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DOE STANDARD

GUIDELINE TO GOOD PRACTICES FOR PLANNING, SCHEDULING, AND COORDINATION OF MAINTENANCE AT DOE NUCLEAR FACILITIES

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FOREWORD

The purpose of the *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities* is to provide contractor maintenance organizations with information that may be used for the development and implementation of a rigorously controlled maintenance program directed at planning, scheduling, and coordinating work packages for maintenance tasks at DOE nuclear facilities. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, *Maintenance Management Program*, Chapter II, Element 6. 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 programs that are applicable to their facility.

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1. INTRODUCTION

1.1 Purpose

This guide is intended to assist facility maintenance operations in the review of existing and in developing new programs to ensure maintenance work package planning, scheduling, and coordination identifies all technical and administrative requirements for a work activity and provides the materials, tools, and support activities needed to perform the work. It is expected that each DOE facility may use different approaches or methods than those defined in this guide. 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. Additional information pertinent to the implementation of this guideline is found in the following DOE Guidelines:

1) DOE-NE-STD-1003-91 "*Guidelines to Good Practice for Training and Qualification of Maintenance Personnel*"

2) "*Writer's Guide for Technical Procedures*"

3) "*Guidelines to Good Practices for Postmaintenance Testing at DOE Nuclear Facilities*"

4) "*Guidelines to Good Practices for Control and Calibration of Measuring and Test Equipment (M&TE) at DOE Nuclear Facilities*"

5) "*Guidelines to Good Practices for Maintenance History at DOE Nuclear Facilities*"

6) "*Guidelines to Good Practice for Modification Work at DOE Nuclear Facilities*"

7) "*Guidelines to Good Practice for Procurement of Parts, Materials, and Services at DOE Nuclear Facilities*"

8) "*Guidelines to Good Practice for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities*"

9) "*DOE Guideline DOE-NE-STD-1004-92 Root Cause Analysis Guidance Document*"

10) "*Guidelines to Good Practices for Management Involvement at DOE Nuclear Facilities*"

Appendix H 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 programs. Facilities that have existing documented maintenance 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 should verify the adequacy or improve existing maintenance programs by adapting this guide to their specific facility and individual maintenance disciplines.

2. DEFINITIONS

2.1 Acronyms Used in This Standard. The acronyms used in this standard are defined as follows:

a. ALARA - As Low As Reasonably Achievable

b. ASME - American Society of Mechanical Engineers

c. DOE - Department of Energy

d. EQ - Environmental Qualification

e. MIG - Maintenance Importance Generator

f. MJR - Maintenance Job Request

g. PM - Preventive Maintenance

h. PMT - Postmaintenance Test

i. RWP - Radiation Work Permit

j. SSC - Structures, Systems, and Components

k. SWP - Safe Work Permit

2.2 ALARA (As Low As Reasonably Achievable). A radiation protection philosophy requiring that personnel exposure to radiation and radioactive material be kept not only within regulatory limits, but be maintained as low as reasonably achievable in light of current technology with appropriate consideration for economic and social factors, and benefits derived.

2.3 Corrective Maintenance. Repair and restoration of SSC that have failed or are malfunctioning and are not performing their intended function. As a rule of thumb, if the specific component (such as packing or bearing) requiring maintenance has failed, the action required to repair it should be classified as corrective maintenance.

2.4 Deficiency. Any condition that deviates from the design of a structure, system, or component (SSC) and results in a degraded ability to accomplish its intended function.

2.5 Deficiency Tag/Sticker. A small tag or adhesive-backed sticker that is used to identify a plant material deficiency. The form may be marked with a serialized number for administrative control, work order identification, and deficiency location by maintenance personnel.

2.6 Facility. Any equipment, structure, system, process, or activity that fulfills a specific purpose. Examples include storage areas, fusion research devices, nuclear reactors, production or processing plants, waste management disposal systems and burial grounds, testing laboratories, research laboratories, transportation activities, weapons development and production, standards and calibrations labs, and accommodations for analytical examinations of irradiated and un-irradiated components.

2.7 Maintenance. Day-to-day work that is required to maintain and preserve plant and capital equipment in a condition suitable for its designated purpose and includes preventive, predictive, and corrective (repair) maintenance.

2.8 Maintenance Importance Generator (MIG). A computerized system using predetermined rules to compare data on an MJR and to establish relative-importance ranking for each maintenance job.

2.9 Maintenance Job Request (MJR) (Appendix D). Means of obtaining maintenance services available on both paper and electronic mediums and initiated by maintenance customers. Issued to Maintenance Planners and Estimators and used to define, plan, and execute maintenance activities. Documentation of a deficient equipment condition, requires detailed documentation of work performed, spare parts, procedures, or testing to verify maintenance was performed correctly. The MJR may also serve as documentation for completion of minor maintenance activities such as lubrication, light bulb replacement, etc.

2.10 Maintenance Management. The administration of a program utilizing such concepts as organization, plans, procedures, schedules, cost control, periodic evaluation, and feedback for the effective performance and control of maintenance with adequate provisions for interface with other concerned disciplines such as health, safety, environmental compliance, quality control, and security. All work done in conjunction with existing property is either maintenance (preserving), repair (restoring), service (cleaning and making usable), or improvements (modification). The work to be considered under the DOE maintenance management program is only that for maintenance, repair, and modification.

2.11 Maintenance Procedure. A document providing direction to implement policy, comply with external directives, or meet operational objectives in a consistent manner. A procedure provides necessary delineation of roles, responsibilities, action steps, and requirements.

2.12 Maintenance Work Instructions. Written instructions provided to the craftsperson to assist in performance of a task. The level of detail of these instructions is based on the complexity of the task, special engineering considerations/specifications, and skill levels of the workers performing the task (skill-of-the-craft).

2.13 Maintenance Work Package. A consolidated document that identifies to the craftsperson all the necessary requirements to safely and accurately perform a maintenance task with minimum delays.

2.14 Minor Maintenance. Maintenance actions for deficiencies on plant electrical, mechanical, or instrument components or parts where all the following conditions are met:

a) The component is nonsafety-related or, if the component is safety-related, the portion or part being worked does not perform or affect a safety-related function.

b) The component or part does not perform an environmental qualification (EQ) function.

c) Integrity of the component will not be violated.

d) Material substitution will not be involved.

e) Disassembly of the component or part will not be required.

f) Welding will not be performed on a component or part that is safety-related, treated as safety-related, or seismically mounted.

g) Welding will not be performed on a pressure vessel.

h) Welding will not be performed on system piping.

i) A tagout will not be required.

j) The work performed is of such a minor nature that a written procedure is not required. However, if a procedure exists, it may be used.

k) "Documented" postmaintenance testing will not be required.

l) The work is of such a simple nature that a detailed job planning package is not required.

(Examples of activities that may qualify as "minor maintenance" and those that do not qualify are given in Appendix C. These are examples only and do not constitute a definitive list.)

2.15 Outage. Condition existing whenever normal operations has stopped, due to planned or unplanned occurrences.

2.16 Performance Test. A test of SSC to verify that required performance characteristics may be achieved, to detect any abnormal performance characteristics, and to determine the effect of maintenance and operating activities on equipment performance.

2.17 Performance Monitoring. Systematic monitoring and trending of the performance of selected plant SSC to measure and assess the impact of any performance changes on overall plant efficiency, reliability, and availability.

2.18 Periodic Maintenance. Preventive maintenance activities accomplished on a routine basis (typically based on operating hours or calendar time) and may include any combination of external inspections, alignments or calibrations, internal inspections, overhauls, and SSC replacements.

2.19 Planned Maintenance. Preventive maintenance activities performed prior to SSC failure and may be initiated by predictive or periodic maintenance results, by vendor recommendations, or by experience/lessons learned. These include items such as scheduled valve repacking, replacement of bearings as indicated from vibration analysis, major or minor overhauls based on experience factors or vendor recommendations and replacement of known life-span components. For example, repacking a valve due to packing leakage would be corrective maintenance, but scheduled repacking prior to leakage would be planned maintenance.

2.20 Postmaintenance Test. Any appropriate testing performed following maintenance to verify that a particular piece of equipment or system performs its intended function based on its design criteria and that the original deficiency has been corrected and no new deficiencies created.

2.21 Predictive Maintenance. Predictive maintenance activities involve continuous or periodic monitoring and diagnosis in order to forecast component degradation so that "as-needed" planned maintenance may be performed prior to SSC failure. Not all SSC conditions and failure modes may be monitored; therefore, predictive maintenance should be selectively applied. Reliable predictive maintenance is normally preferable to periodic internal inspection or equipment overhauls.

2.22 Preventive Maintenance. Preventive maintenance includes periodic and planned maintenance actions taken to maintain SSC within their design operating conditions, extend its life, and is performed to prevent SSC failure. This includes technical safety requirements surveillances, in-service inspections, and other regulatory forms of preventive maintenance.

2.23 Root Cause. A determination based on analytical techniques that determines the fundamental cause of failure.

2.24 Structures, Systems and Components (SSC). Physical items designed, built, or installed to support the operation of the plant.

2.25 Technical Support. The engineering, design, specialized inspections, planning, or other such support of capital asset maintenance and repair.

2.26 Work Control Document. Proceduralized document used by facility personnel to perform inspections, testing or work.

3. PLANNING, SCHEDULING, AND COORDINATION OF MAINTENANCE ACTIVITIES

3.1 Discussion

3.1.1 Planning

3.1.1.1 To correctly and efficiently perform the planning function, management should provide adequate guidance on the level of control necessary to ensure consistent quality maintenance of plant equipment. The requirements to provide procedures for safety-related equipment and equipment important to plant safety are well defined in DOE Order 4330.4A, *Maintenance Management Program*, DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, and technical safety requirements. However, large disparities exist throughout the industry in the level of instruction provided to craftspersons for performing work on plant equipment. Many plants rely heavily on "skill-of-the-craft" but have not assessed the actual skill levels possessed by their personnel. For example, it is commonly accepted that an electrician possesses the necessary skills to install wiring lugs; however, the industry continues to have problems with loose wiring.

3.1.1.2 "Skill-of-the-craft" skills should be given careful consideration when preparing planned packages, job request, and work instructions to ensure that additional training, worker qualifications, or job oversight/quality control are included, if required. For example, work instructions for non-facility contractors may need to include more detail, inspections, or supervisory guidance. To reduce problems caused by inadequate instructions being provided to the craftspersons, managers should establish minimum levels of craft proficiency and implement training programs to ensure that the expected craft skill levels are developed and maintained (see DOE-NE-STD-1003-91 "*Guide to Good Practice for Training and Qualification of Maintenance Personne*l"). Deficiencies identified through daily activities, industry experience, or root cause analysis may result in the identification of additional training needs to maintain this skill level. For work beyond expected skills, detailed work instructions should be provided to the craftspersons. "Skills-of-the-craft," are work skills that should be common knowledge to the individual performing the work. Plant employees should be formally trained, by means of an accredited on the-job training (OJT) program, and qualified to perform these skills or they should be assigned to work under the supervision of a qualified individual.

Some examples of these skills include the following:

- tightening or replacing fittings
- replacing gaskets, bolting, valve packing, stationary seals
- valve lapping
- standard testing, such as insulation resistance, voltage, etc.
- replacing fuses and lamps
- lubricating equipment
- removing corrosion from surfaces
- trimming refrigerant charge
- removing oil from refrigeration plants
- cleaning threads by mechanical means
- cutting fasteners to length
- wire wrapping (except on printed circuit boards)
- soldering (except on printed circuit boards)
- crimping of lugs and splices
- tubing installation
- tubing fitting makeup

a) "Skill-of-the-craft" skills are considered to be standard industry practices and do not usually require job steps, instructions, or an approved procedure in hand. However, if a job requires a work-authorizing document such as a maintenance job request (Appendix D), the inclusion of "skill-of-the-craft" does not alter this requirement. The use of "skill-of-the-craft" in the performance of a job is not considered to be a change of work scope, providing it is confined to the job covered by the maintenance job request and that all other work performed is in accordance with approved plant procedures. In all cases, however, all work should be documented on the maintenance job request:.

3.1.1.3 The primary objective of work planning is to identify all technical and administrative requirements for a work activity and to provide the materials, tools, and support activities needed to perform the work. These items should be provided to craftspersons in an easy-to-use, complete work package. Effective planning should help ensure that consistent, quality maintenance activities are conducted safely and correctly. Also, when coupled with an effective scheduling and coordination methodology, many delays in performing plant maintenance should be eliminated. Work planning is an evolutionary process that should be periodically assessed through field observation of work being performed and direct feedback from the craftspersons to the planners. An effective planning program should contain the following key elements:

- management commitment, overview, and support to ensure success of the program
- management direction to ensure appropriate level of detailed work instructions is developed and provided
- consistency in planning between disciplines to avoid confusion and frustration of work groups
- thorough reviews by experienced individuals of products produced by the planning group to minimize and eliminate errors
- feedback from craftspersons and supervisors to facilitate future planning activities

- use of job history for establishing standard job durations, parts, and consumables for repetitive jobs

3.1.2 Scheduling

Scheduling of corrective and preventive maintenance and of planned and forced outage work is necessary to ensure that maintenance is conducted efficiently and within prescribed time limits. Scheduling daily activities based on accurate planning estimates should improve the use of time on the job and help reduce hazardous exposure. Scheduling of planned outages is important to support the return of the facility to service on schedule (and within the approved budget) and results in improved availability and capacity factors. A contingency schedule should be maintained so that if a forced outage occurs, the forced outage time is minimized and effectively used and so that all needed maintenance is performed prior to restart.

An effective schedule should assist management in controlling and directing maintenance activities and should enhance the ability to assess progress. The schedule should reflect the long-range plan and day-to-day activities. Effective scheduling should enhance the efficient use of resources significantly by decreasing duplication of support work, decreasing craftspersons idle time and ensuring completion of planned tasks. The schedule should be the road map for reaching plant maintenance goals.

Scheduling is an integral part of the overall preparation for maintenance activities and should be performed concurrently with the planning activities covered in this guideline. The integrated schedule should be based upon such details as work scope, importance to plant goals, prerequisites and interrelations, resources, and constraints, developed during the planning process.

A properly prepared and updated integrated schedule should be a tool to assist in managing maintenance activities. Performance deteriorates if a schedule is not available to identify and properly sequence maintenance tasks. Sufficient detail should be included to coordinate activities and track progress. By grouping individual work items and integrating major tasks, more efficient use of support resources should be achieved.

The integrated schedule should form the basis for progress reporting. The schedule should remain useful if it is updated frequently based on the progress reports.

Effective daily schedules are needed to implement the maintenance activity plans represented by the integrated schedule. Management should track and periodically assess performance to the daily schedule. Effectiveness of the daily scheduling process during normal operation should be a good indicator of how effective the daily schedule may be during outages.

The integrated schedule should be reviewed by those responsible for implementation. It should be accepted and widely used by personnel involved in maintenance activities. Preparation of schedules for contingencies should decrease the time necessary to respond to problems if they occur and increase the information available for decision making.

A maintenance job request priority coding system should be established to aide in scheduling maintenance activities. An example of such a coding system is as follows:

a. *Critical (C)*: Equipment or systems that shall operate greater than 90 percent of the time. Being out of service for one working day may result in imminent and significant environmental damage; potential to expose personnel to serious health and safety damage, including injury or death; breach of security; or interruption of production or experiment.

b. *Urgent (U)*: Equipment, systems, or experiments important to plant goals and which when out of service may result in a significant interruption of production or experiment. Importance is great enough to justify diverting personnel from other assignments and to work overtime, based on real-time circumstances. Required uptime is greater than 80 percent.

c. *Priority (P)*: Equipment, systems, or experiments important to plant goals but which have backup or redundant hardware. Required uptime is greater than 70 percent.

d. *Routine (R)*: Equipment, systems, or experiments not meeting one of above categories which may be worked in most economical manner.

3.1.3 Coordination

Plant maintenance activities may be complex projects involving large numbers of personnel. Resources to support the activities should be coordinated in a timely, controlled manner to ensure that they are ready to support the schedule. The types of resources to be considered include personnel, material, expendable supplies, special tools, and services.

Since the quality of maintenance activities performed directly impacts the plant's reliability, management of the work force to achieve quality workmanship while maximizing productivity requires close control by maintenance managers and supervisors.

Material availability is an important element to a successful maintenance program. Many items, particularly material needed for modifications and repair parts for older equipment, may be long lead-time items. They should be identified and ordered well in advance and tracked to delivery to ensure that they will be available at the job-site when needed.

Daily meetings, with affected individuals, should be conducted to focus on the progress of key jobs and to provide short-range coordination of scheduled activities. Meetings should be managed to efficiently use the time of the managers and supervisors, to minimize redirection of work in progress, and to prevent delays to oncoming work shifts. Care should be taken to ensure that meetings focus on problems and their solutions and do not become a forum for exchange of status only.

Performance measures of the rate of activity completion, schedule adherence, productivity, and progress toward meeting plant maintenance goals, should be developed (see DOE "*Guidelines to Good Practices for Management Involvement at DOE Nuclear Facilities*.") These measures should be periodically checked for validity and should be used by maintenance management to monitor performance.

3.2 Scope

3.2.1 This document addresses the elements considered essential for maintenance managers and direct line supervisors to assign responsibilities and outline methods that may be used in the overall planning, scheduling, and coordination functions to accomplish the following:

a) Identify and screen plant deficiencies.

b) Control minor maintenance work activities within the plant work control system.

c) Determine the level of detail necessary to accomplish maintenance tasks and troubleshooting.

d) Use maintenance history in planning corrective maintenance and repetitive job tasks (see DOE "*Guidelines to Good Practices for Maintenance History at DOE Nuclear Facilities*.")

e) Identify needed support to perform maintenance.

f) Prepare and assemble a maintenance work package.

Activities that are not covered in this guideline, but are closely related to the planning, scheduling, and coordinating process, include the following:

a) procedures and work package approval

b) work package closeout and maintenance history update

3.2.2 A system of planning, scheduling, and coordinating maintenance work activities should be clearly defined based upon the Maintenance Operations Model (Appendix A), which consists of five interrelated processes applicable to each maintenance job. The processes are as follows:

- Plan Maintenance Job. Identify the scope of a needed maintenance job. Produce a maintenance job plan. Determine maintenance job planning category, priority, and safety concerns. Identify and procure materials, and identify other maintenance task resources. Prepare the maintenance job package.

- Schedule Maintenance Job. Calculate estimated start date and project resources for the maintenance job. Schedule and commit required resources and special tools/equipment items to allow performance of all maintenance tasks within the maintenance job.

- Execute Maintenance Job. Initiate and perform a maintenance job and collect job information as defined in the maintenance job package.

- Execute Postmaintenance Test. Verify facilities and equipment items fulfill their design functions when returned to service after execution of a maintenance job.

- Complete Maintenance Job. Perform maintenance job closeout to include completion of all documentation contained in the maintenance job package to ensure historical information is captured.

3.2.3 Appendix B (Facility Management) illustrates a comprehensive "Work Control Program" based on the requirements of DOE Order 4330.4A, *Maintenance Management Program*. The implementation of this program should ensure that the maintenance activities in nuclear facilities are conducted in a manner that preserves and restores the availability and operability of the SSC important to safe and reliable plant operation.

3.3 Responsibilities

3.3.1 The maintenance manager should have overall responsibility for the establishment, implementation, and performance of the planning, scheduling, and coordination program as described below:

a. maintaining equipment in accordance with applicable manufacturer's recommendations for facility application and the requirements of this guideline;

b. specifying maintenance methods, procedures, and controls to ensure the quality of materials, parts, and workmanship;

c. ensuring maintenance personnel are appropriately qualified;

d. ensuring an adequate supply of suitable spare parts, materials, and supplies to service equipment covered by the maintenance program;

e. maintaining maintenance history files, and analyzing root causes of off-normal operation (see "*DOE Guideline DOE-NE-STD-1004-92 Root Cause Analysis Guidance Document*");

f. coordinating maintenance with the owner/operator to establish proper plant conditions, obtaining authorizations to conduct maintenance activities, and obtaining acceptance prior to return to service;

g. coordinating activities/work crews to minimize interferences

h. maintaining critical path work on schedule or initiating appropriate alternatives as needed

i. inspecting areas periodically to ensure safety, ALARA, and housekeeping requirements are maintained

j. keeping plant management appraised, in a timely manner, of the overall status of work and potential problems

k. maintaining a record of significant events and problems for use in planning future maintenance activities

l. monitoring the overall effectiveness of the maintenance program and incorporating program changes based on lessons learned from plant history, performance, worker observations, and industry experience;

m. approving revisions to the program.

3.3.2 The operations manager should be responsible for:

a. ensuring that maintenance tasks are properly authorized;

b. setting and reviewing priorities for maintenance activities;

c. identifying postmaintenance test requirements and acceptance criteria;

d. providing schedule and technical assistance to maintenance;

e. restoring systems and components to correct operating alignment or standby modes upon completion of maintenance tasks;

f. making the final equipment operability/acceptance determination, if applicable, prior to returning the equipment to service.

3.3.3 The technical support manager should be responsible for assisting, as required, in the development and implementation of the planning, scheduling, and coordination program as noted below:

a. maintaining an engineering staff which develops a close working relationship with maintenance planners;

b. assist in the development of special procedures and work instructions for equipment;

c. analyzing data for trends to prevent and resolve repetitive equipment failure problems (see "*DOE Guideline DOE-NE-STD-1004-92 Root Cause Analysis Guidance Document*");

d. reviewing and approving modifications to systems (see DOE "*Guidelines to Good Practice for Modification Work at DOE Nuclear Facilities*";

e. assisting in troubleshooting of plant equipment problems;

f. providing recommendations to maintenance managers to upgrade equipment performance (including processing design changes) or to make necessary maintenance program adjustments.

3.3.4 The Planner should be responsible for the following:

a. ensuring that Job Packages and Work Instructions are developed which satisfy the detail essential to effective job\task completion.

b. ensuring that incoming MJRs are screened and determined to contain all applicable information.

c. ensuring adequate work definition and initiating requests for support crafts.

d. serving as initial customer contact and reflecting a positive customer-service attitude by providing assistance in obtaining needed support or service.

e. planning jobs and ensuring that applicable requirements of interfacing policies, procedures, and programs are incorporated into the Work Instructions.

3.4 Planning Guidelines

3.4.1 Maintenance Job Request (MJR) Processing

NOTE: Deficiency identification and control of work vary widely from plant to plant. This section provides the basic elements needed in the work control system to provide the planner with adequate information to perform the planning function.

3.4.1.1 A maintenance job request (MJR) should be initiated and a maintenance deficiency tag/sticker attached as soon as practical after discovery of a plant equipment deficiency. (See Appendix D, Maintenance Job Request.)

3.4.1.2 All MJRs for plant equipment should be delivered to the owner/operator designated representative for review and appropriate action to minimize further equipment damage. The owner/operator review should include the following:

a) Verify the MJR is not a duplicate of an existing MJR.

b) Equipment noun name, identification number, and location are properly entered.

c) Originator information is included on the form and is legible.

d) Deficiency tag number and location are documented, if applicable.

e) Failure/problem description is accurate and clearly stated.

f) Identification of special conditions necessary to remove equipment from service such as a limiting condition for operation, a system outage, or a major plant outage.

g) Priority is assigned, technical safety requirements are identified, and time limits for action are specified, if applicable.

3.4.1.3 Reviewed MJRs should be initialed by the owner/operator representative and forwarded to the maintenance planning department.

3.4.1.4 The planning supervisor, or designated individual should review the MJR and perform the following:

a) Determine if the work on the Maintenance Job Request should be performed as a minor maintenance task.

b) Assign the MJR to the responsible craft planner.

3.4.1.5 The craft planner should review the MJR and perform the following:

a) Verify the MJR is not a duplicate of an existing MJR.

b) Walkdown of the identified deficiency. Use the walkdown checklist (Appendix E) as necessary to assist with job planning.

c) Verify the identified deficiency accurately describes the equipment problem. For example, "waste disposal pump leaks," does not provide enough information to assess the urgency of needed repairs or to provide accurate direction in performing repairs on the pump. A more accurate and quantitative problem description would be, 'The casing flange on the waste disposal pump leaks 10 drops per minute during pump operation at full load."

d) Identify special equipment/conditions to be considered in planning the work such as scaffolding requirements, special tools, interference removal, special radiological considerations, etc.

e) If the activity should be performed as minor maintenance, forward the MJR to the appropriate craft supervisor or scheduler for accomplishment.

3.4.2 Maintenance Job Request (MJR) Planning

NOTE: The planner should perform the following steps using Appendix E (Walkdown Checklist).

3.4.2.1 Identify any other pending and/or appropriate maintenance tasks, such as preventive maintenance, surveillance tests, or related corrective maintenance, that may be performed concurrently with the work being planned. Discussion with operations, scheduling, and engineering may be necessary to coordinate all associated work.

3.4.2.2 Identify and initiate appropriate requests as necessary for additional task and/or support needs such as scaffolding erection, electrical disconnection, piping removal, etc.

3.4.2.3 Review component history to determine when and what actions were previously taken for similar repairs. Consider repairs to similar equipment in other locations. Repetitive maintenance trends for problem equipment, components, and structures should be brought to the attention of engineering for resolution.

3.4.2.4 Obtain applicable detailed drawings of the component(s) and associated system(s) to be repaired or affected by the repair.

3.4.2.5 Review vendor information for special requirements for component repair and parts that may be needed to perform repairs.

3.4.2.6 Provide a listing of required special tools and parts for the job in the job package. If like-for-like replacement parts are not available, contact engineering for resolution.

3.4.2.7 Check for parts availability. Order/reserve parts as necessary to perform repair.

3.4.2.8 Determine procedure requirements based on equipment classification, ALARA (as low as reasonably achievable) considerations, and/or extent of repair needed to restore the equipment to operating condition (see DOE "W*riter's Guide for Technical Procedures*"). Typically, the following types of repairs should have an approved procedure or work instructions prior to work:

- work on safety-related equipment
- work on environmentally qualified (EQ) equipment
- welding
- code repairs
- repairs that involve quality control verification
- configuration managed equipment

Where pre-approved procedures are available, work should be performed using these procedures.

3.4.2.9 If an approved procedure is not required as determined in Step 3.4.2.8, provide work instructions to the craftsperson in sufficient detail to correct the equipment deficiency. Vendor recommendations, engineering requirements, craft training/skills (skill-of-the-craft), special tool needs, and hazards involved in performing the task should be considered when preparing these instructions. Engineering review of new work instructions should be performed to ensure adequacy. Work instructions to control troubleshooting should be developed as outlined in Appendix F.

Note: Consideration should be given to maintaining a library of routine, recurring maintenance instructions to minimize planning time. Previous job histories should be reviewed to establish standard job durations, typical parts and consumables needed, and other job requirements listed in Appendix G (Planning Checksheet).

3.4.2.10 Working with craft supervision and reviewing maintenance history records to determine time and coordination requirements to accomplish the task.

3.4.2.11 Initiate special permits necessary to perform the maintenance task. Flame permits, confined space permits, tagging requests, radiation work permit requests, etc., should be included in the work package if available.

3.4.2.12 When ALARA work planning is performed, special consideration should be given to providing adequate detail to assist the craftsperson in performing the task and reducing radiation exposure. Examples of items that should be considered include the following:

- reviewing previous work packages for lessons learned and effective methods of performing the task
- reviewing area photographs, if available, to identify problems that may delay work
- providing detailed tool lists
- providing rigging and handling sketches
- performing mockups or practice runs in non-radiation areas
- using portable shielding to reduce radiation levels
- dividing work into distinct tasks to be performed by different individuals
- holding an in-depth prejob briefing to ensure craftspersons have a clear understanding of the task to be performed
- improving access to the work through portable scaffolding or work platforms
- flagging work areas to control access
- including ALARA personnel in the planning process
- designing special tools that may reduce time to complete repair

3.4.2.13 Work with the operations manager and engineers to determine the following:

a) operational impacts such as alarms, possible actuation, special system alignment, or operator actions

b) postmaintenance test requirements that should be performed to check the maintenance performed and to return the component to operation, "*Guidelines to Good Practices for Postmaintenance Testing at DOE Nuclear Facilities*" addresses postmaintenance testing.

3.4.2.14 Assemble the work package. Include items listed in Appendix G (Planning Checksheet), as required. Plant document control procedures should be followed to ensure the most recent revision of a procedure is used by the craftsperson in performing the maintenance.

3.4.2.15 Place work package in the appropriate file or forward to scheduling for accomplishment. Files should include the following:

a) Ready to Work - All requirements are met; parts are available; support needs, such as scaffolding, are identified.

b) Hold for Parts - Repair parts are on order but have not been received or are not available.

c) Hold for Plant Conditions - All requirements have been met; however, special plant conditions, such as a component outage/limiting condition for operation, are needed to perform the work.

d) Outage Item - Plant outage or major system outage is needed to perform task.

3.5 Scheduling Guidelines

3.5.1 Schedule Requirements

The schedule should be a management tool (specifically including first line supervision) to control and direct maintenance activities. It should be used by management to determine the critical path and explore alternatives when needed. The schedule should be a concise method for tracking completion of maintenance tasks, particularly critical path activities. The following are some of the attributes that should be included in the schedule:

- The schedule should be useful. The individuals expected to follow the schedule need to understand that it should make their tasks and the tasks of others easier. They also should understand the importance of their tasks in relation to the schedule as a whole.

- The schedule report format should be appropriate for the user. The level of detail needed by the plant manager is different from the level of detail needed by a craft supervisor.

- The schedule should be proactive in that it should predict and lead activities and not only be an historical document.

- The schedule should be credible. It should be based on the best information available and reviewed and accepted by those actually responsible for doing the work.

- The schedule should be up to date. The schedule should be updated to reflect changing situations to maintain credibility. An out-of-date schedule often may be worse than no schedule.

- The schedule should be flexible, within the overall goals of the plant, in order to produce optimum results in dealing with unanticipated events.

- There should be one overall schedule. The overall schedule should be developed such that a hierarchy of schedules of varying detail may be obtained from a common data base. It has generally proven difficult to keep two or more schedules consistent, even when significantly different in level of detail shown.

3.5.2 Schedule Methods

To be responsive to the needs of management, a computerized scheduling system should be used.

Computerized scheduling offers the following advantages:

- rapid update capability
- ease in exploring alternatives
- resource determination and leveling
- identification of work-site congestion
- reports tailored to user

The success of a computerized planning and scheduling program is very dependent on the knowledge and experience of planning personnel and on the management support, training, and emphasis placed on its use. All supervisory personnel should have a basic understanding of the schedule program appropriate to their needs and uses of the schedule. Training sessions may be used to enhance this understanding and explain the reporting, updating, and adherence policies.

3.5.3 Schedule Detail

The detail included in the overall schedule should be that required to ensure coordination of work and permit assessment of progress. It is particularly important to include details of tasks that have interfaces among the various crafts and support personnel. The following are some examples of the coordination required:

- Operations Manager should be able to anticipate tagout needs.
- Radiological protection personnel should be able to determine in advance the needs for radiation work permits and technician support.
- Quality Control personnel and other inspection groups should be able to anticipate the need for their presence at the job site.
- Critical resource needs, such as overhead cranes, should be provided in sufficient detail to avoid interference, conflicts, and work delays.

- Major radiological protection actions, such as installation of temporary shielding, should be scheduled events.

- Major support activities, such as scaffolding erection, should be adequately defined in the schedule.

For minor jobs, some plants have been successful in identifying support requirements, such as tagging and radiation work permit (RWP) requirements, within the coding structure for activities in the schedule. When this is done, it is very important that sufficient training and familiarization be given to enable personnel to interpret the coding easily. It has generally been found necessary to explicitly schedule the support needed for major tasks rather than use only activity coding. A sufficient number of activities should be scheduled to ensure the short-term visibility needed for work coordination and progress tracking. Milestones should be defined for the completion of logical collections of tasks. Use of these intermediate milestones may provide an overall measure of the progress of maintenance activities and identify tasks significantly behind schedule. Management may then take appropriate corrective action.

Associating detailed work lists to a single activity in the schedule, rather than explicitly scheduling start dates for each job, has proven useful. This provides visibility of details but permits the individual tasks to be managed by the responsible departments and/or first-line supervisors. This is only successful, however, when a particular sequence of completing the work is not required, the support and interface requirements are minor, and a strong daily schedule and good communications exist. Note that the completion of the individual jobs should be closely monitored and progress tracked or there is a risk that delays in completion of one or more of the jobs may result in major schedule delays.

3.5.4 Daily Schedules

Daily schedules are important to ensure that work is properly coordinated even when there may be last-minute schedule changes. A daily schedule is generally used as the basis for discussions at daily meetings. The daily schedule may be generated by the computerized scheduling program itself or developed separately from information contained in the scheduling program data base.

A three-day look-ahead schedule issued daily has proven useful at many plants. This schedule provides the detail necessary to control the present day's work and provides an opportunity for craft planning for the next few days without an unreasonable amount of data. Extending the look-ahead period longer than about five days and not issuing the schedule on a daily basis increases the risk that data may not be current when needed.

A detailed review of the daily schedule should be an integral part of shift turnover activities to ensure that the on-coming shift is familiar with any short-term adjustments made to the schedule. This is particularly important for operator turnovers to ensure that operators know the status of the plant and are familiar with upcoming maintenance activities including tagging needs.

3.5.5 Schedule Preparation

The following items should be considered during the schedule preparation process:

- The schedule should be success oriented (i.e., contingency plans should not be included). If a contingency plan needs to be implemented, the schedule then should be revised to fit the particular situation.

- The schedule should be challenging but achievable. It should be consistent with the goals set by management.

- Work items should be coded to identify their discrete locations in the plant. They then may be reviewed together to assess the degree of area congestion and to minimize duplication of support work such as scaffolding and insulation removal.

- The schedule should be craft-loaded and the sequence and timing of activities adjusted to ensure that resource requirements are consistent with resource availability.

- Tests, inspections, or other tasks that may identify additional work should be scheduled as early as possible to permit time for completion of the additional work within the established envelope.

- Significant as-found, postmaintenance, and postmodification testing should be explicitly scheduled. Time should be allotted for testing, line up, and other activities required for returning systems to service. System interactions and operator resources should be considered when scheduling system and plant startup.

3.5.6 Schedule Integration

Integration of major tasks is a key to successful schedule development. There should be one all inclusive schedule that includes work to be done by non-facility contractors contributing support to the schedule as well as work to be done by site personnel.

Details for specific tasks should be provided by those responsible for the task. The planning organization should integrate these details into the overall schedule.

Manpower and support requirements should be included for maintenance activities. Work that should be integrated includes preventive maintenance, corrective maintenance, modifications, surveillance testing, and inservice inspections.

Non-facility contractors should be involved in early planning to ensure their work is integrated and scheduled properly.

3.5.7 Schedule Review

Schedule users, including non-facility contractors, should be required to review and comment on the schedule. Several reviews during the preparation process frequently avoid last-minute problems during the final review. Comments should be resolved before the next revision of the schedule. Support of this activity by line managers is a key to the success of the schedule.

The rationale behind specific schedule decisions should be documented and explained to those who are responsible for implementing the schedule. The explanation also should include restraints on the activity and restraints the activity places on others.

Opportunities for schedule improvements should be explored during the review process. This should include review of technical safety requirements and other regulatory requirements to determine if changes are possible that may result in work efficiency or schedule improvements without sacrificing safety.

The overall intent of the schedule review process, coupled with obtaining user input to the planning process, should be to provide a sense of ownership of the schedule to those who are expected to implement it.

3.5.8 Format, Progress Reporting, Updating, and Distribution

The schedule should be viewed as a tool by everyone involved in maintenance activities. The information provided to individuals should be commensurate with their responsibility and authority.

The following points on schedule distribution should be considered:

- Detailed information should be limited to the needs of the recipient. For example, a machinist overhauling a valve may need only start and finish times. The supervisor, however, should know the work scheduled several days in advance so availability of needed tools, materials, and required support may be ensured. The discipline manager should require advance schedule information for all associated work so assignments may be planned.

- Progress information should be summarized for management personnel, emphasizing problem areas and potential problem areas. Progress associated with the critical path or near-critical path should receive particular attention.

- The schedule information provided should be concise and understandable to the user.

The fundamental principles of a progress reporting system should be simplicity, accuracy, and timeliness. The individuals responsible for the work also should be responsible for progress reporting. To be most effective, the reporting system should be structured to be useful to those reporting and doing the work. The information requested should be limited to the minimum required.

The individuals responsible for progress reporting should be selected, by name, in advance of the start of the maintenance activities. Training should be held for those selected to ensure they understand the reporting system, the information needed, and how the information may be used. The need to report problems should be emphasized. Reporting should be more accurate and timely if the need for the data is fully understood. Vendors and contractors should be included in the progress reporting system.

Progress may be reported in a number of ways, some of which depend on the particular scheduling system used. For some systems, reporting start date, time, and remaining duration has been effective. An effective method is marking up daily schedules used by the work groups and returning them to the scheduling organization. Reporting progress relative to intermediate milestones also is useful.

As mentioned in section 3.5.1 of this guideline, "Schedule Requirements," the schedule should be current. The schedule should be updated regularly, based on the progress reports. The interval of updating should depend on the rate of change. For major changes and changes affecting the critical path or near-critical path, daily updates may be necessary. The key is that the schedule is maintained credible and provides the guidance needed to those responsible for performing the work.

3.6 Coordination Guidelines

3.6.1 Organization and Supervision

Extensive involvement of managers and supervisors in maintenance activities ensures timely completion of work, quality of completed work, and safety of personnel and equipment. Timely corrective actions should be taken when performance deficiencies are noted.

Supervisors should routinely monitor maintenance work in progress to ensure timely availability of support services and coordination with other activities and to ensure that activities are performed in accordance with plant policies and procedures. Particular emphasis should be given to the following areas in training supervisors:

- monitoring on-going work to control quality and progress
- providing accurate and timely work status reporting
- coordinating support and interface work activities
- ensuring the timely availability of tools, supplies, and parts
- understanding schedule interpretation and use

Supervisory controls should be applied to verification of tagouts prior to opening piping, valves, or mechanical equipment or working on electrical equipment. Additionally, specific precautions should be taken to exclude foreign material intrusion into open systems.

3.6.2 Prejob Coordination

Coordination of maintenance activities may involve detailed integration and timely implementation of many interrelated activities. Planners should be responsible for identifying and planning these interrelated activities, but the actions of managers and supervisors determine the success of completing the scheduled work.

Specific coordination and integration activities that should be considered by the line supervisors in preparing for work include the following:

- effective integration of plant system operation and maintenance activities to ensure proper plant conditions, timely equipment or system tagouts, initiation and completion of maintenance or modifications, and timely performance of inspections

- ALARA actions, including shielding installation and prejob briefings on ALARA precautions

- support of maintenance activities by health physics and decontamination personnel, including support during the performance of tasks, identifying and posting work areas, and timely decontamination of tools, floors, and equipment

- allocation of space and crane use

- inspection of maintenance activities by quality control personnel, including completion of associated documents

- continuous document processing, issuing, and closeout throughout the job

The effectiveness of prejob coordination should be routinely assessed by managers and supervisors and corrective actions taken when required to improve the efficiency of conduct of work.

3.6.3 Material Staging and Availability

A clear definition of the responsibility for ensuring that adequate parts and material are on site and available for the performance of scheduled work activities is necessary to avoid problems during the performance of maintenance. Plant responsibilities regarding procurement of material required for maintenance and modifications should be included in the definition. Having one organization responsible for coordinating material needs and a single point of contact for expediting material has proven successful and should be considered. (See DOE "*Guidelines to Good Practices for Procurement of Parts, Materials, and Services at DOE Nuclear Facilities.*")

Parts and material required for maintenance activities should be identified and purchased in time to allow for receipt and inspection well before they are needed. After processing, these parts and material should be identified for specific work packages and segregated from other stock inventory. Standard stock items and consumables required for planned work should be allocated to ensure their availability. (see DOE *Guidelines to Good Practices for Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance at DOE Nuclear Facilities.*")

Adequate storage and protection of parts and materials segregated for planned maintenance activities should be provided. This is particularly important for material staged at the job-site and not within normal storage areas.

Periodic reports highlighting any material or parts problems should be distributed to appropriate management personnel. Problems with material availability should be identified early to permit contingency planning.

3.6.4 Daily Meetings

Well managed planning and scheduling meetings are necessary to keep facility personnel aware of significant maintenance activities that are in progress and to make corrections to schedules. Meetings should be effectively managed to limit the time personnel spend in the meetings. Participation in meetings should be limited to those personnel affected. Three types of meetings, discussed below, have been shown to be effective in improving communications among work groups and in enhancing job coordination.

A daily directional meeting may be held after the start of the primary work shift. This meeting should be attended by management personnel and representatives from all major work groups. The meeting should focus on major jobs and evolutions planned for the next 48 hours and identify any redirection necessary due to significant problems such as lack of materials, shortage of other support resources, delays in key support activities, or other problems. Care should be taken to not unnecessarily perturb work in progress. At many plants, the planning organization prepares discussion material for this meeting including considerations for alternative paths. Results of the directional meeting affecting activities should be factored into the schedule at the daily planning meeting.

A planning meeting should be held each day following the directional meeting to review the near-term (next three to five days) schedule and verify that jobs may be worked as scheduled. Planners, and representatives of the operations manager, radiological protection, and other support departments should attend. The participants at this meeting should ensure that the information contained in the next updated schedule is consistent with current plans and resource availability. The schedule then should be updated by incorporating information from the directional meeting and the planning meeting. Re-prioritizing or rescheduling some work may be necessary for some support groups.

A shift work coordination meeting should be held shortly before the start of each shift. This meeting should be attended by oncoming shift supervision for each of the groups supporting the maintenance schedule, including maintenance, health physics, technical staff engineering, area coordinators, and task coordinators, for jobs requiring significant support. The Operations Supervisor for the oncoming shift should also attend. The shift work coordination meeting should address all scheduled work for the upcoming shift by exception and should modify the schedule as necessary to reflect last-minute changes. Reissue of the daily schedule to reflect these changes should not be - necessary. Items requiring multi-discipline support should be identified to the respective support groups and an estimate of the quantity of resources and the time required should be provided. Each attendee should leave the meeting with a clear under-standing of what their work group should do on the upcoming shift. The meeting should end in time for supervisors to return to their work groups before the shift starts.

Assignments for problem resolution should be made at meetings, but resolution should not be attempted during the meeting. The meetings should not be used as the primary method to determine status of maintenance activities.

3.6.5 Performance Monitoring

Performance measures should be developed to monitor the progress toward meeting plant maintenance goals (see DOE "*Guidelines to Good Practices for Management Involvement at DOE Nuclear Facilities*") Progress toward meeting these goals should be monitored frequently. Results of the routine monitoring should be reported to plant management. Examples of goals that are typically monitored include:

- rate of activity completion
- percent compliance to the daily schedule
- progress against the schedule
- amount and rate of bulk work (nonscheduled or listed work) completed
- expended man-hours versus planned man-hours by each craft or work group
- number of industrial accidents
- expended man-rem versus planned man-rem
- amount of radwaste generated

- number of skin and clothing contaminations

The performance measures should be monitored frequently to check that they are valid measures of plant maintenance status. Examples of areas that may be checked to ensure that the progress reported actually reflects real status include the following:

- The rate of activity completion is checked against the projected activity completion, the number of activities remaining, and the remaining duration on the schedule to ensure that the current rate supports the scheduled completion date.

- Compliance to the daily schedule is maintained at a high level to ensure that scheduled work is being completed to support the overall plant maintenance goals.

- Progress against the overall schedule is tracked to identify areas where work completion does not support the schedule.

- Bulk work completions should be tracked against remaining resources and time to ensure that bulk work is being completed at a rate that supports the schedule.

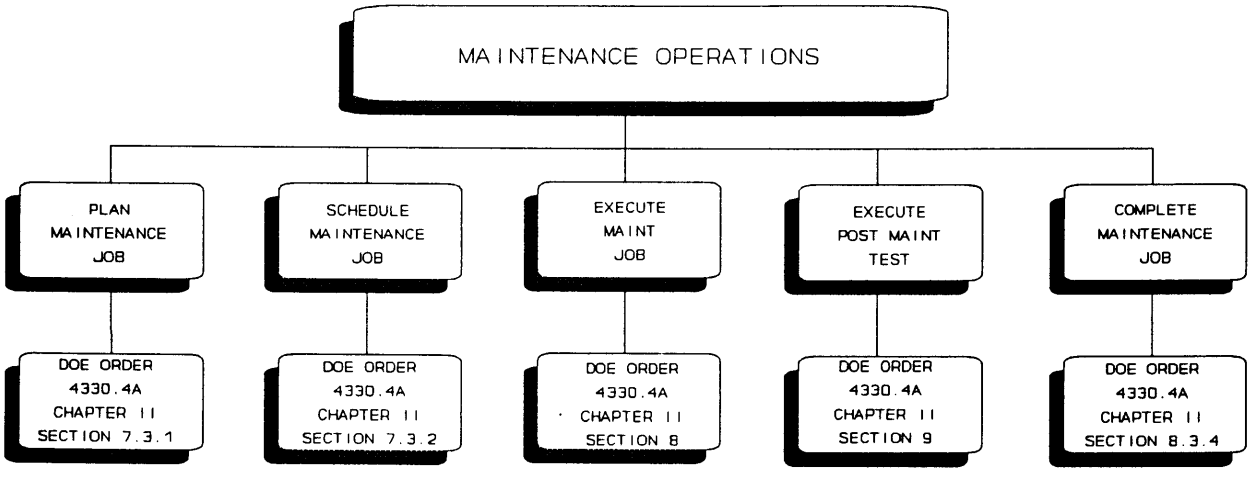
- Actual man-hours expended are tracked against earned value (original estimates) of completed jobs and against remaining scheduled work, manhours, and time remaining to ensure that sufficient resources and time exist to complete the maintenance activities as scheduled.

- Other performance measures, such as industrial accidents, skin and clothing contaminations, and overall exposure, should be tracked to identify areas of concern where actual values are exceeding projections.

Deviations in the expected results identified in reviews of the performance measures, such as those listed previously, should be analyzed to identify their root causes and should be reported to plant management for appropriate corrective action. (see "*DOE Guideline DOE-NE-STD-1004-92 Root Cause Analysis Guidance Document*")

APPENDIX A
MAINTENANCE OPERATIONS MODEL

APPENDIX A



The Maintenance Operations Model incorporates five interrelated processes applicable to each maintenance job. These five processes are Plan Maintenance Job, Schedule Maintenance Job, Execute Maintenance Job, Execute Postmaintenance Testing, and Complete Maintenance Job.

The Plan Maintenance Job process is identifying the job scope; producing a job plan; determining the planning category, priority, and safety concerns; identifying and procuring parts, materials, and supplies; identifying other task resources required; and preparing the work package. This process was developed based on DOE Order 4330.4A Chapter II Section 7.3.1.

The Schedule Maintenance Job process is calculating estimated start date and project resources required for job; scheduling and committing required resources and special tools/equipment to allow performance of all job tasks associated with the job. This process was developed based on DOE Order 4330.4A Chapter II Section 7.3.2.

The Execute Maintenance Job process is initiating and performing the job; and collecting job information as defined in the work package. This process was developed based on DOE Order 4330.4A Chapter II Section 8.

The Execute Postmaintenance Testing process is verifying facilities SSC fulfill their design functions prior to return to service after execution of the job. This process was developed based on DOE Order 4330.4A Chapter II Section 9.

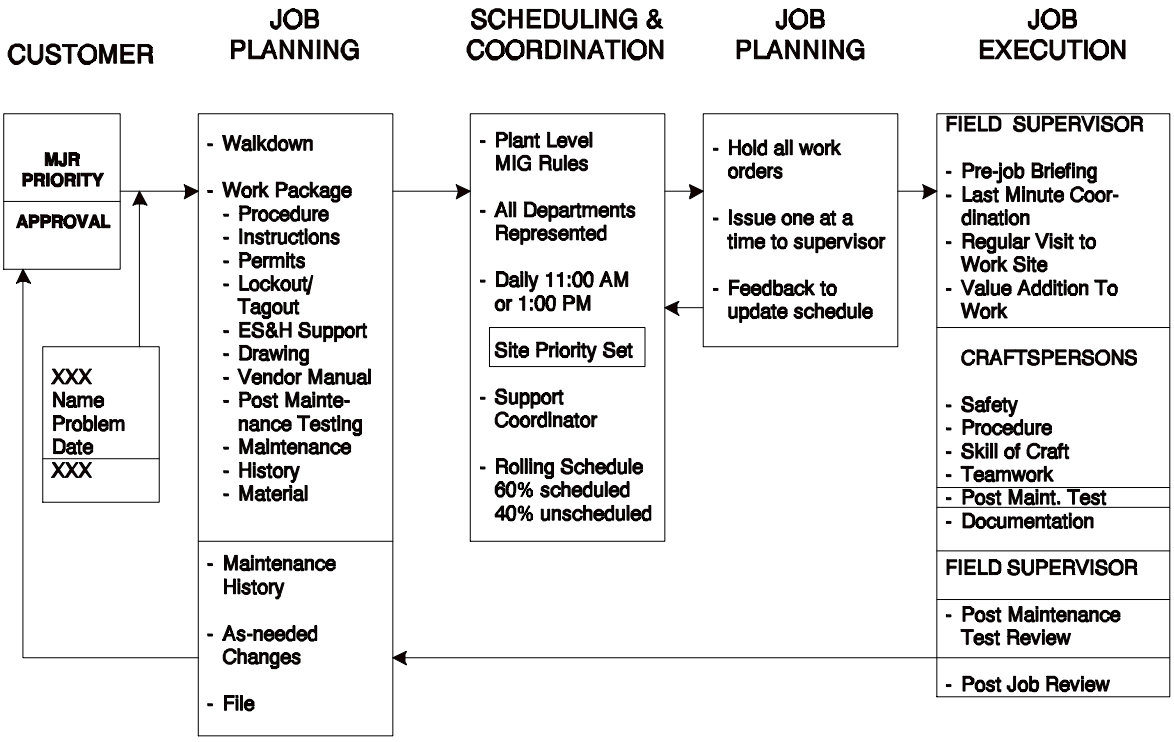
The Complete Maintenance Job process is performing job closeout to include completion of all documentation contained in the work package to ensure historical information is captured. This process was developed based on DOE Order 4330.4A Chapter II Section 8.3.4.

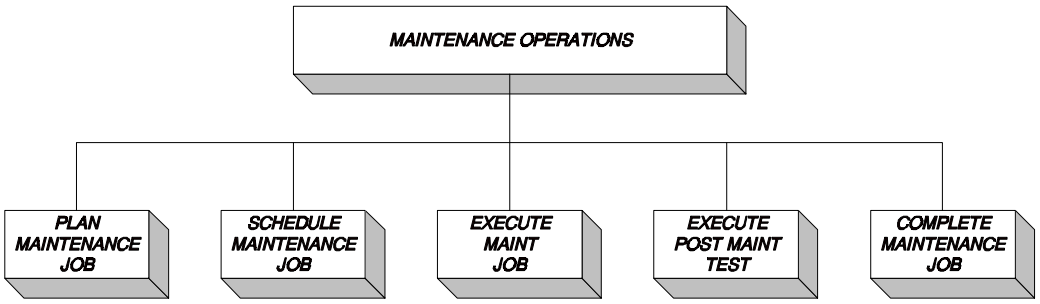
APPENDIX B
FACILITY MANAGEMENT

APPENDIX B

FACILITY MANAGEMENT

MAINTENANCE WORK CONTROL PROCESS FOR 4330.4A IMPLEMENTATION





APPENDIX C
EXAMPLES OF MINOR MAINTENANCE

APPENDIX C

EXAMPLES OF MINOR MAINTENANCE

Examples of Mechanical Minor Maintenance

A. The following are examples of work that may qualify as minor maintenance:

1. Manual Valve: Adjust packing on manual valves not subject to testing, repair or replace handwheel, lubricate valve stem.

2. Pumps: Adjust packing; adjust cooling water flow.

3. Flanges: Tighten to stop leakage (not to exceed recommended torque values).

4. Diaphragms: Seal against in-leakage.

5. Brackets/Hangers: Replace missing bolts (except safety-related/seismically qualified or material substitution).

6. Doors: Repair or replace knobs, hinges, bars, or closures.

7. Plumbing: Repair or replace commodes, water fountains, sinks.

8. Structures: Patch walls, roofs, etc. (except fire barrier seals).

9. Grating/Stair Treads: Repair or replace grating, clips, or treads.

B. The following are examples of work that does not qualify as minor maintenance:

1. Manual Valves: Adjust packing on valves that require testing.

2. Motor-operated Valves: Adjust or replace packing.

3. Pumps: Replace packing or seals, replace casing bolts, replace gasket.

4. Flanges: Replace gasket or fasteners; install or remove blank flange.

APPENDIX C

EXAMPLES OF MINOR MAINTENANCE

Examples of Electrical Minor Maintenance

A. The following are examples of work that may qualify as minor maintenance:

1. Lamps or Bulbs: Replace.
2. Fuses: Replace where fuse is not required to be safety-related.
3. Junction Boxes (non-EQ): Replace covers or screws.
4. Conduit: Replace covers, screws, brackets.
5. Motors: Replace air filters, replace cover screws, replace screens.
6. Plant Paging System: Repair or replace handles, knobs, etc.
7. Portable Sump Pumps: Repair or replace motor or wiring.
8. Door Locks or Latches: Repair or replace (except fire and security doors).
9. Telephone Equipment: Install, replace, or repair.

B. The following are examples of work that does not qualify as minor maintenance:

1. Light Fixture: Repair or replace where tagout is required.
2. Fuses: Replace where fuse is safety-related.
3. Fire Alarm Panel: Repair.
4. Protection Relay Test Switches: Repair or replace.

APPENDIX C

EXAMPLES OF MINOR MAINTENANCE

Examples of Instrument Minor Maintenance

A. The following are examples of work that may qualify as minor maintenance:

1. Lamps or Bulbs: Replace.
2. Fuses: Replace where they do not perform a safety-related function.
3. Pressure Gauges: Replace gauge or glass.
4. Instrument tubing: Tighten.
5. Air Filters: Replace.
6. Knobs: Tighten, repair, or replace.

B. The following are examples of work that does not qualify as minor maintenance:

1. Electro-pneumatic Equipment and Positioners: Clean or adjust.
2. Pneumatic Controllers: Clean, adjust, or calibrate.
3. Fuses: Replace when the fuse performs a safety-related function.
4. Transmitters: Vent or fill.

APPENDIX D
EXAMPLE MAINTENANCE JOB REQUEST

APPENDIX D
EXAMPLE MAINTENANCE JOB REQUEST

08/27/92	MAINTENANCE JOB REQUEST			UNCLASSIFIED PAGE 1 OF 2
Date Written: - -	Priority Code:	Work Order #:	Account #:	Job Number:
Badge:	Requester:	Phone:	Building:	Authorized By/Badge
Deliver To:	Badge:	Name:	Building:	Room: / Phone:
Category Codes	___ Corrective Maintenance ___ Preventive Maintenance		___ Other ___ Predictive Maintenance	
Required Work Permits:	___ None ___ Electrical	___ Safety ___ Other (Specify)	___ Radiation _____	
Required Completion Date: - -	Equip ID/Code /	Work Location:	Special QA Action: ___ (Specify)	

08/27/92	MAINTENANCE JOB REQUEST			UNCLASSIFIED PAGE 2 OF 2
Date Written: - -	Priority Code:	Work Order #:	Account #:	Job Number:

Description of Work Requested
(Include specific location, drawing #, required tests, sketches, and inspections)

MJR TEST DESCRIPTION:

PLEASE BE AS SPECIFIC AS POSSIBLE

APPENDIX E

EXAMPLE WALKDOWN CHECKLIST

APPENDIX E
EXAMPLE WALKDOWN CHECKLIST

PROPERTY NUMBER _____	**WALK-DOWN CHECKLIST**	**MJR NO.** _____

NAMEPLATE DATA INFORMATION

MANUFACTURER _____ HORSEPOWER _____ RPM _____

TYPE _____ SIZE _____ VOLTAGE _____ AMPS _____

FIGURE _____ MODEL _____ FRAME _____ TYPE _____

PRESSURE _____ TEMP _____ SERVICE FACTOR _____

DRAWING _____ ITEM _____ SERIAL NO. _____

ADDITIONAL NAMEPLATE INFORMATION _____

OUTAGE REQUIRED ☐ YES ☐ NO

SCAFFOLDING ☐ YES ☐ NO

INSULATION REMOVAL ☐ YES ☐ NO

BOLTING MATERIAL DEGRADED ☐ YES ☐ NO

MACHINING ☐ YES ☐ NO

WELDING/CUTTING ☐ YES ☐ NO

CRANE SERVICES ☐ YES ☐ NO

RIGGING ☐ YES ☐ NO

RIGGING REQUIRED _____

ADDITIONAL SUPPORT PERSONNEL REQUIRED:

_____

_____

_____

_____

_____

_____

_____

INSTALLATION TYPE: ☐ N/A

☐ FLANGED ☐ WELDED ☐ BRAZED ☐ SCREWED ☐ BOLTED ☐ _____ OTHER

EQUIPMENT TYPE:

☐ PUMP ☐ VALVE ☐ MOTOR ☐ FILTER ☐ DOOR ☐ _____ OTHER

FASTENER SIZE: ☐ N/A **APPLICATION:**

BOLT: _____ _____

STUD: _____ _____

NUT: _____ _____

OPERATIONS REQUIREMENTS

LOCK-OUT TAG-OUT REQUIREMENTS ☐ NONE REQUIRED

☐ MECHANICAL ☐ ELECTRICAL ☐ HIGH VOLTAGE

POWER SUPPLY: _____

OTHER COMPONENTS / EQUIPMENT AFFECTED BY HOLD-OFF: _____

OPERATIONS COMMENTS: _____

SPECIAL CONDITIONS / TIME RESTRICTIONS: _____

WALK-DOWN PERFORMED BY: _____ **BADGE NO.** _____ **DATE** _____

APPENDIX F
EXAMPLE TROUBLESHOOTING GUIDE

APPENDIX F

EXAMPLE TROUBLESHOOTING GUIDE

For work that requires troubleshooting for unknown conditions on energized, pressurized, or operating equipment, perform the following:

1. Prior to developing the troubleshooting methodology, review/consult with the following sources of information as necessary to understand the equipment/systems interactions:

    a. system engineers
    b. owner/operator personnel (organization responsible for the equipment)
    c. training
    d. technical safety requirements
    e. final safety analysis report (FSAR)
    f. equipment vendor manuals
    g. equipment manufacturers
    h. applicable procedures
    i. applicable system/circuit drawings
    j. vendor drawings

2. Include the following, as applicable, in the work instructions to the craftsperson:

    a. Notes, precautions, and prerequisites for the specific task (e.g., "system contains live steam, do not vent"; "do not exceed three motor starts in any one-hour period"; "do not remove input/output signal cable before de-energizing power supply").

    b. Steps to record and observe as-found/as-left conditions of the affected equipment.

    c. Steps to record any abnormalities observed during equipment operation, e.g., bearing noise, smoke, vibration, etc.

    d. Steps to prevent further damage if any abnormal conditions are observed.

    e. Specific instructions for craft/technician to stop work when problems or conditions encountered were not anticipated or are not understood. They should be directed to consult with their supervisor or planner prior to taking action.

    f. Steps to record and verify lifted/landed leads. Lifted lead forms should be included in the work package as required.

APPENDIX F

EXAMPLE TROUBLESHOOTING GUIDE

g. Steps to record the identification numbers and calibration due dates of measuring and test equipment used (see DOE "*Guidelines to Good Practices for Control and Calibration of Measuring and Test Equipment (M&TE) at DOE Nuclear Facilities*."

h. Steps to tag and retain all parts removed during the troubleshooting process. These parts shall be retained as appropriate for further investigation/analysis by maintenance or systems engineer.

3. For troubleshooting of safety-related equipment, or equipment important to safe and reliable plant operation, a troubleshooting impact statement should be included as part of the planned package. Include the following information on the statement:

   a. scope of the troubleshooting

   b. required equipment status

   c. work boundaries for the activity

   d. potential plant upsets that may occur

   e. approval of owner/operator supervision prior to beginning troubleshooting activities

4. Any follow-up corrective maintenance deemed necessary as a result of troubleshooting should be performed under a separate corrective maintenance work order or under an approved revision to the work plan.

APPENDIX G
EXAMPLE PLANNING CHECKSHEET

APPENDIX G
EXAMPLE PLANNING CHECKSHEET

PAGE 1 OF 2	**JOB PLANNING CHECKSHEET**	MJR NO._____

******* EQUIPMENT CATEGORIES *******

CATEGORY I ☐ **HIGH-RISK STRUCTURES, SYSTEMS, and COMPONENTS (SSC)**
(Sections A, B, and C SHALL be completed)

CATEGORY II ☐ **MEDIUM-RISK STRUCTURES, SYSTEMS, and COMPONENTS (SSC)**
(Sections A and B SHALL be completed. Section C as required)

CATEGORY III ☐ **LOW-RISK STRUCTURES, SYSTEMS, and COMPONENTS (SSC)**
(Section A SHALL be completed. Sections B and C as required)

******* SECTION A *******

NOTE: WHENEVER BLOCK IS CHECKED, PLANNER SHALL ADD EVALUATION DATE.

HEALTH and SAFETY	**YES**	**NO**	**DATE / COMMENTS (AS REQUIRED)**
JOB HAZARD ANALYSIS	☐	☐	____/ _____
CONFINED SPACE	☐	☐	____/ _____
LOCK OUT - TAG OUT	☐	☐	____/ _____
HIGH VOLTAGE HOLD-OFF	☐	☐	____/ _____
CONTAMINATION CONTROL *(ALARA)*	☐	☐	____/ _____
PERMITS			
OSWP	☐	☐	____/ _____
EXCAVATION	☐	☐	____/ _____
PENETRATION	☐	☐	____/ _____
ASBESTOS/CERAMIC FIBER	☐	☐	____/ _____
WASTE DISPOSAL	☐	☐	____/ _____
POTABLE WATER	☐	☐	____/ _____
STORM/SANITARY SEWER CONNECTION	☐	☐	____/ _____
OTHER _____	☐	☐	____/ _____

NOTE: CHECK THIS BOX ONLY IF NO PERMITS OF ANY TYPE ARE REQUIRED

NO PERMITS REQUIRED ☐

JOB PACKAGE INCLUDES

MJR	■		**MJR INCLUDED WITH ALL JOBS**
OTHER REQUIREMENTS	**YES**	**NO**	**DATE / COMMENTS (AS REQUIRED)**
NEPA ASSESSMENT REQUIRED	☐	☐	____/ _____
DAVIS-BACON ASSESSMENT REQUIRED	☐	☐	____/ _____

******* JOB PACKAGE APPROVAL *******

ESTIMATED CREW SIZE _____ ESTIMATED NUMBER OF MANHOURS _____

JOB PACKAGE INCLUDES NECESSARY INFORMATION, AND MATERIAL LOCATIONS

PLANNER ESTIMATOR _____ BADGE NO. _____ DATE _____

FMO SUPERVISOR _____ BADGE NO. _____ DATE _____

******* SECTION B *******

WORK START APPROVAL

CUSTOMER _____ BADGE NO. _____ DATE _____

COMMENTS _____

_____

APPENDIX G
EXAMPLE PLANNING CHECKSHEET

PAGE 2 OF 2	**JOB PLANNING CHECKSHEET**	MJR NO._____

***** SECTION B (CONTINUED) *****

NOTE: WHENEVER BLOCK IS CHECKED, PLANNER SHALL ADD EVALUATION DATE.

SPECIAL REQUIREMENTS	YES	NO	DATE / COMMENTS (AS REQUIRED)
CROSS MJR'S ISSUED TO SUPPORT WCC'S	☐	☐	____/ _____
SPECIAL TOOLS/MATERIAL	☐	☐	____/ _____
CERTIFICATION REQUIREMENTS (specify)	☐	☐	____/ _____
PREVIOUS REPAIR HISTORY REQUIRED	☐	☐	____/ _____
POSTMAINTENANCE TESTING			
DOCUMENTED/FORMAL	☐	☐	____/ _____
CHECKOUT/VERIFICATION	☐	☐	____/ _____
JOB-SITE INSPECTION			
SECURITY DEPT.	☐	☐	____/ _____
FIRE DEPARTMENT	☐	☐	____/ _____
HEALTH PHYSICS	☐	☐	____/ _____
INDUSTRIAL HYGIENE	☐	☐	____/ _____
INDUSTRIAL SAFETY	☐	☐	____/ _____
CRITICALITY SAFETY	☐	☐	____/ _____
PLANNER ESTIMATOR	☐	☐	____/ _____
OTHER _____	☐	☐	____/ _____
JOB PACKAGE INCLUDES			
MJR CONT. SHEET WITH WORK INSTRUCTIONS *(REQUIRED FOR CATEGORY I & II)*	☐	☐	____/ _____
REPAIR HISTORY FORM *(REQUIRED FOR CATEGORY I & II)*	☐	☐	____/ _____
BILL OF MATERIALS	☐	☐	____/ _____
PROCEDURES *(REQUIRED FOR CATEGORY I)*	☐	☐	____/ _____
CFC DRAWINGS *(REQUIRED FOR CATEGORY I MODS)*	☐	☐	____/ _____
TECHNICAL MANUALS	☐	☐	____/ _____
JOB PLAN *(REQUIRED FOR CATEGORY I)*	☐	☐	____/ _____
QA/QC REQUIREMENTS	☐	☐	____/ _____
VENDOR DATA	☐	☐	____/ _____
OTHER _____	☐	☐	____/ _____

***** SECTION C *****

JOB-SITE INSPECTION COMPLETE

CUSTOMER	*(REQUIRED FOR CATEGORY I)*	☐	☐	____/ _____
FMO SUPERVISOR	*(REQUIRED FOR CATEGORY I)*	☐	☐	____/ _____

APPENDIX H
PLANNING, SCHEDULING, AND COORDINATION OF MAINTENANCE
SAMPLE LESSON PLAN

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PLANNING, SCHEDULING, AND COORDINATION OF MAINTENANCE
SAMPLE LESSON PLAN

LESSON PLAN

1. The instructor should be familiar with the following background information:

   a. An effective system for planning, scheduling, and coordinating maintenance work should provide benefits such as improved maintenance efficiency, reduced radiation exposure, and increased equipment availability.

   b. Planning is that function where the actions and support of a specific maintenance activity are prearranged prior to the crew receiving the assignment work package. Some elements of planning include the following:

      - the work activity defined in scope,
      - identification of required support,
      - adequate task instruction or procedures,
      - identification of qualified craftsperson,
      - and maintenance history update.

   c. Scheduling is that function where multiple work activities are arranged to conduct overall site maintenance efficiently and within prescribed time limits. Scheduling includes:

      - accurate site-wide priority setting, and
      - scheduling meetings to integrate multiple work activities in order to prevent conflicting job tasks, and site support requirements.

   d. Coordination is a sub-function of scheduling where work permits, tagouts, Quality Control verifications, and other support activities are organized and timed to support the overall efficiency of the maintenance task.

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's daily/weekly planning and scheduling sheet, a copy of a current backlog report, and a listing of the job priority codes.

3. This lesson has the following trainee enabling objectives:

a. Explain the facility's planning, scheduling, and coordinating process,

b. Define the concept of backlog of corrective maintenance work, and

c. State the priority system.

4. Some important factors in ensuring that site maintenance is performed in an efficient and timely manner are job/task planning, integrated scheduling of multiple work activities, and coordination of tagouts, permits and materials. If these considerations are performed effectively, then each work crew should receive a work package and accomplish the work task without spending valuable craftspersons time chasing down parts, searching for support documentation, or waiting on other departmental support. Components of planning, scheduling, and coordination include the following:

a. All maintenance work orders on operational equipment should be reviewed by the planning organization. This review should address the following:

- the deficiency identified on the work order should be verified as correct prior to issuing the job. (This prevents mobilization of a crew for a non-maintenance activity.

- appropriate procedures, drawing, vendor manuals, and historical information should be selected to support the activity,

- essential tools, equipment, parts, and materials should be identified and available,

- manpower requirements should be specified,

- ALARA considerations should be included in the job scope,

- identification of the initial system or component conditions should be performed prior to performing maintenance,

- instructions for equipment restoration and postmaintenance testing should be included in the work order, and

- a post-activity review of completed work documentation and an update to the equipment history files.

b. Corrective Maintenance Backlog should be monitored to help ensure that important jobs are not being unnecessarily delayed, and that management control is maintained over the amount and type of work in the backlog. Corrective maintenance backlog is an important indicator of how responsible the maintenance organization is to their customers. If the customer, usually operations and/or fabrication, has to work around defective or out-of-service equipment, then the overall operability of the site may be compromised. The greater the amount of defective equipment and the longer the equipment is left defective, the more significant that risk becomes.

c. A work priority system is used to minimize the congestion of jobs that are important to safe and reliable operations with those that are of less importance. An example of a work priority system includes the following:

- *Critical (C)*: Equipment or systems that shall operate greater than 90 percent of the time. Being out of service for one working day may result in imminent and significant environmental damage; potential to expose personnel to serious health and safety damage, including injury or death; breach of security; or interruption of production or experiment.

- *Urgent (U)*: Equipment, systems, or experiments important to plant goals and which when out of service may result in a significant interruption of' production or experiment. Importance is great enough to justify diverting personnel from other assignments and to work overtime, based on realtime circumstances. Required uptime is greater than 80 percent.

- *Priority (P)*: Equipment, systems, or experiments important to plant goals but which have backup or redundant hardware. Required uptime is greater than 70 percent.

- *Routine (R)*: Equipment, systems, or experiments not meeting one of above categories which may be worked in most economical manner.

d. The effective coordination of maintenance activities requires plant wide adherence to site work priorities, and timely support from other departments for items such as permits, tagouts, and radiological protection coverage.

5. Discuss with the trainees the scheduling work sheet, a backlog report, and the work priority system. Emphasize a clear understanding of each item.

CONCLUDING MATERIAL

Review Activities:

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

Area Offices
Amarillo
Brookhaven
Kansas City
Kirtland
Princeton

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

Preparing Activity:

DOE-NE-73

Project Number:

MNTY-0005