

MAINTENANCE PROGRAMS

1.0 SCOPE

This performance assessment guide for maintenance programs will be used to carry out the oversight responsibility of the U.S. Department of Energy (DOE) Brookhaven Group. This guide was prepared to assist in conducting performance-based assessments of prime contractors and subcontractors to ensure that their maintenance programs identify, disposition, and take corrective action on issues that affect satisfactory facility performance. The goals are to ensure that laboratory employees and the public do not experience injuries and illness as a result of maintenance programs safety activities and that there is little or no economic loss to the Government.

Maintenance programs assessments will be directed at all prime contractors and subcontractors working at DOE sites. DOE line management must ensure that contractors comply with DOE Orders and Federal and State regulations. Information developed from this assessment will determine the degree to which this is being done as well as the effectiveness of the laboratory's program.

2.0 ATTRIBUTES AND LINES OF INQUIRY

This section provides lines of inquiry to help assess whether the laboratory has implemented a program that ensures that maintenance programs requirements are incorporated into line activities. This section will be used to evaluate the laboratory's line organization.

2.1 A maintenance organization with specific lines of authority, responsibility, and accountability has been clearly defined and implemented. Requirements for communication and interface between the maintenance organization and other laboratory organizations are clearly delineated.

- Do the engineering and technical support functions have direct and continuous interface with the maintenance organization?
- Do the engineering and technical support functions provide support in determining the cause of repetitive equipment failures and to investigate the root cause of unplanned events?
- Do engineering and technical support functions incorporate the following specifications into all maintenance activities: manufacturers' recommendations; specifications for

operability; action levels; acceptance criteria; procurement specifications; installation and test requirements; and test equipment and procedures?

- Do engineering and technical support functions identify and evaluate potential degradation mechanisms caused by environment and service over time, and provide direction for timely mitigation of their effects?
- Are contracted maintenance services controlled and overseen to ensure that contracted work is performed to the same standard established for the maintenance organization?
- Are contracted personnel qualified for the work they are to perform?
- Are the Quality Assurance (QA) and Quality Control (QC) programs applied to maintenance activities commensurate with their safety and security significance?
- Have working relationships been developed among all interfacing organizations supporting the maintenance function?
- Does the maintenance organization achieve a high level of performance in maintenance activities by effective implementation and control of maintenance activities?
- Does the maintenance organization provide time for and emphasize long-range planning?
- Are maintenance personnel held accountable for their performance through supervisory counseling, performance appraisals, and, when necessary, disciplinary measures?
- Have entry-level criteria been established to ensure that maintenance personnel have the requisite background and experience to be trainable for work in facilities?
- Do position incumbents meet the prescribed job qualification requirements?
- Have appropriate job qualification requirements been established for all facility maintenance positions affecting the safe and reliable operation of facilities?
- Are maintenance job qualification requirements periodically reviewed, evaluated, and revised?

- Are adequate engineering and technical support personnel readily available?
- Are qualified personnel recruited for temporary staff increases needed to support planned outages or other activities?
- Is timely action taken to anticipate and fill maintenance vacancies?
- Are long-range maintenance staffing plans developed?
- Are appropriate career progression plans used to develop the management, supervisory, and technical expertise of personnel and thus help to ensure that future maintenance staff vacancies are filled with qualified personnel?

2.2 The administration of the maintenance function ensures that a high level of performance is achieved by establishing written performance standards, periodically observing and assessing the performance of maintenance personnel and systems, and holding personnel accountable for their performance.

- Are the conduct of maintenance activities documented to provide for systematic, coordinated, and accurate implementation of maintenance policies, goals, and objectives?
- Are sufficient staff, equipment, and funding requested, justified, and available so that the maintenance organization can effectively perform its function and adequately train maintenance personnel?
- Are administrative work control functions documented in policies, procedures, and checklists?
- Do maintenance procedures establish the responsibility for maintenance, accountability for work, authority, and lines of communication within the maintenance program?
- Do maintenance procedures define documentation requirements, required references, and means of review, approval, and updating?
- Do maintenance procedures define the maintenance program, including standards for maintenance activities?
- Are the maintenance program and maintenance standards communicated to the working level by training workers in good work practices?

- Are the maintenance program and maintenance standards communicated to the working level by supervisors who observe and guide work activities?
- Is the maintenance program understood and effectively and consistently implemented by all involved personnel?
- Are administrative controls, such as preventive maintenance scheduling, use of special tools and lifting equipment, and use of measuring and test equipment, employed in the conduct of facility maintenance activities?
- Does the maintenance organization have effective channels of oral and written communications with such supporting groups as operations, safety, and engineering?
- Do the maintenance program documents define the communication necessary to develop working relationships and keep personnel at all levels cognizant of the information needed in order to perform their functions?
- Are technical issues associated with maintenance identified and resolved with involved organizations?
- Are rewards and other forms of recognition given to maintenance personnel for superior performance?
- Are maintenance personnel who are involved in significant or frequent violations of requirements encouraged to improve through counseling, by remedial training, or by disciplinary measures, as appropriate?
- Are performance appraisals and routine personnel feedback from supervisors or managers utilized to enhance individual employee performance?
- Are activities such as employee participation programs utilized to encourage personnel to develop methods to improve safety, reliability, quality, and productivity?
- Are maintenance commitments routinely met?
- Is the status of open commitments tracked and kept up-to-date?
- Are performance indicators reviewed and used to improve maintenance performance?
- Does long-range planning of major maintenance activities and facility outages establish a scope for funding and staff resources to meet the needs of the maintenance program?

2.3 Written maintenance policies, goals, and objectives are documented in appropriate manuals and communicated to all maintenance personnel. Maintenance work is conducted based on these goals and objectives.

- Have policies been developed and implemented that define the maintenance organization, establish administrative objectives and levels of responsibility, and generally serve to consistently regulate and guide the conduct of maintenance activities?
- Are maintenance personnel assigned responsibility for achievement of specific objectives?
- Do maintenance personnel understand the actions necessary, within the scope of their duties and responsibilities, to achieve these objectives?
- Have maintenance goals been developed and implemented to improve maintenance performance and to measure maintenance effectiveness?
- Are maintenance objectives challenging and stated in measurable terms?
- Do maintenance objectives address areas where improvement is needed?
- Has the maintenance organization established goals to minimize (1) the impact on planned outages by planning and completing maintenance activities in a timely manner; (2) the number of forced outages; (3) unplanned challenges to critical systems; and (4) the lost-time accident rate?
- Has the maintenance organization established a goal to minimize facility and equipment downtime, personnel errors, reduce repeat maintenance work requests (rework), and to complete scheduled surveillances and preventive maintenance activities in a timely manner?
- Has the maintenance organization established a goal to manage the corrective maintenance backlog to minimize the backlog and completion time of outstanding deficiencies?
- Has the maintenance organization established a goal to control overtime, to provide adequate staffing levels, to provide adequate training to maintenance personnel, and to complete outage and non-outage work on schedule?
- Have substantive maintenance goals that challenge the capability and ingenuity of the maintenance manager been established?

- Are maintenance goals and objectives attainable and not considered "sacred"?
- Are initial objectives revised if proven unfeasible, irrelevant, or impossible?
- Are effective safety programs implemented with clearly defined policies, procedures, and responsibilities to protect maintenance personnel?
- Do policies, procedures, and responsibilities clearly define the QA and QC program interface with maintenance?

2.4 Maintenance training and qualification programs serve to develop and maintain the knowledge and skills required by maintenance personnel to effectively perform maintenance activities.

- Is the responsibility for establishing, maintaining, and implementing the maintenance training programs defined, understood, and coordinated between the maintenance and training organizations?
- Have maintenance training programs been defined to encompass managerial, supervisory, planner/scheduler, engineering, and craft personnel?
- Does initial training, consisting of classroom and on-the-job training, develop necessary job-related knowledge and skills, including basic technical and applied science subjects?
- Does initial training cover maintenance fundamentals and troubleshooting and repair techniques; facility systems and components; special maintenance craft skills; and practical factor demonstration?
- Does initial training cover work control procedures and industrial safety, including hazards associated with work on specific equipment/systems and emergency response?
- Does initial training cover QA and QC; maintenance procedures and job-specific work practices, including surveillance procedures; in-house and DOE-wide operating experience, including actual events; and emergency response?
- Does continuing training maintain and improve job-related knowledge and skills?
- Does continuing training address facility system and component changes, procedure changes, and DOE-wide and in-house operating experiences, including facility operation?

- Does continuing training include seldom-used knowledge and skills that affect safe and reliable facility operation?
- Does the maintenance organization provide support and guidance for maintenance training programs, including defining the jobs, tasks, skill levels, and responsibilities of the maintenance training programs?
- Is support and guidance for identifying individuals to fill maintenance training positions provided?
- Does the maintenance organization provide support and guidance for defining training programs for each position, determining the content and emphasis of needed training, and supporting training schedules?
- Does the maintenance organization provide support and guidance for determining the training needs of and tailoring the training program for each individual based on his/her previous education, training, experience, and skill level?
- Does the maintenance organization provide support and guidance for acquiring instructors and trainers?
- Does the maintenance organization provide support and guidance for establishing qualification criteria, with emphasis on successful performance in the field?
- Does the maintenance organization provide support and guidance for coordinating the conduct of instruction during on-the-job training?
- Does the maintenance organization provide effectiveness feedback to the training organizations to enhance and, where necessary, adjust course teaching methods, content, and emphasis?
- Is training implementation coordinated between the maintenance and training organizations to prepare training schedules, determine who should attend training sessions, and ensure qualified instructors are available to teach the courses?
- Does the maintenance training program include formal on-the-job training (OJT), in which facility personnel achieve learning objectives through practical hands-on training conducted within the job environment?
- Is OJT conducted in accordance with formally defined training programs that specifically identify items the trainee must accomplish by personnel who have successfully qualified as OJT Trainers?

- When trainees perform maintenance on installed equipment, does a qualified OJT instructor observe the work so that the trainee properly accomplishes the activity and understands how to avoid errors that could affect personnel safety or adversely impact the facility?
- Is the number of trainees simultaneously participating in any OJT, limited in order to ensure that each trainee receives effective and adequate instruction?
- Do trainees independently perform maintenance only on facility equipment for which they are qualified?
- Are qualification standards and evaluation methods adequate to verify trainee competence for formal qualification approval and documentation?
- Are maintenance managers directly involved in approving and periodically reviewing the maintenance training program?
- Are maintenance training programs systematically improved to ensure that trainees develop the required skills and knowledge?
- Is feedback from job performance used to help evaluate and refine maintenance skills?
- Does management and supervisory training include generic areas such as managerial and supervisory skills, accountability, assessment and observation of routine activities, communication skills, teamwork, and company management philosophies?
- Is position-specific training provided to first-line supervisors?

2.5 Periodic inspections of equipment and facilities are conducted, ensuring that proper condition, cleanliness, and housekeeping are maintained to support safe and reliable facility operations.

- Have standards for equipment and facility condition, cleanliness, and housekeeping been established and communicated to all maintenance personnel?
- Are adherence to standards for equipment and facility condition, cleanliness, and housekeeping, assessed through the conduct of routine periodic inspections by managers and supervisors?
- Is temporary environmental protection (e.g., from dust, humidity, freeze, and shock) provided for facility equipment, when needed to support construction, outage, or maintenance activities?

- Are appropriate facility maintenance personnel aware of facility condition standards?
- Are appropriate facility maintenance personnel trained in the techniques required to perform condition inspections?
- Do condition inspection procedures define expected standards, assign responsibilities for program implementation, and establish means to measure program effectiveness?
- Have inspection areas been assigned so that the entire facility is inspected, including radiation and locked areas with difficult access?
- Are checklists of the equipment to be inspected and types of problems to look for available as guides for the inspectors?
- Have schedules for the performance of routine periodic inspections been established?
- Do schedules for the performance of routine periodic inspections identify the area(s) to be inspected and provide for periodic rotation of inspectors?
- Are the results of each inspection transmitted to the facility manager and maintenance manager?
- Are significant conditions or safety deficiencies immediately reported to the appropriate supervisor for near-term attention?
- Are facility deficiencies entered into the work control system for correction?
- Are identified deficiencies corrected in a timely manner, so that facility personnel can see the positive results of the inspection program?
- Are personnel assigned corrective action when deficiencies are identified?
- Are deficiencies tracked to completion?
- Are reported deficiencies monitored to identify recurring, generic, and long-term problems?

2.6 All real property and installed equipment is inspected at predetermined frequencies to ensure that these facilities are maintained in a condition consistent with assigned missions or long-range planning.

- Are Condition Assessment Surveys (facility inspections) ranging from simple, visual walkthrough-type assessments to in-depth studies using a variety of technical diagnostic techniques, conducted?
- Does the condition assessment survey program aid in the early detection of potential facility problems in order to prevent deterioration, possible damage to adjacent materials or systems, and failure of components?
- Are the standards and procedures that form the basis for condition assessments reflected in checklists that prompt and assist the inspection team in the deficiency identification process?
- Is the condition assessment process standardized and performed on a predetermined basis, ranging from quarterly to every 3 years?
- Are condition assessments performed by individuals trained to recognize and identify symptoms of facility problems?
- Is particular attention given to potential problem areas such as interfaces between components, especially with respect to different systems or components from different manufacturers or suppliers?
- After the identification of symptoms of problems or deficiencies, are diagnostic analyses performed to determine whether there is, in fact, a problem, the nature and extent of the problem, and options for corrective action?
- Do personnel performing diagnostic analyses have technical knowledge of the systems, equipment, or components involved, and of the materials used in construction and maintenance?
- Are diagnostic analyses based on logical, standardized, professionally developed procedures, ensuring that identified deficiencies are efficiently and correctly evaluated?
- For efficiency, are the condition assessment survey teams given target estimates for levels of anticipated problems, time required for inspection, and number of buildings and amount of contained equipment to be inspected?
- For efficiency, are the condition assessment survey teams given symptom checklists and standards to be applied in identifying symptoms?

- Are condition assessment surveys conducted by dedicated teams that may include architects, engineers, inspectors, consultants, or others trained for the job?

2.7 The laboratory has developed maintenance plans that provide a clear understanding of the total maintenance needs and planned significant projects for the year and, at a summary level, the maintenance activities that support the long-range life-cycle facility maintenance requirements.

- Does the laboratory maintenance organization develop and annually update plans describing required maintenance activities and integrating maintenance activities for which they are responsible?
- Do maintenance plans address maintenance activities by functional unit of site infrastructure?
- Do laboratory maintenance plans include narrative descriptions of the laboratory's maintenance management program and do they address all elements of a successful maintenance program?
- Do laboratory maintenance plans address classical maintenance and repair activities funded by operating expense accounts, including labor and associated supervision and materials, as well as other indirect and overhead-funded activities?
- Do laboratory maintenance plans address preventive, corrective, predictive, and emergency maintenance?
- Do laboratory maintenance plans address support functions such as inspections, administration, engineering, and training?
- Do laboratory maintenance plans address nonmaintenance work activities (such as janitorial services, snow removal, and asbestos abatement) that help to describe the "total" responsibilities of the maintenance organization?
- Are nonmaintenance activities (such as janitorial services, snow removal, and asbestos abatement) funded as nonmaintenance work?
- Does the maintenance plan describe the strategy to monitor and control the maintenance backlog to ensure that facilities are adequately maintained?
- After the scope of major maintenance activities is established as required, are funding and staff resources estimated to meet the needs of the maintenance program?

- Does long-range planning encompass recurring major maintenance items such as turbine overhaul, steam generator inspections, and major pump rebuilds?
- Does long-range planning encompass timing of planned maintenance and downtime, significant projects, and modifications?
- Are future organizational structure and staffing changes aimed at continuing improvements in the maintenance program and the facility as a whole a part of the long-range plan?
- Does long-range planning encompass equipment replacement as components reach the end of their service life, and timing of outages for the other facilities in the system, when reliance on them for resources is part of the maintenance plan?
- Does long-range planning include regulatory issues and events that will change or impact the maintenance program?
- Does long-range planning consider budget changes or projects that may divert major dollars from maintenance activities?

2.8 Maintenance facilities, equipment, and tools are periodically reviewed for adequacy in supporting facility maintenance and maintenance training.

- Are maintenance facilities, including storage facilities and laydown and staging areas, sized and arranged to promote the safe and effective completion of work?
- Have maintenance training facilities, shops, satellite work areas, laydown and staging areas, storage facilities, mockups, temporary facilities, shower and toilet facilities, lunch areas, conference areas, and offices all been evaluated for adequacy?
- Do work-area lighting schemes and other environmental conditions promote safe and effective working conditions?
- Are work areas uncluttered and in an orderly condition?
- Is facility equipment accessible for maintenance activities?
- Are fixed local area hoists, ladders, and work platforms provided, as needed?
- Do storage facilities for parts and materials being gathered for or issued for maintenance jobs, provide adequate environmental controls to protect maintenance materials?

- Are tool and equipment storage facilities located near shops and normal work areas to improve maintenance efficiency?
- Is adequate office equipment provided for efficient and effective work?
- Does communication equipment provide reliable, necessary facility coverage?
- Are facility equipment and associated components properly labeled with sufficient information so that they can be easily identified by personnel?
- Have plans for identifying and using maintenance laydown and staging areas been developed and kept current?
- Are communications systems available and arranged such that maintenance activities can be conducted without interfering with facility operations and controls? (Areas that should be considered in particular are testing and troubleshooting of electrical and electronic equipment.)

2.9 Parts, materials, and services required to perform maintenance activities are available when needed.

- Is an effective procurement process provided to ensure that parts, materials, and services are available for work activities when they are scheduled?
- Do procurement documents provide clear and adequate technical and quality assurance requirements, consistent with design specifications?
- Does the maintenance program address topics such as storage, in-storage preventive maintenance, and shelf-life requirements?
- Are proper engineering control and approval obtained on any deviation from design specifications for maintenance parts or materials?
- Are mechanisms in place to provide for the expeditious procurement of maintenance parts and material on a high-priority basis when needed?
- Have methods been established to acquire replacement parts that are not available through the original supplier?
- Are lessons learned from experience, such as lead times, parts usage, and supplier reliability, factored into materials management?

- Are material and parts usage reviewed to determine possible new additions to be included in spare parts or site stores catalogs?
- Are offsite services used when justified by specifications and/or economic reasons?
- Do purchased major electrical systems and equipment include provisions for isolation, to permit disconnection for maintainability?
- Are long lead-time maintenance items, services, and their procurement sources identified in order to expedite their procurement?
- Are deficient or nonconforming items resolved in an effective and timely manner?
- Are QA records controlled and maintained to provide documentation and traceability for qualified parts and materials?
- Are Material Safety Data Sheets obtained for hazardous materials and chemicals that are procured?
- Is identification of the need for specialized services from vendors made early to provide for timely submittal of, bidding on, and award of contracts?
- Are applicable QA provisions followed?

2.10 All phases of receiving, inspecting, handling, storing, retrieving, and issuing of equipment, parts, and materials for maintenance are covered by effectively implemented policies and procedures from the time an item is received until it is installed at the facility.

- Is effective material control practical and achievable when the right materials in the correct quantities are delivered to the job location at the proper time?
- Have policies and procedures been prepared to specifically describe the responsibilities and techniques for receiving, inspecting, handling, storing, retrieving, and issuing equipment, parts, and materials?
- Are procedures/instructions available for items requiring special handling?
- Are maintenance materials inspected to ensure conformance to purchasing requirements prior to release for use and storage?
- Can documentation for received material be accounted for and retrieved?

- Are nonconforming items identified with tags or labels, and are they controlled to prevent unauthorized use?
- Is effective material procurement status tracking provided, including accurate stock records and tracking of purchase orders?
- Are maintenance materials stored, protected, and identified in a manner that provides ready availability for their intended use?
- Is a shelf-life control program provided for store items that are important to safe and reliable facility operation?
- Are safety-related and nonsafety-related materials and equipment segregated from each other to prevent inadvertent use of the wrong category of item?
- Are periodic inspections of staging areas, stores, and warehouses performed?
- Is the quality of stored equipment, parts, and materials maintained in accordance with vendor information by appropriate means, such as environmental and shelf-life controls and preventive maintenance activities, where necessary?
- Are parts and materials issued for installation properly controlled?
- Are unused parts and materials promptly returned to a controlled storage area?
- Do completed work requests/orders document material traceability?
- Are critical parts readily traceable from purchase to installation?
- Are flammable and hazardous materials identified, segregated, and properly controlled during receipt inspection, storage, and issuance?
- Are equipment and materials used by nonfacility personnel (personnel not directly employed by the laboratory) subject to inspection, storage, and issuance controls equivalent to items received through normal facility processes?
- Have procedures, including such items as weight, size, chemical reactivity, radioactivity, lifting instructions, and susceptibility to physical shock, damage, or electrostatic sensitivity, been prepared for items requiring special handling instructions?

2.11 Methods have been established to provide for the storage, issue, and maintenance of an adequate and readily available supply of tools and equipment and also for the development of special tools and equipment needed in the maintenance program.

- Are proper tools, equipment, and consumable supplies available to support work requirements?
- Does the process of providing tools and equipment for the facility include proper storage and issue controls?
- Are special tools, jigs, and fixtures identified and stored to permit retrieval when needed?
- Are proper loading, lifting, and transporting equipment available for movement of large equipment?
- Are maintenance tools and other support equipment included in the preventive maintenance program?
- Are special tools, test rigs, special equipment, hoisting and rigging equipment, and mockups suitable for their intended use?
- Are special tools, test rigs, special equipment, hoisting and rigging equipment, and mockups properly identified?
- Are specific instructions provided to control the use of hoisting and rigging equipment?
- Are scaffolding and rigging equipment identified, tested, and properly stored?
- Are equipment and tools maintained in a high state of readiness?
- Are fixed local area hoists and work platforms provided, as needed, to facilitate maintenance access to facility equipment?
- Does the process of providing and developing tools and equipment for the facility include consideration of safety, availability for future use, cost-effectiveness, control, and storage?
- Are worn, defective, or otherwise unusable tools identified, segregated, and disposed of, so that only safe, usable tools are available for use?

2.12 Surveillance, inspecting, and testing activities provide certainty that the equipment needed for safe and reliable facility operation performs within required limits and that preventive maintenance (PM), defined as including periodic and planned maintenance, is used to maintain a piece of equipment within design operating conditions and to realize its maximum reasonable useful life.

- Has a master list of equipment to be included in the PM program been developed and analyzed for cost-effectiveness?
- Has an effective PM program, which includes systems and equipment that affect safe and reliable facility operation, been implemented?
- Is PM performed at predetermined and scheduled intervals arranged to maximize equipment availability?
- Are considerations such as operational experience, vendor recommendations, engineering analysis, cost/benefit analysis, and reliability considerations, used as a basis to establish PM tasks and intervals?
- Are PM activities scheduled and performed within established intervals?
- Are PM activities scheduled and performed, when possible, in conjunction with corrective maintenance activities on the same equipment?
- Is PM waived or deferred only with management approval?
- Does PM documentation provide a record of activities performed, data collected, and the "as-found" and "as-left" condition of the equipment?
- Is PM used to assess equipment performance, make adjustments, and perform other corrective actions where needed?
- Are PM work procedures used for facility equipment requiring special permits, special plant conditions or lineup, and/or special tools, parts, or lubricants?
- As part of the maintenance surveillance program, are functional tests of installed equipment and/or systems (such as standby equipment or nonoperating equipment scheduled for rotation) conducted and documented?
- Is trending data, such as bearing temperatures, pump speed, and vibration data, acquired, as part of the maintenance surveillance program, for long-term performance evaluations?

- Do administrative systems and controls provide for timely completion and review of required surveillances?
- Do maintenance surveillance testing programs result in a high degree of reliability in the equipment needed for safe facility operation?
- Is the effectiveness of the surveillance program periodically evaluated at an appropriate level of management, with results used to make program improvements?
- Are abnormalities found during surveillances or PM immediately reported to higher authority?
- Is the basis for the planned PM program documented?
- Do any deferrals of PM tasks have technical bases?

2.13 A predictive maintenance program has been established and utilized to monitor; determine trends; and analyze parameters, properties, and performance characteristics or signatures of equipment, in order to forecast equipment degradation so that "as-needed" planned maintenance can be performed prior to equipment failure.

- Are predictive maintenance techniques, such as reliability-centered maintenance (RCM) programs, used to identify the need for PM prior to equipment failure so that the predictive maintenance program is effective in reducing the failure of structures, systems, and components?
- Are data gathered from tests, diagnostic equipment, fluid analyses, and other similar methods, analyzed for use in identifying trends and defining action plans/corrective actions?
- Is in-process monitoring of equipment controlled by establishing the proper conditions, systems configuration, and operating parameters to help ensure that the data collected are comparable and trendable?
- Are equipment monitoring locations identified and marked to obtain consistent readings each time predictive maintenance data are recorded?
- Have mechanisms been established to provide feedback to the facility maintenance program in time to preclude equipment failure?
- Does the predictive maintenance program provide data to the PM program?

- Does the predictive maintenance program provide for retrieval of equipment history data?
- Are the root causes determined for all system/component/part failures, if possible?
- Is the PM program modified, based on the root causes, corrective actions, and corrective action results of all system/component/part failures?
- Is predictive maintenance selectively applied where experience indicates that it is most cost-effective or best enhances safety?

2.14 Corrective (repair) maintenance is performed in a manner ensuring that quality repairs are performed and that equipment failure or malfunctioning during service is restored in a timely manner.

- Has a detailed master list of equipment, components, and structures been developed for inclusion in the maintenance program?
- Are maintenance personnel attentive to identifying and correcting facility deficiencies, with a goal of maintaining equipment/systems in optimum operating condition?
- Are corrective maintenance activities controlled to ensure equipment and/or systems are returned to normal operating configuration?
- Are good maintenance work practices followed?
- Are proper tools and equipment used for maintenance work?
- Are good safety practices followed during maintenance work?
- Are foreign materials and contaminants excluded from open systems and equipment during maintenance work?
- Are pre-job briefings; training; job procedure use; quality workmanship, materials, and parts; and proper post-job reporting used?
- Are maintenance worksites clean and orderly?
- Do corrective maintenance activities ensure that the condition that caused the failure is identified, corrected, and documented?

2.15 Facility modification and temporary modification work is accomplished under the same basic administrative controls as those applied to facility maintenance activities. Changes to the maintenance program to incorporate facility modifications are commensurate with the complexity of the task, the extent of the modification, and the importance of the equipment.

- Do temporary modifications, defined as temporary repairs to the facility allowing equipment to remain in or be returned to service in a condition that is not the same as the original design specification, receive appropriate reviews prior to implementation to ensure the adequacy of the repair and to assess its effect on personnel and equipment safety and reliability?
- Are temporary modifications tracked after their completion for consideration of permanent repairs?
- When temporary modifications are made, is permanent corrective action taken as soon as possible?
- Prior to implementation, is a review performed of facility modifications to determine future required maintenance activities and to specify that these activities be added to the maintenance surveillance, preventive, and predictive programs, as applicable?
- When facility modifications require changes to facility processes, alarm setpoints, and computer software, are these changes controlled?
- Do modifications packages identify changes to the spare parts system, dispositions of parts/material reused, and the like?
- Are documents affected by plant modifications, such as drawings and procedures commonly used for system operation, tagouts, and maintenance, updated prior to operation of the system or equipment?
- Are onsite modifications, rework, and repairs that are performed by vendors or construction forces, controlled in a manner similar to other work activities?

2.16 A systematic analysis methodology is used to determine and correct root causes of problems, unplanned events, and occurrences related to maintenance.

- Are recurring maintenance problems reduced by identifying and resolving the root causes of the problems?

- Has an analysis program been established to investigate and methodically collect facts concerning unplanned occurrences that have an impact on safety or reliability or are of a recurring nature?
- Is all available information about unplanned occurrences analyzed, including evaluation of probable causes of the incident or problem?
- Do analyses of information about unplanned occurrences include one or more analysis techniques, including the following: event and causal factor charting; barrier analysis; walkthrough task analysis; change analysis; and fault tree analysis?
- Are outside experts used when required?
- Are root causes identified such that correction of the root cause prevents recurrence of the unplanned occurrence?
- Are root causes identified such that correction of the root causes is feasible?
- Are root causes identified such that their correction avoids adversely impacting safety, reliability, or operational goals?
- Are root causes categorized in terms of either human or equipment performance?
- When all root causes involved have been determined, are corrective action plans developed, executed, and tracked to completion?
- Does the analysis program address any generic corrective actions that need to be taken after problems with the specific piece of equipment have been determined and corrected?
- After analysis is performed to determine the root cause(s) of failure, is corrective action taken that includes feedback into the preventive and predictive maintenance programs and maintenance training and qualification programs?

2.17 Facility and/or maintenance managers develop and use standardized procedures, methodologies, and systems for the review and analysis of the efficiency of their maintenance programs.

- Are periodic assessments of equipment, systems, and facilities conducted to determine inadequacies in PM actions and tools and equipment availability?
- Are results of periodic assessments of equipment, systems, and facilities used to adjust PM actions and tool and equipment availability?

- Are reviews of the overall effectiveness and efficiency of the procurement and material control process conducted?
- Is measuring and test equipment periodically reviewed to verify that it is supporting the safe and reliable operation of the facility?
- Is the maintenance training program periodically reviewed to identify training program enhancements or changes in emphasis?
- Is the work control system periodically reviewed to ensure that all necessary work is being accomplished?
- Is the work control system periodically reviewed to ensure that documentation is consistent with the work accomplished?
- Are reviews of a consistent, broad range of performance indicators performed periodically?
- Are the results of performance indicator reviews and analyses used as the basis for program improvements?
- Are adjustments made to PM frequencies, based on results of performance indicator reviews and analyses?
- Are maintenance activities added or deleted, based on results of performance indicator reviews and analyses?
- Are proposed design changes instituted, based on results of performance indicator reviews and analyses?
- Are adjustments made to spare parts and materials stock levels, based on results of performance indicator reviews and analyses?
- Are adjustments made to labor and/or training levels, based on results of performance indicator reviews and analyses?
- Are adjustments made in tools, equipment, and facilities or modifications to improve facility equipment maintainability?
- Is the backlog management program periodically reviewed to verify that actions are effective in maintaining or reducing the backlog to comply with the backlog work control criteria?

2.18 Management and maintenance organizations have a quantitative means of measuring performance and effectiveness, to improve the maintenance system.

- Does each maintenance organization develop a method of measuring maintenance system performance (such as the maintenance and repair costs of buildings measured in dollars per square foot, the growth of backlog of maintenance and repair, the amount of unscheduled maintenance and repair costs, the amount of emergency maintenance costs, or other similar items)?
- Are programs routinely implemented to monitor, collect, trend, and analyze performance data (including thermal, hydraulic, electrical, acoustical, and mechanical data) for equipment, systems, and components important to facility reliability and efficiency?
- Are performance data analyzed and the results used to determine the reliability of key facility systems and components?
- Are results of performance data analyses used to identify ways to optimize facility reliability and efficiency?
- Are maintenance performance indicators and trends, such as post-maintenance test results; periodic surveillance test results; ratio of PM costs to corrective maintenance costs; maintenance work request backlog; time to restore component function after failure discovery; and frequency of maintenance rework, used to focus management attention on areas that should be documented and addressed?
- Are performance indicators used by maintenance managers to quantitatively track progress toward defined goals?

2.19 To enhance the safety of facility operations, maintenance managers are sufficiently involved with facility operations and maintenance to be technically informed and personally familiar with conditions at the operating facility.

- Do maintenance managers become involved and learn what is going on by frequently touring the facility?
- Are effective corrective actions taken for noted problems?
- Is the maintenance program periodically reviewed by facility management in self-assessments?

- Is maintenance performance checked by observing people at work, by inspecting, monitoring, and checking equipment, and by timely follow-up of corrective actions?
- Is personnel performance observed, appropriately recognized, and supported, with the end goal of enhancing personnel performance?
- Do maintenance managers include time in their routine schedules for walking through the facility?
- Are facility tours and personnel contacts performed during "off-shifts," covering selected facility areas and personnel activities?
- Are the results and observations of facility tours documented, and are corrective action plans created where appropriate?
- Do senior managers monitor the assessment activities of their subordinate managers and supervisors?
- Are management and supervisory assessment and improvement efforts performance oriented?
- Are line managers and supervisors responsible for determining and implementing corrective actions?
- Are selected operational data reflecting facility performance analyzed and trended?
- Are the results of operational data analyses and trending forwarded to appropriate levels of management?
- Are root causes determined for problems identified during monitoring of facility activities?
- Are root causes determined by analysis of trends?
- Are corrective actions initiated and tracked to completion?
- Are management assessments conducted to determine the reasons for success or failure in achieving objectives?
- Are results of management assessments incorporated into future objectives?
- Does maintenance management establish the percentage of time that first-line supervisors are expected to spend supervising fieldwork?

- Has management established a feedback system to identify problem areas and create participation in improvements?

2.20 A work-sampling program for the purpose of determining the extent of various craft activities and their related delay times has been established such that they may be used to measure the utilization of crafts in performing work in a maintenance management program.

- When performing work sampling, is the craft or shop group utilized as the unit of measure, rather than the individual craftsman?
- When performing work sampling, are the categories of time affecting the total job (such as travel, job preparation, direct work, and delay time or idle status associated with the work activities) determined and used?
- Does work sampling provide a base case or basis against which all subsequent improvements can be measured?
- Is work sampling used to measure the effects of planned improvements to craft utilization?
- Is maintenance performance checked by observing people at work?

2.21 Cost accumulation and reporting systems have been established to facilitate the work control system that is utilized to evaluate maintenance performance.

- Does maintenance accounting allow management to understand clearly the scope of planned maintenance efforts for the funding allotted?
- Are procedures in place to define proper cost coding and cost verification?
- Do managers and supervisors review cost data to prevent overruns and to detect adverse trends?
- Are estimated job costs from the planning effort evaluated against final job costs?
- Are budgets justified by factual or historical maintenance costs or by some other industry-recognized method that provides information on the resources required to maintain the capital asset in a state of good repair?

3.0 STANDARDS AND REQUIREMENTS

3.1 Specific DOE Orders and Standards.

- DOE O 232.1A, "Occurrence Reporting and Processing of Operations Information."
- DOE O 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees"
- DOE 2300.1B, "Audit Resolution and Followup."
- DOE 2321.1B, "Auditing of Programs and Operations."
- DOE 3790.1A, "Federal Employee Occupational Safety and Health Program, Chapter VIII."
- DOE 4330.4B, "Maintenance Management Program."
- DOE 5700.6C, "Quality Assurance."

3.2 Title 10 CFR Requirements.

- 10 CFR 830.120, "Quality Assurance Requirements for DOE Nuclear Facilities."

4.0 GUIDANCE TO ASSESSOR

This assessment guide is intended to assist in conducting a performance assessment of maintenance programs. It is not to be considered as all-inclusive, inflexible, or limiting reasonable assessment concentration when lines of inquiry responses dictate that an area must be more thoroughly probed.