up actions assure all levels that management is interested in and acts upon individual input.

A work sampling program should be used to establish and update baseline effectiveness values and to assess the impact of imposed constraints and limitations such as radiation contamination control and historical repair time versus engineered time standards to provide for productivity improvements.

Maintenance workmanship standards used to gauge and ensure an appropriate level of performance are those consensus standards associated with specific maintenance activities such as:

- National Electric Code
- Asbestos Abatement Standards
- OSHA regulations
- National Standards for Calibration and Certification
- Garage (vehicle) repair/service standards
- Warranty/guarantee stipulations
- FCC telecommunications regulations
- Davis-Bacon Act
- Waste Stream Management
- ALARA Contamination Control
- Plant housekeeping standards
- Environmental regulations

A Real-Property Cost Collection System (using a series of blanket work orders for each building) may be used to assist in identifying cost drivers associated with Plant buildings and structures.

Programmatic maintenance support should be identified by accounting work orders associated with specific programmatic activity.

Current cost drivers which usurp maintenance resources normally allocated to facility maintenance and production/process equipment tasks include:

- Safety Class Items
- OSHA and environmental compliance
- Various upgrades

2.2 Guidelines

2.2.1 Manager Involvement

Managers should include time for non-scheduled walk-throughs of facility work areas as a regular management activity. These walk-throughs should be directed at improving dialogue with workers at all levels of the maintenance organization. Implementation of this method should be an on-going process. Maintenance management should establish the percentage of time that first-line supervisors are expected to spend supervising field work and providing value-added involvement in crew activities (an industry average is approximately fifty percent). Facility and work-site tours should be conducted randomly for management visibility to and contact with weekend, and second and third shift workers. These tours may also be selectively and judiciously accomplished based on concerns resulting from program reviews or other feedback. The results of management walk-through observations and contacts should be documented and communicated to affected organizations and individuals and followed to logical conclusion. Managers should demonstrate to all employees their commitment to excellence in all areas of maintenance.

2.2.2 Performance Indicators, Goals, and Objectives Results

Accomplishments toward established performance indicators, goals and objectives should be developed, trended, and reported to provide feedback to those affected. *DOE Guidelines to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities* discusses the development of performance indicators, goals, and objectives for maintenance.

A well-structured formal Total Quality Management Program should be developed within the Maintenance organization. Various councils, task analysis teams, engineering, and technical support groups should continually review:

- Significant program elements to determine and recommend opportunities for maintenance program improvement
- Critical work in progress
- System and procedure applicability
- Real-time and history data
- Root cause resolution
- Activity intervals and acceptance criteria
- Acquire and apply value-added new technology
- Project status
- Non-Facility maintenance personnel performance
- Site planning

These groups should meet regularly with management to:

- Review and report progress
- Maintain management visibility and awareness
- Ensure management support for proposed actions
- Obtain management approvals

Meetings with affected individuals/groups, should be conducted on a regular schedule to provide for sharing information through interrogative/interactive participation. Reported accomplishments should be tracked and regularly evaluated for trends (both positive and negative) which provide timely visibility and opportunity for informed knowledge-based management decisions leading to continued improvement. Trends (both positive and negative) should be analyzed for root cause determination (see DOE-NE-STD-1004-92, "*Root Cause Analysis Guidance Document*"). Action plans to correct deficiencies and reverse negative trends should be implemented, when appropriate. Positive indicators should be evaluated for stability, reliability, and the potential for broader application.

2.2.3 Problem Analysis

Root cause analysis of unplanned, recurring, and persistent maintenance problems, incidents, and outages which impact safe and reliable operations, although historically performed has only recently adopted formal methodologies to systematically and clearly lead to their effective resolution. Root cause is seldom a single factor.

Individuals at all levels should be trained in the use of one or more of a variety of formal problem analysis and solving methodologies, including:

- Kepnor-Tregoe
- Job Hazard Analysis
- Function Analysis
- Total Quality Management - Performance Improvement Process
- Reliability, Availability, and Maintainability Analysis
- Single Failure Analysis
- Root Cause Analysis
- Facility Safety Analysis and Review Phases
- Risk Assessment (Failure Modes and Effects)
- Value Engineering

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The interaction and effects of one or more of the following factors should be considered:

- Design
- Drawings
- Procedures
- Training
- Qualification verification
- Tools
- Attitude
- Supervision
- Human error
- Management control
- Communication

When the nature of specific concerns warrants (based upon uniqueness, warranty, complexity, time-constraints, state-of-the-art technology, special skills/equipment/tools, etc.) outside expertise may need to be contracted to ensure the appropriate focus.

Root cause categories should be established to:

- Facilitate future analyses
- Correlate proven corrective actions
- Focus management action to the critical few

These methods result in value-added and knowledge-based correction plans which should be followed to validated resolution, documented in the maintenance history files, and applicable information should be shared as lessons learned for broad-based benefit from local actions.

2.2.3.1 Information Collection

Problems should be coded and clearly defined to permit status tracking.

In addition to maintenance history files, information pertinent to the most recent occurrence is valuable during problem analysis and may be obtained from:

- Maintenance Job Requests
- Shop floor activity logs
- Strip-chart and other recording devices
- Operator statements (facts and symptoms)
- Troubleshooting results
- Craftsperson statements
- Industry experience

Information and data gathered from the most recent occurrence should be recorded as maintenance history.

2.2.3.2 Information Analysis, Cause Determination, and Corrective Action

The responsibility and authority for performing the analysis, cause determination and corrective action recommendations should be clearly defined.

Owner/operators and other involved/informed individuals should be members of a problem analysis teams.

The problem analysis methodology suitable for the type problem, formality warranted, and application of the information available should be used.

All information should be evaluated to establish a list of most probable or associated causes (care should be taken to go beyond simply addressing symptoms).

Each probable cause should be analyzed until the combination of factors which, when corrected, should prevent recurrence of the problem is determined. That combination of factors is the actual root cause.

The criteria for acceptable root cause resolution are:

- Implementation should prevent recurrence of the problem
- The proposed action is feasible
- Implementation should not adversely impact safety, reliability, or operational goals
- The proposed action results in long-term improvement
- Generic applicability

A plan defining the acceptable root cause corrective action should be:

- Developed
- Documented
- Approved by applicable managers
- Implemented
- Tracked to validated completion

Analyses and corrective action plans should include generic applicability to:

- Similar items
- Training and qualification programs
- Documentation revision
- Maintenance activities
- Tool availability

2.2.3.3 Corrective Action Followup

Following validated problem resolution, postmaintenance testing should be performed to ensure all critical parameters are within tolerance and the owner/operator considers the item acceptable for return to normal service.

2.2.3.4 Generic Followup

Management should be responsible for ensuring that generic applicability of validated resolutions are communicated through the lessons learned validator system.

Generic applicability within the plant should be tracked until validated completion.

2.2.4 Feedback

Management should actively solicit and encourage constructive feedback from all affected individuals and organizations including line, staff, support (craftspersons, planners, engineers, and etc.), and customers regarding performance concerns and opportunities for improvement at all levels of the maintenance organization. A written and verbal means for interested individuals to identify concerns and to suggest actions for resolving deficiencies should be provided. Feedback should be evaluated and actions implemented which result in improved maintenance services. The individual identifying the concern or suggestion should receive feedback with a timely response from management which:

- Demonstrates management's interest in the input
- Explains the rationale for either no action or alternate action
- Indicates status of suggested action

Concerns which involve a broad area of responsibilities should be addressed by project teams consisting of representatives from all affected crafts and organizations. These project teams should be given the necessary time to provide effective action.

2.2.5 Program Reviews

Each element which forms the Maintenance Program should be assessed periodically by appropriate individuals and organizations to ensure:

- Applicability
- Effectiveness
- Improvement milestones implemented during the last assessment are reflected therein

A Maintenance Standing Order process may be used to establish a self-assessing surveillance program to verify compliance with program needs.

Standing Orders on surveillance:

- Assigns surveillance responsibilities and accountability
- Specifies the number and interval of surveillances
- Requires the implementation of written checklists when performing surveillances
- Requires documentation and reporting
- Requires follow-up on findings through validated resolution

Deficient areas should be assigned to accountable individuals for action planning and follow-up.

Conditions and needs which affect the capability to perform should be regularly reported and evaluated regarding:

- Work force (functions, crews, individuals)
- Equipment
- Systems
- Facilities
- Scheduling
- Coordination
- Tools/materials/equipment availability

Documented root causes defined during evaluations should form the basis for program improvements.

Training should be a continuing process to provide assurance that maintenance personnel are knowledgeable of applicable plant physical and procedural modifications, changes to regulatory requirements, and lessons learned from industry and in-house operating experience that may affect job performance. Refer to DOE-NE-STD-1003-91 *"Guide to Good Practice for Training and Qualification of Maintenance Personnel"* for more detail information concerning training.

Training includes numerous areas, for example:

- Skills (all levels)
- Performance Based Training (PBT)
- On-The-Job (OTJ)
- Certification/Qualification
- Health, Safety, Environmental Accountability (HSEA)
- Administrative
- Refresher

Maintenance management should be directly involved in the training program:

- Needs identification
- Development
- Planning/Facilities
- Documentation
- Adjustment
- Scheduling
- Approval
- Evaluation
- Reinforcement through personal actions

New and revised technical and regulatory needs should be continuously monitored to ensure adequate and timely training program:

- Development
- Scheduling
- Adjustment/emphasis
- Coverage

Changes to the training program should be based upon:

- Management recommendation
- Trainee feedback
- Performance deficiencies where skills inadequacy is determined as the root cause

Procurement policy and practices should be regularly assessed for overall effectiveness using documented actual experience information regarding:

- Usage versus inventory levels
- Delayed/deferred maintenance related to: Service factor (out-of-stock); Non-conforming or defective items; Handling, storage, shelf-life problems; Inaccurate inventory records; Incorrect or delayed delivery
- System errors; Incorrect, Incomplete, Illegible, Wrong form/format, Unauthorized approval

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The responsibility and accountability should be established and documented for quality record:

- Transmittal
- Distribution
- Retention
- Maintenance
- Disposition
- New document addition

Responsible maintenance managers should specify what constitutes quality records and regularly assess their status to ensure:

- They are legible, identifiable, retrievable
- Damage, deterioration, and loss are controlled
- Addition, retention, and disposition schedules are enforced

APPENDIX A
MAINTENANCE MANAGEMENT INVOLVEMENT
SAMPLE LESSON PLAN

**MAINTENANCE MANAGEMENT INVOLVEMENT
SAMPLE LESSON PLAN**

LESSON PLAN

1. The instructor should be familiar with the following background information:
 - a. To ensure safety and excellence of all facility operations, managers and supervisors should be technically informed and personally familiar with the operating conditions at the site.
 - b. It is important that maintenance management establish the percentage of time that first line supervisors are expected to spend supervising field activities. Additionally, unnecessary paperwork, excessive meetings, and other administrative activities that keep supervisors out of the field should be reduced.
 - c. An analysis program should be established to investigate unplanned events or occurrences of a recurring nature that indicate corrective actions have not been effective in eliminating the root cause.
 - d. A root cause is defined as the most basic reason or collection of reasons for an unplanned event which if corrected will prevent recurrence of that event.
 - e. Correcting the causes of both equipment and human error problems may result in improved facility reliability by decreasing the probability of recurrence of that problem.
 - f. Maintenance performance indicators should be trended and tracked for program improvements.
 - g. Managers should periodically review and assess various elements of the site maintenance program. An evaluation of each maintenance program element should be conducted at least once every other year.
2. To teach this lesson, the following training housekeeping items are required:
 - a. Location for the training,
 - b. Approximately 30 minute time period for the training,

- c. Notification of selected employees, and
 - d. A copy of the facility or corporate policy relating to management responsibility for site operations.
3. This lesson has the following trainee enabling objective:
- a. Explain management's role in facility operations.
 - b. Explain a maintenance problem analysis program, and
 - c. Define the criteria for identifying a root cause.
4. Some important aspects in management role in overall facility operations include the following:
- a. To ensure safety of facility operations, managers and supervisors should be technically informed and personally familiar with the operating conditions at the site or facility. This does not mean managers should know every operational detail, but it does imply a knowledge level that allows them to speak the language of the technology and understand its basic workings.
 - b. A problem analysis program is a system designed to help correct the causes of both equipment and human error problems. This may improve the reliability of the site by decreasing the probability of recurrence. Some thoughts on this type of program include:
 - 1) Examples of proven and accepted techniques for analyzing for root cause include the following:
 - event and causal charting (system utilizing a block diagram to depict cause and effect),
 - barrier analysis (questioning process used to determine what programmatic system or "barrier" may have prevented the problem),
 - walk-through task analysis (step-by-step reenactment to determine the failure mode,
 - change analysis (looks at the problem from the standpoint of what was expected and what actually happened), and
 - interviewing (a verbal, intuitive investigation process).

- 2) An acceptable root cause should meet three criteria:
 - its correction should prevent recurrence of the unplanned occurrence,
 - its correction should be feasible, and
 - its correction should not adversely impact safety, reliability, or operational goals.
- 3) The most important aspect of an analysis program is to fix the problem and not merely conduct an academic, analytical thought exercise. Therefore, after the root cause has been determined, corrective actions should be initiated to correct the deficiency and prevent recurrence. Follow-up should be incorporated into the corrective action to ensure the "fix" is appropriate and the problem does not recur.
- c. Management should periodically review and assess various elements of the site maintenance program. An evaluation or self-assessment of each maintenance program element, as defined in 4330.4A, should be conducted at least once every other year. This evaluation should include inputs from maintenance managers and supervisors, and from other groups such as operations, technical staffs, and corporate departments. Additionally, performance based observations of actual field maintenance should be performed to examine problem areas in implementation of maintenance program elements. Examples of program elements to consider include the following:
 - assessment of the work control system,
 - assessment of facility equipment and worker conduct of maintenance practices,
 - assessment of maintenance training,
 - assessment of spare parts and material procurement activities,
 - assessment of the use and control of measuring and test equipment, and
 - assessment of supervisory effectiveness.
5. Discuss with the trainees the facility policies on management involvement and responsibilities.

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CONCLUDING MATERIAL

Review Activities:

<u>DOE</u>	<u>Field Offices</u>
AD	AL
DP	CH
EH	ID
EM	NV
ER	OR
NP	RL
NS	SR
RW	SF

Preparing Activity:

DOE-NE-73

Project Number:

MNTY-0010

Area Offices

Amarillo
Brookhaven
Kansas City
Kirtland
Princeton

Facilities

ANL
BNL
LBL
PNL
PPPL
SNL
NV REEC_o.
NV EG&G
OR OSTI
WHC
EG&G
RF
SLAC
WSRC