MODULE 2

PRINCIPLES OF OPERATION AND MAINTENANCE

MODULE 2 OBJECTIVES

- To outline from a corporate perspective the principles of operation and maintenance.
- To show the direction given to the local plant management as a guide to be built into the detailed procedures for running the plant.
- To identify the key managerial positions responsibile for ensuring adherance to these principles.

MODULE 2
MAIN TOPICS

- General goal of a NPP
- What is operations?
- What is maintenance?
- Pre-requisites for doing a job
- Performance objectives & criteria for operating NPP's
- Functions of Production Manager, Shift Supervisor & Maintenance Superintendent

GENERAL GOAL OF AN NPP

- To produce electricity
  - Safely
  - Reliably
  - Economically

OPERATING POLICIES AND PRINCIPLES

POLICY:

'Operating Policies and Principles' shall document the agreement between station management and the Atomic Energy Control Board on how the station will be operated, maintained, and modified to keep risk to the public low. It will define the boundaries of the operating license, within which station operation will take place.

Under no circumstances will the Operating Policies and Principles be intentionally violated. If conditions are found to exist which contravene Operating Policies and Principles, the affected system shall be placed in the normal configuration or other safe state, or the unit shall be put in a safe state following procedures and practices approved by the Station Manager, Production Manager or Technical Manager.

All revisions shall be reviewed for consistency within Nuclear Generating Division by the Manager, Nuclear Operating Standards Department.

Any operating conditions or restrictions specifically included in the Operating License shall be observed as part of the Operating Policies and Principles.

Responsibilities:

All Production and Technical Personnel

- Be familiar with the concept of Operating Policies and Principles.

Shift Supervisors

- Ensure that the station is operated and maintained in accordance with the Operating Policies and Principles.

GENERAL GOAL OF AN NPP

- Energy Conversion Process:
  - Uranium to neutrons - Fuel system
  - Neutrons to heat - Moderator system
  - Heat to steam - Heat Transport system
  - Steam to torque - Turbine system
  - Torque to magnetic field - Generator system
  - Magnetic field to electricity - Output Transf. system
  - Electricity to improved living - Social system

WHAT IS OPERATIONS?

- Manipulation by 'Operators' of 250 systems with all the equipment to produce electricity from uranium.
- Starting up systems sequential, opening valves, starting pumps, moving fluids & gases.
- Monitoring simultaneously the condition of all systems and equipment in the steady state as full power is sustained over weeks & months.

WHAT IS OPERATION?

- Taking appropriate actions when systems or equipment performance is not in accordance with pre-defined limits.
- Shut down & removing systems & equipment in sequence from service for repairs or checks.
- Taking appropriate emergency action to mitigate events during accident conditions and/or emergencies.

WHAT IS MAINTENANCE

- The process of limiting deterioration & restoring system & equipment performance to, 'as new'.
- Fixing things when they are broken.
- Checking & repairing equipment based on the amount of time since it was last checked.

WHAT IS MAINTENANCE

- Checking & repairing equipment based on the condition detected during its operation.
- Checking systems & equipment because it is a condition of the operating license &/or regulations.

SAFETY: MAJOR CONSIDERATIONS

Employee and public safety must be the prime consideration at all times.

- Whenever equipment or systems require maintenance work to be performed, they must first be 'de-energized' i.e. cooled, depressurized, drained, ventilated and electrical power removed.

- Arrangements must be made to ensure that when equipment is de-energized there is no inadvertent re-energizing. The workers must not be put at risk while work is being carried out.

- Prior to disabling a system, alternative provisions should be made to maintain functions where required ie. removal of a heat sink

- Where necessary the timing of removal of systems must be carefully considered and also the amount of time out-of-service must be minimized depending on plant conditions.

- Other situations require that provisions be made to return the system to service quickly - this is called 're-call time'.

- The standard arrangement for ventilation, barriers and fall arrest provision are all part of the job.

- Last but not least is the requirement to test the equipment or system after maintenance work has been done before declaring the system 'in service'

- Final requirement, clean up the job site, return all the tools and write up the reports.

PREREQUISITES FOR DOING A 'JOB' WELL

- An NPP has 500 staff, every day each does various 'jobs'.
- 2,000 jobs done each day.
- 10,000 jobs per week plus weekends.

PREREQUISITES FOR DOING A 'JOB' WELL

- Assume 100 contractors, each do 4 jobs.
- 400 jobs done each day by contractors.
- 2,000 jobs per week, plus weekend.

PREREQUISITES FOR DOING A 'JOB' WELL

- 12,000 jobs per week - 624,000 jobs/year.
- If all are done well, what is likely result.
- If all are done poorly, what is likely result.

PREREQUISITES FOR DOING A 'JOB' WELL

- The 5 basic requirements for a job to be done well are:
  - Staff must be capable of doing requested work.
  - Staff must have relevant up to date documentation / instructions.
  - Must have 'tools' & 'materials' to do the work.
  - Must be given & understand clear instruction on what is required of them.
  - Must be properly supervised.

PREREQUISITES FOR DOING A 'JOB' WELL

- In the absence of any one of these requirements the job will not be done well.

PERFORMANCE OBJECTIVES & CRITERIA FOR OPERATING NPP'S

- In order to achieve the 5 basic requirements much thought & effort has been made by the nuclear industry.
- INPO in conjunction with the utilities have set out 'performance objectives & criteria'.
- These have been adopted by many utilities & are based on 'best practices'.

PERFORMANCE OBJECTIVES & CRITERIA FOR OPERATING NPP'S

- Rely on learning from others & own mistakes.
- Benchmarking is used extensively to assess & monitor performance.
- Plant evaluations are used for objective formal assessments.

PERFORMANCE OBJECTIVES & CRITERIA FOR OPERATING NPP'S

- The task of doing 624,000 jobs per year well is a enormous task.
- To provide an insight to the process the following four main areas of station activities will be examined in detail:
  - Organization & Administration
  - Operations
  - Maintenance
  - Technical Support

ORGANIZATION & ADMINISTRATION

- The following areas within organization & administration are examined in detail:
  - Management
  - Industrial Safety
  - Station Nuclear Safety Review Groups
  - Quality Assessment
  - Configuration Management
  - Quality Improvement Programs

ORGANIZATION & ADMINISTRATION

- Management
  - Performance Objective:
    - » Managers, by leadership and example, promote a high regard for nuclear safety & reliability. Promotes a high standards of performance, and demonstrate high ethical standards.

MANAGEMENT

PERFORMANCE OBJECTIVE

Managers, by leadership and example, promote a high regard for nuclear safety and reliability, promote high standards of performance, and demonstrate high ethical standards.

CRITERIA

(a) Open communication exists at all organizational levels. Feedback to managers from station personnel is solicited.

(b) Managers encourage and foster cooperation and teamwork between station organizations, especially where successful implementation of work activities requires support from several groups.

(c) Station personnel demonstrate a conservative approach to operational activities, and their decisions reflect a sense of responsibility for reactor safety.

(d) Managers establish high standards of performance and reinforce implementation of these standards when performance does not meet expectations.

(e) Managers reinforce, through delegation of responsibility, individual ownership and accountability. Personnel are encouraged to admit errors, seek help when needed, and assume responsibility for their decisions and actions.

(f) Managers demonstrate a broad knowledge of their areas of responsibility and an understanding of the functions and activities of other appropriate station and Corporate organizations.

(g) Managers consistently demonstrate, by example, motivation to improve station performance and to achieve station goals and objectives.

(h) Managers recognize the accomplishments of others and the importance of each individual's contribution to overall performance.

(i) Managers use daily interactions with station personnel to teach, coach, and guide the development of others.

(j) Managers establish priorities to ensure that personnel are able to obtain necessary resources to complete assigned tasks.

ORGANIZATION & ADMINISTRATION

- Industrial Safety
  - Performance Objectives:
    - » Station industrial safety programs contribute to a high degree of personal safety.

INDUSTRIAL SAFETY

PERFORMANCE OBJECTIVE

Station industrial safety programs contribute to a high degree of personnel safety.

CRITERIA

(a) An effective industrial safety program with clearly defined policies, procedures, and responsibilities is implemented.

(b) Initial and continuing training are conducted for all station personnel on the industrial safety program requirements and safe work practices.

(c) Managers and supervisors actively support and enforce the Industrial Safety Program.

(d) Managers and supervisors are held accountable for achieving a high level of industrial safety performance in their work groups.

(e) Personnel at all levels, including contractors, demonstrate good industrial work practices and adhere to the Station Industrial Safety Program requirements.

(f) A safe and orderly working environment exists. Safety hazards are identified and corrected in a timely manner.

(g) Personnel safety equipment and fire protection equipment is kept in good condition by routine inspection and maintenance programs.

(h) Accidents and near accidents are investigated and analyzed for trends and generic lessons. Lessons learned from in-house accident investigations and other industry operating experience are used to improve industrial safety.

(i) Industrial safety practices and conditions are periodically evaluated, and the results are used to make improvements.

ORGANIZATION & ADMINISTRATION

- Station Nuclear Safety Review Groups
  - Performance Objective:
    - » Review of station nuclear activities by knowledgeable interdisciplinary group(s) contributes to achievement of a high degree of nuclear safety.

STATION NUCLEAR SAFETY REVIEW GROUPS

PERFORMANCE OBJECTIVE

Review of station nuclear activities by knowledgeable interdisciplinary groups contributes to achievement of a high degree of nuclear safety.

CRITERIA

(a) The review of nuclear safety is performed under the direction of station and Corporate policies. The review includes the technical disciplines and experience necessary to recognize potential nuclear safety issues in station procedures and activities.

(b) Interdisciplinary groups review all station activities important to nuclear safety.

(c) Items are reviewed in sufficient depth to identify significant safety issues. The nuclear safety review groups are cognizant of safety concerns identified by designated task forces or subcommittees.

(d) Reviews are conducted and results are documented in a timely manner.

(e) The interface with Corporate safety review groups is clearly defined. Effective coordination is maintained.

(f) Reviews identify action items, including unresolved safety questions, and track them to ensure appropriate resolution.

(g) The effectiveness of the nuclear safety review function is periodically evaluated, and the results are used to make improvements.

ORGANIZATION & ADMINISTRATION

- Configuration management
  - Performance Objectives:
    - » Station activities are effectively managed to verify that the plant configuration & operation conforn to design requirements and design documents.

CONFIGURATION MANAGEMENT

PERFORMANCE OBJECTIVE

Station activities are effectively managed to verify that the plant configuration and operation conform to design requirements and design documents.

CRITERIA

(a) Configuration management responsibilities, authorities, and interfaces are clearly defined and understood.

(b) The scope and application of configuration management controls are clearly defined and communicated. Station procedures, drawings, structures, systems, components, and software are included.

(c) Proposed changes to the plant configuration are controlled through an integrated review and approval process.

(d) Detailed reviews of configuration changes are conducted to determine impact on other systems, equipment, procedures and other documents, training, and safety. Conformance with design requirements and the design bases is determined.

(e) Controlled and documented functional and operational design requirements are readily available to appropriate station personnel.

(f) Documentation is maintained to reflect actual plant configuration and current design requirements.

(g) The effectiveness of configuration management activities is periodically assessed.

(h) Assessment of modifications includes the evaluation of the impact on safety analysis (as documented in the Safety Report).

ORGANIZATION & ADMINISTRATION

- Quality Improvement Program
  - Performance Objectives:
    - » Quality improvement programs are effectively implemented and lead to continual improvement in the quality of station activities.

QUALITY ASSESSMENTS

PERFORMANCE OBJECTIVE

Quality programs effectively monitor activities that affect safe and reliable plant operation and provide feedback to line management on quality of performance.

CRITERIA

(a) Line managers and supervisors are responsible for and held accountable for the quality of work performed within their area of responsibility. Quality assessment activities reinforce and support the line functions managers and supervisors.

(b) Personnel at all levels are committed to quality performance.

(c) The scope of quality assurance and quality control activities is clearly defined. Sufficient staffing and resources are provided for these activities.

(d) Quality assurance programs of vendors and contractors include adequate measures to achieve quality. The programs provide for utility checks on the quality of products and services delivered and on the processes used to prepare them for delivery.

(e) Quality measures are applied in a graduated manner to selected nonsafety-related systems, equipment, and activities based on their importance to safe and reliable station operation.

(f) Quality audits and surveillances are scheduled based on the importance of the activity, past performance, suspected weak areas, and changes to organizations or procedures. All aspects of operation are periodically audited. They are timed to identify problems early in a process.

(g) Quality audits and surveillances are performed by individuals capable of identifying performance issues in the areas monitored. Such individuals can be members of the quality staff, line managers and supervisors, or others who are suitably trained and experienced. Such individuals are not directly responsible for the performance activities being audited and have not verified any activity being audited.

(h) Quality audits and surveillances are performed according to procedures, and evaluate both compliance with requirements and the effectiveness of the program, including the identification and correction of problems.

(i) Quality monitoring results are adequately documented and evaluated to allow early detection and correction of performance problems.

(j) Results, including noted deficiencies and their causes, are reported to line management for identification of root causes and appropriate corrective action. Substantive issues affecting performance are reported to senior line management.

(k) Summary results and trends are reported to station managers on a periodic basis. Reports focus on performance effectiveness.

OPERATIONS

- Main operation performance objectives and criteria to be examined are:
  - Operation organization & administration.
  - Conduct of operators.
  - Operating procedures & documentation
  - Operator knowledge & performance

OPERATIONS

- Operation Organization & Administration
  - Performance Objective:
    - » Operations organization and administration ensure effective implementation and control of operations activities.

OPERATIONS ORGANIZATION AND ADMINISTRATION

PERFORMANCE OBJECTIVE

Operations organization and administration ensure effective implementation and control of operations activities.

CRITERIA

(a) The organizational structure is clearly defined.

(b) Staffing and resources are sufficient to accomplish assigned tasks.

(c) Responsibilities and authority of each organizational position are clearly defined and understood. Authorities are commensurate with responsibilities. Personnel are held accountable for carrying out assigned responsibilities. Assigned responsibilities include:

(1) The designation of at least one individual at any point in time with the assigned responsibility for safely shutting down the reactor, without consultation, when that individual determines that public and personnel safety may be in jeopardy if such action is not taken,

(2) The designation of an individual with the assigned responsibility to provide direction (authorization) for raising reactor power following a shutdown, trip, or power reduction.

(d) Contractor tasks, responsibilities, authorities, and interfaces are clearly defined, understood, and monitored.

(e) Interfaces with supporting groups, including Corporate, are clearly defined and understood. Documents that cross organizational boundaries are identified and controlled.

(f) Managers and supervisors demonstrate and require a conservative approach toward activities affecting the reactor core and safety systems.

(g) Administrative controls are effectively implemented for operations activities that affect safe and reliable plant operation. Examples of such activities include work protection, use of jumpers, posted operator aids, shift turnover, and use of operating manuals and operating memos. The effectiveness of these controls is periodically assessed.

(h) Operational problems, including events and material deficiencies that affect plant operations, are effectively tracked, investigated, and reviewed periodically to ensure timely resolution.

(i) Operations personnel are actively encouraged to develop improved methods of meeting safety, quality, and productivity goals.

(j) Performance indicators are established and used to improve operations performance.

OPERATIONS

- Conduct of Operators
  - Performance Objectives:
  - Operational activities are conducted in a manner that ensures safe and reliable plant operation. Reactor safety is a foremost consideration in station operations. Management policies and actions actively support this operating philosophy.

CONDUCT OF OPERATIONS

PERFORMANCE OBJECTIVE

Operational activities are conducted in a manner that ensures safe and reliable plant operation. Reactor safety is a foremost consideration in station operations. Management policies and actions actively support this operating philosophy.

CRITERIA

(a) Operators adhere to and operate within operating policies and principles.

(b) Operators are attentive and responsive to station parameters and conditions. Operators are not distracted from reactor safety responsibility.

(c) Safety systems are maintained operable and reliable to the maximum extent possible. When safety system components are disabled, the length of time this condition exists is minimized and controls are established to ensure station safety is maintained. Safety systems and functions are not taken out of service without the appropriate approval of the shift supervisor or station manager.

(d) The operating conditions of station equipment are effectively monitored. Plant equipment deficiencies are evaluated and prioritized to ensure equipment is restored to full capability in a timely manner.

(e) Operators interpret and respond conservatively to all instrument indications, including conditions when inconsistencies are present, unless the indications have been conclusively proven to be incorrect.

(f) Operational events, including unexpected plant transients or abnormal conditions, are investigated to determine root causes. Effective corrective actions are taken in a timely manner.

(g) Control room activities are conducted in a businesslike and professional manner. Control room access is limited, and access to the control area is restricted to appropriate personnel.

(h) Appropriate station activities and testing are properly authorized by management and are controlled by qualified operations personnel. Trainees are not allowed to operate plant equipment except under the direct supervision of a qualified operator.

(i) Operational and testing activities are conducted in accordance with approved procedures.

(j) Operations activities are planned and conducted in a manner that keeps radiation exposures as low as reasonably achievable and minimizes the spread of contamination.

(k) Line managers and supervisors periodically observe simulator and operations activities to identify and correct problems and to ensure adherence to station policies and procedures.

OPERATIONS

- Operation Procedures & Documentation
  - Performance Criteria:
    - » Operations procedures and documents are clear, technically accurate, provide appropriate direction, and are effectively used to support safe operation of the station.

OPERATIONS PROCEDURES AND DOCUMENTATION

PERFORMANCE OBJECTIVE

Operations procedures and documents are clear, technically accurate, provide appropriate direction, and are effectively used to support safe operation of the station.

CRITERIA

(a) The preparation, review, approval, and revision of procedures and other operations related documents are properly controlled and timely. Revisions to procedures as a result of plant modifications are incorporated before operating the system or component.

(b) The guidance of applicable source documents is incorporated into station operating procedures (eg, emergency procedure guidelines safety analysis and vendor technical manuals).

(c) Emergency and nonroutine operating procedures effectively guide the operations staff in responding to the following events:

(1) Serious process failures,
(2) Loss or impairment of safety systems,
(3) Abnormal radiation hazards,
(4) Excessive emissions of radioactive liquid or gaseous effluent,
(5) Fires,
(6) Common mode events (eg, flooding, earthquakes).

(d) Procedures are clear, concise, and contain adequate information for users to understand and perform their activities effectively.

(1) Portions or steps of other documents that are used or referred to when performing a procedure are specifically identified in the procedure,

(2) Technical details, such as setpoints, control logic, and equipment numbers, are correct and consistent among procedures, drawings, operating flow sheets, and system descriptions,

(3) Human factors considerations (such as sequenced procedure steps and use and placement of notes and caution statements) are incorporated into procedures to promote error-free performance.

(e) Procedures reflect a conservative approach to safe and reliable plant operation.

(f) New and revised procedures are reviewed for technical accuracy prior to initial use, and are checked by such means as verification and validation techniques to ensure correctness and usability prior to and during initial use. Simulators are used to validate operating procedures where appropriate.

(g) A policy governing the use of procedures is implemented. The policy includes the following:

OPERATIONS

- Operator knowledge & performance
  - Performance criteria:
    - » Operator knowledge, training and qualification, and performance support safe and reliable station operation.

OPERATOR KNOWLEDGE AND PERFORMANCE

PERFORMANCE OBJECTIVE

Operator knowledge, training and qualification, and performance support safe and reliable station operation.

CRITERIA

(a) Operator activities are performed by or under direct supervision of personnel who have completed formal qualification of the tasks to be performed.

(b) Operators understand job-related areas such as the following:

(1) Station technology, systems, and procedures,

(2) Radiological protection theory and techniques including as low as reasonably achievable applications,

(3) Specialized fundamentals, concepts, and applications,

(4) Environmental regulations,

(5) General information and functions such as station layout, reporting relationships, communications methods, document and procedure issue and revision, records management, material procurement, quality assurance, and industrial safety practices,

(6) Operating practices including administrative and shift activities, diagnostics and transient response, supervisory teamwork and communication skills, and mitigating core damage,

(7) Application of appropriate lessons learned from in-house and industry operating experience,

(8) Reactivity effects of operations such as power changes or refuelling,

(9) Site-wide normal and emergency power supplies, normal, alternate, and emergency distribution schemes, and the impact of electrical transients on the plant in operating, startup, and shutdown modes.

(c) On-the-job training requirements are identified, completed, and documented prior to assignment to perform tasks independently.

(d) Continuing training addresses areas that include hardware and procedure changes, infrequently used skills, and lessons learned from in-house and industry operating experience.

(e) Operators are knowledgeable of the functioning of the control computers and associated control programs.

MAINTENANCE

- Maintenance organization and administration
  - Performance criteria:
    - » The maintenance organization and administration ensure effective and efficient implementation and control of maintenance activities.

MAINTENANCE ORGANIZATION AND ADMINISTRATION

PERFORMANCE OBJECTIVE

The maintenance organization and administration ensure effective and efficient implementation and control of maintenance activities.

CRITERIA

(a) The organizational structure is clearly defined.

(b) Staffing and resources are sufficient to accomplish assigned tasks.

(c) Responsibilities, authority, and expectation for each organizational position are clearly defined and understood. Authorities are commensurate with responsibilities. Personnel are held accountable for carrying out assigned responsibilities.

(d) Contractor tasks, responsibilities, authorities, and interfaces are clearly defined, understood, and monitored.

(e) Interfaces with supporting groups, including Corporate, are clearly defined and understood. Documents that cross organizational boundaries are identified and controlled.

(f) High performance standards for station maintenance activities are established, communicated, and reinforced.

(g) Managers and supervisors routinely observe maintenance activities to identify and correct problems and to ensure adherence to station policies and procedures including industrial safety and radiological protection. Supervisor presence in the field contributes to improved job performance.

(h) Managers and supervisors maintain an awareness of the key aspects of maintenance through appropriate monitoring of performance, materiel condition, and maintenance records. Goals are used to improve performance in selected areas. Corrective action is taken when adverse conditions or trends are noted.

(i) Administrative controls are employed in the conduct of maintenance activities that affect safe and reliable plant operation. Examples of such activities include scheduling of preventive maintenance, use of procedures, field verification, implementation of configuration controls, use of special tools and lifting equipment, use and calibration of measuring and test equipment, and use of proper materials.

(j) Contract and other nonplant personnel use the same (or equivalent) plant-approved policies, procedures, and controls and the same workmanship standards as plant maintenance personnel.

(k) Personnel are actively encouraged to develop methods to improve safety, reliability, quality, and productivity.

MAINTENANCE

- Plant condition:
  - *Performance criteria:*
    - » The condition of the plant equipment is maintained to support safe and reliable plant operation.

PLANT CONDITION

PERFORMANCE OBJECTIVE

The equipment condition of the plant is maintained to support safe and reliable plant operation.

CRITERIA

(a) Systems and equipment are maintained in good working order. Examples of this include the following:

(1) Equipment important to safety and reliability is maintained to a high standard of materiel condition and performs its design function when needed,

(2) Fluid system leaks are minimized and leaks are controlled and corrected,

(3) Equipment is appropriately protected from adverse environmental conditions. Protective measures are effectively implemented during extended nonoperational periods,

(4) Instruments, controls, and associated indicators are calibrated and operational,

(5) Good lubrication practices are followed,

(6) Fasteners and supports are properly installed,

(7) Equipment, structures, and systems are properly preserved and insulated.

(b) Equipment deficiencies are identified, are in the work control system, and are corrected in a timely manner. The causes of component malfunctions are promptly determined and evaluated to determine whether repair, replacement, or modification of the component is appropriate to ensure safe and reliable operation.

(c) Temporary repairs are evaluated, controlled, and tracked. The use of temporary repairs is minimized, and permanent repairs are made at the earliest reasonable opportunity.

(d) Temporary environmental protection (eg, dust, humidity, freezing, shock) is provided for plant equipment when needed to support construction, outage, or maintenance activities.

(e) Newly installed or modified systems or equipment are tested and verified to satisfy all design requirements and to be in good working order in all required operating modes. The required documents and training are in place prior to operational acceptance by the plant staff.

(f) Illumination of station areas, rooms, and grounds is sufficient to perform work activities and inspections properly and safely.

MAINTENANCE

- Conduct of maintenance
  - Performance criteria:
    - » Maintenance is conducted in a safe and efficient manner to support safe and reliable plant operation.

CONDUCT OF MAINTENANCE

PERFORMANCE OBJECTIVE

Maintenance is conducted in a safe and efficient manner to support safe and reliable plant operation.

CRITERIA

(a) Personnel exhibit professionalism and competency in performing assigned tasks that consistently result in quality workmanship. When unexpected conditions arise, personnel seek appropriate guidance before proceeding.

(b) Maintenance personnel identify and pursue corrective action for plant deficiencies with a goal of maintaining equipment and systems in an optimum condition.

(c) Maintenance managers, supervisors, and maintainers actively use as low as reasonably achievable concepts to minimize personnel exposure.

(d) Support groups, such as operations, technical, and radiological protection, are appropriately involved in maintenance activities. Participation of these groups is coordinated to effectively support the maintenance effort.

(e) Maintenance work is properly authorized, controlled, and documented. Documentation includes sufficient details of as-found and as-left conditions of the equipment and work performed to support root cause analysis of problems.

(f) Prejob and postjob briefings are effectively used.

(g) Work activities are performed in accordance with controlled procedures, instructions, and drawings as required by plant policy. Maintenance personnel identify and provide timely feedback to correct procedural problems.

(h) Good maintenance practices, such as those listed below, are followed:

(1) Work practices are technically sound,

(2) Proper tools, equipment, and materials are used,

(3) Good industrial safety, radiological protection, and as low as reasonably achievable practices are followed,

(4) Foreign materials and contaminants are excluded from open systems and equipment,

(5) Work locations are clean and orderly during and after maintenance.

(i) Postmaintenance testing is performed, results are reviewed, and corrective actions are taken as necessary.

MAINTENANCE

- Preventive maintenance
  - Performance criteria:
    - » Preventive maintenance contributes to optimum performance and reliability of plant systems and equipment.

PREVENTIVE MAINTENANCE

PERFORMANCE OBJECTIVE

Preventive maintenance contributes to optimum performance and reliability of plant systems and equipment.

CRITERIA -

(a) A preventive maintenance program is effectively implemented and includes systems, equipment, and appropriate spare parts that affect safe and reliable plant operation. The preventive maintenance program is established prior to systems and equipment being declared in service.

(b) Preventive maintenance is performed at appropriate intervals. These intervals maximize equipment availability. Considerations such as operational experience, service conditions, vendor recommendations, engineering analysis, as low as reasonably achievable, and cost-benefit analysis are used as a basis to establish preventive maintenance tasks and intervals.

(c) Preventive maintenance activities are scheduled and performed within established intervals. Preventive maintenance is waived or deferred only if justified by plant conditions or appropriate technical reviews. Management approval is obtained for waivers and deferrals of preventive maintenance activities.

(d) Preventive maintenance should include predictive maintenance. Predictive maintenance consists of monitoring, trending, and analysing the performance of equipment to prevent equipment failure.

(e) Preventive maintenance documentation provides a record of activities performed, data collected, and, where appropriate, the "as-found" and "as-left" condition of the equipment.

(f) Preventive maintenance results are routinely monitored, analyzed, and used in conjunction with the equipment performance history to periodically adjust the content and frequency of preventive maintenance activities.

(g) The effectiveness of the Preventive Maintenance Program is periodically evaluated at an appropriate level of management, and the results are used to make program improvements.

MAINTENANCE

- Maintenance procedures and documentation
  - Performance criteria:
    - » Maintenance procedures and other work-related documents are clear, technically accurate, and consistently used to ensure that maintenance is performed safely and efficiently.

MAINTENANCE PROCEDURES AND DOCUMENTATION

PERFORMANCE OBJECTIVE

Maintenance procedures and other work-related documents are clear, technically accurate, and consistently used to ensure that maintenance is performed safely and efficiently.

CRITERIA

(a) The preparation, review, approval, and revision of procedures and other work-related documents are properly controlled.

(b) Referenced documents (such as excerpts from installation, maintenance, or manufacturer manuals) receive a similar review and approval to procedures.

(c) Procedures and other work-related documents, such as installation, maintenance, and manufacturer manuals, drawings, reference materials, and posted job performance aids used in support of maintenance, are technically accurate and current. They are properly filed and easily retrievable.

(d) Procedures are readily available and clearly identified.

(e) New and revised procedures are reviewed for technical accuracy prior to use and are checked by such means as verification and validation techniques to ensure correctness and usability prior to or during initial use.

(f) Procedures are clear, concise, and contain adequate information for users to understand and perform their activities effectively.

(1) Portions or steps of other documents that are used or referred to when performing a procedure are specifically identified in the procedure,

(2) Technical details, such as setpoints, control logic, and equipment numbers, are correct and consistent among procedures, drawings, operating flow sheets, and system descriptions,

(3) Human factors considerations (such as sequenced procedure steps, use, and placement of notes and caution statements) are incorporated into procedures to promote error-free performance.

(g) Hold points, such as quality and radiological protection checks, are included in procedures as needed.

(h) A policy governing the use of procedures is implemented. The policy includes the following:

(1) Directions for when procedures are to be used as general guidance, are to be followed step by step, or require sign-off for each step,

(2) Directions for when a procedure must be physically at the job site,

MAINTENANCE

- Maintenance personnel knowledge and performance
  - Performance criteria:
    - » Maintenance personnel training, knowledge, qualification, and performance support safe and reliable plant operation.

MAINTENANCE PERSONNEL KNOWLEDGE AND PERFORMANCE

PERFORMANCE OBJECTIVE

Maintenance personnel training, knowledge, qualification, and performance support safe and reliable plant operation.

CRITERIA

(a) Maintenance is performed by or under the direct supervision of personnel who have completed applicable formal qualification for the tasks to be performed.

(b) Maintenance personnel understand job-related areas such as the following:

(1) General information and functions such as plant layout, reporting relationships, communications methods, document and procedure issue and revision, records management, material procurement, quality assurance, and industrial safety practices,

(2) Radiological protection theory and techniques including as low as reasonably achievable applications,

(3) Fundamental concepts and applications,

(4) Tool and test equipment selection, inspection, care, and use,

(5) Plant/component/system fundamentals and effect of maintenance on plant systems,

(6) Component inspection, repair, and adjustment techniques for power plant systems including procedure application, quality control requirements, specialized skills, and job responsibilities,

(7) Plant-specific application of appropriate lessons learned from in-house and industry operating experience,

(8) Cleanliness and housekeeping practices.

(c) On-the-job training requirements are identified, completed, and documented prior to assignment to perform tasks independently.

(d) Continuing training effectively addresses plant hardware and procedure changes, infrequently used skills, and lessons learned from in-house, industry, and operating experience.

(e) Qualification standards and evaluation methods are adequate to verify trainee and contractor competence for assigned functions at the station.

(f) Initial and continuing training, including programs to develop supervisory skills, are effectively implemented.

TECHNICAL SUPPORT

- Technical support organization and administration.
  - Performance criteria:
    - » Technical support organization and administration ensure effective implementation and control of technical support activities.

TECHNICAL SUPPORT ORGANIZATION AND ADMINISTRATION

PERFORMANCE OBJECTIVE

Technical support organization and administration ensure effective implementation and control of technical support activities.

CRITERIA

(a) The organizational structure is clearly defined.

(b) Staffing and resources are sufficient to accomplish assigned tasks.

(c) Responsibilities and authority for each organizational position are clearly defined and understood. Authorities are commensurate with responsibilities. Personnel are held accountable for carrying out assigned responsibilities.

(d) Contractor tasks, responsibilities, authorities, and interfaces are clearly defined and understood.

(e) Interfaces with supporting groups, including Corporate groups, are clearly defined and understood. Documents that cross organizational boundaries are identified and controlled.

(f) Technical support personnel appropriately monitor and have sufficient expertise regarding plant systems, components, and operations to effectively investigate and resolve plant problems.

(g) High performance standards for technical support activities are established, communicated, measured, and reinforced.

(h) Technical support personnel are actively encouraged to develop improved methods of meeting safety, quality, and productivity goals.

(i) Technical support personnel coordinate and monitor technical services provided by outside organizations.

(j) Administrative controls are employed in the conduct of technical support activities that affect safe and reliable plant operation.

(k) The effectiveness of technical support is monitored and periodically assessed. The results are used to improve technical support.

(l) Technical support personnel effectively implement lessons learned and recommendations resulting from in-house and industry operating experience pertinent to their activities.

(m) Measures are in place to ensure that all technical support work is performed in accordance with all relevant technical codes and standards.

(n) Management actions and administrative controls demonstrate a conservative approach toward activities affecting safety-related systems.

TECHNICAL SUPPORT

- Surveillance testing and in-service inspection programs
  - Performance criteria:
    - » Surveillance testing and in-service inspection activities provide assurance that equipment needed for safe and reliable plant operation will perform reliably and within required limits.

SURVEILLANCE TESTING AND IN-SERVICE INSPECTION PROGRAMS

PERFORMANCE OBJECTIVE

Surveillance testing and in-service inspection activities provide assurance that equipment needed for safe and reliable plant operation will perform reliably and within required limits.

CRITERIA

(a) *Administrative systems and controls ensure timely completion and review of required* surveillance testing and in-service inspection activities.

(b) Procedures used for surveillance testing contain sufficient detail to ensure safe plant operation during testing, and provide for consistent test performance and accurate results. Procedures simulate, as near as practical, the actual conditions under which the system must operate on demand.

(c) Redundant systems/components are tested individually to ensure independent operability.

(d) Acceptance criteria are clearly identified and prompt corrective action is taken when acceptance criteria are not met.

(e) Timely reviews of completed surveillance test data are sufficient to ensure that all acceptance criteria are met and any trends are identified. Results are analyzed to determine whether special safety systems, safety support systems, and other safety-related systems meet availability and reliability targets.

(f) Actual equipment performance and test data are trended to identify degrading conditions and actions to be taken to improve safety and reliability.

(g) Reviews of in-service inspection results are sufficient to ensure all acceptance criteria are met, and to identify any deteriorating conditions.

(h) The Surveillance Testing and In-Service Inspection Programs are implemented in accordance with applicable codes and standards.

(i) The technical bases for surveillance tests and in-service inspections, and their methods (including references), are documented and available.

(j) Instruments and tools used for surveillance testing and in-service inspection are periodically calibrated or tested and have sufficient accuracy and sensitivity.

(k) The effectiveness of surveillance testing and in-service inspection programs is periodically evaluated, and the results are used to make program improvements.

(l) The frequency of surveillance testing is related to the results of reliability analyses, the frequency and type of service, or the age of the equipment or system. Following a large-scale component

TECHNICAL SUPPORT

- Plant modifications
  - Performance criteria:
    - » Permanent and temporary modifications are used to enhance plant safety and reliability. Modification processes are timely and ensure proper design, review, control, implementation, and documentation of plant design changes.

PLANT MODIFICATIONS

PERFORMANCE OBJECTIVE

Permanent and temporary modifications are used to enhance plant safety and reliability. Modification processes are timely and ensure proper design, review, control, implementation, and documentation of plant design changes.

CRITERIA

(a) Approved procedures and knowledgeable personnel are used to design, review, and implement permanent and temporary modifications. The design authority for all design activities is clearly defined, and interfaces are controlled to coordinate design change activities and implement configuration management.

(b) All modification requests are reviewed for inclusion in the modification program. Appropriate cost-benefit criteria, such as cost-benefit analyses, regulatory requirements, licensing impact, and safety and reliability enhancements, are used to screen and prioritize proposed modifications. Approved requests are incorporated into a long-range plan. Each modification is planned, scheduled, monitored, and tracked to ensure timely completions within the authorized cost.

(c) Activities related to modifications, including design, procurement of original and spare parts, walk downs, installation, testing, document update, and closeout, are effectively coordinated among responsible groups.

(d) Plant design requirements are addressed and properly documented during the design of plant modifications. Confirmation of continued compliance with the analyzed safe operating envelope is performed prior to any plant modification.

(e) Special design activities, such as computer programs and unique calculation techniques, are verified, validated, and approved prior to use.

(f) Conceptual and preliminary modification designs for changes that directly affect operating plant systems, structures, or components are reviewed and approved by plant management.

(g) Modifications receive an effective review for as low as reasonably achievable, constructability, testability, operability, and maintainability, with input from appropriate plant personnel. In addition, operating experience information, such as plant events and maintenance history, is routinely considered in design and in equipment reliability improvements.

(h) Requirements for installing, verifying installation, inspecting, and testing modifications are specified as part of the design process.

(i) Modifications undergo a formal, interdisciplinary technical review and approval. Drawings, procedures, and other documents affected by the change are included in the review. The bases for review results are clearly documented. Formal guidance delineates requirements for performing and documenting technical reviews including reviews of contracted work. Technical

TECHNICAL SUPPORT

- Plant performance monitoring
  - Performance criteria:
    - » Performance monitoring activities optimize plant reliability and efficiency.

PLANT PERFORMANCE MONITORING

PERFORMANCE OBJECTIVE

Performance monitoring activities optimize plant reliability and efficiency.

CRITERIA

(a) Programs are implemented to routinely monitor, collect, trend, and analyze performance data (including thermal, hydraulic, electrical, chemical, acoustical, and mechanical data) for equipment, systems, structures, and components important to plant reliability and efficiency. Data collected during conduct of predictive maintenance activities is also periodically reviewed as part of this effort.

(b) Approved procedures or guidelines and knowledgeable personnel are used to conduct performance monitoring functions. Tests are conducted consistently to aid in analysing results.

(c) Instrumentation used for performance monitoring is calibrated as necessary and has adequate sensitivity and accuracy to provide reliable results.

(d) Optimum performance levels are defined through baseline data, design parameters, and/or modelling. These levels are adjusted when performance improvement modifications are implemented.

(e) Performance data is analyzed, and the results are used to detect and correct degrading performance.

(f) The reliability of key systems, structures, and components as well as the availability of safety systems is determined and trended. The results are used to enhance equipment performance including appropriate adjustments to preventive maintenance activities.

(g) Auxiliary supporting equipment is monitored, as necessary, to prevent degraded performance of primary equipment.

(h) The effectiveness of the performance monitoring programs is periodically evaluated and the results used to make program improvements.

(i) Programs are implemented to routinely monitor for equipment degradation that could result in an environmental release above approved limits. Appropriate reports on emissions and spills are provided.

TECHNICAL SUPPORT

- Technical support procedures and documentation
  - Performance criteria:
    - » Technical support procedures and documents are clear, technically accurate, provide appropriate direction, and are effectively used to support safe and reliable plant operation.

TECHNICAL SUPPORT PROCEDURES AND DOCUMENTATION

PERFORMANCE OBJECTIVE

Technical support procedures and documents are clear, technically accurate, provide appropriate direction, and are effectively used to support safe and reliable plant operation.

CRITERIA

(a) The preparation, review, approval, revision, and retention of procedures, drawings, and other technical documents are properly controlled and timely.

(b) Procedures are clear, concise, and contain adequate information for users to understand and perform their activities effectively, eg:

(1) Technical details such as setpoints, control logic, and equipment identification numbers are correct and consistent among various procedures, drawings, operational flow sheets, system descriptions, and safety analysis assumptions,

(2) Portions or steps of other documents that are used or referred to when performing a procedure are clearly identified in the procedure,

(3) Human factors considerations (such as sequenced procedure steps and use and placement of notes and caution statements) are incorporated into procedures to promote error-free performance,

(4) Hold and verification points which verify completion of activities critical to plant safety are included in procedures where appropriate.

(c) Procedures, documents, drawing, and other technical data are readily available, clearly identified, and properly controlled.

(d) New and revised procedures are reviewed for technical accuracy, are approved prior to initial use, and are checked by such means as verification and validation techniques to ensure correctness and usability prior to or during initial use.

(e) Procedures, manuals, drawings, and other plant-specific reference materials are controlled, technically accurate, and up to date.

(f) A policy governing the use of procedures is implemented. The policy includes the following:

(1) Directions for when procedures are to be used as general guidance, are to be followed step by step, or require sign-off for each step,

(2) Actions to be taken when procedures conflict, are inadequate for the intended tasks, or when unexpected results occur.

(g) Temporary changes to procedures are effectively controlled, including the following:

TECHNICAL SUPPORT

- Technical support personnel knowledge and performance
  - Performance criteria:
    - » Technical support personnel, knowledge, training and qualification, and performance support safe and reliable station operation.

TECHNICAL SUPPORT PERSONNEL KNOWLEDGE AND PERFORMANCE

PERFORMANCE OBJECTIVE

Technical support personnel, knowledge, training and qualification, and performance support safe and reliable station operation.

CRITERIA

(a) Technical work is performed by or under the supervision of personnel who have completed applicable educational and qualification requirements for the tasks to be performed.

(b) Technical support personnel understand job-related areas including the following:

(1) General information and functions such as plant layout, reporting relationships, communication methods, document and procedure issue and revision, records management, material procurement, industrial safety practices, and quality assurance,

(2) Radiological protection theory and techniques including as low as reasonably achievable applications,

(3) Technical subjects and techniques including codes, standards, operating policies and principles, and regulations, quality processes, plant component and system fundamentals, integrated plant operations, and job-specific responsibilities such as configuration management and modification processes,

(4) Plant-specific application of appropriate lessons learned from in-house and industry operating experience.

(c) On-the-job training requirements are identified, completed, and documented prior to assignment to perform tasks independently.

(d) Continuing training addresses plant hardware and procedure changes, applicable codes, standards, and regulation changes, infrequently used skills, and lessons learned from in-house and industry operating experience.

(e) The knowledge and abilities of contract technical support personnel are equivalent to those of station technical support personnel for assigned functions.

FUNCTION OF PRODUCTION MANAGER, S.S. & M.S

- The responsibility for meeting the majority of the fore mentioned performance criteria are:
  - Production Manager - (PM)
  - Shift Supervisor - (SS)
  - Maintenance Superintendent - (MS)

FUNCTION OF PRODUCTION MANAGER, S.S. & M.S

- All operations & maintenance staff report to these principals.
- About 60 - 70% of station staff are in the operator & maintenance work groups.
- The potential for mistakes of significant consequences are within these groups.

FUNCTION OF PRODUCTION MANAGER, S.S. & M.S.

- The staff in these groups are the front line personnel who have to deal with emergencies. The initial handling is the forerunner to subsequent events.
- Performance Function:
  - Those activities which, when taken together and performed adequately, will ensure that systems and equipment will perform within the intent of their design performance requirements.

FUNCTION OF PM, SS AND MS

GENERAL POLICY:

- Station staff shall be aware of, and conversant with, policies, principles, and procedures to ensure that their performance complies with these documents.
- Work shall be done following approved procedures.
- All field work shall be appropriately authorized.
- Approved skills and work practices which are part of the training program shall be employed.
- In the event of situations which require prompt action but are not covered by an authorized procedure, personnel shall take action to protect the health and safety of the public and station staff.
- When a procedure requires documentation of actions or recording of data, such documentation or recording shall be done as the task is performed.

FUNCTION OF PRODUCTION MANAGER, S.S. & M.S.

- Performance Functions - Specific:
  - Know all the rules.
  - Understand the implications of the rules.
  - Be clear on the limits of authority.
  - Appreciate limits of personal understanding.
  - Do not hesitate to stop work and seek help or clarification.
  - Follow to the letter 'Operating Policies & Principles'.

FUNCTION OF PRODUCTION MANAGER, S.S. & M.S.

- The three positions have responsibility to ensure all field work carried out on a day to day basis is done in accordance with Operating Policies and Principles Etc.

RESPONSIBILITIES OF PRODUCTION MANAGER, SS, MS

- Performance activities include:
  - Preparation of policies and procedures
  - Preparation of support documentation
  - Planning and scheduling
  - Equipment control
  - Calibration of measuring and test equipment

RESPONSIBILITIES OF PRODUCTION MANAGER, SS, MS

- Performance activities con't:
  - Field execution activities
  - Receiving, handling and storage of material and equipment
  - Inspection and testing
  - Commissioning completion assurance
  - Work reporting
  - Document control

ACTIVITIES OF PRODUCTION MANAGER, SS, MS

- Examples of the main day to day activities would relate to the following:
  - Equipment identification of defects or problems
  - Initiation of field work
  - Planning & scheduling
  - Call up and routine maintenance
  - Nuclear prescribed Substance control
  - Station Logs

ACTIVITIES OF PRODUCTION MANAGER, SS, MS

- Examples con't:
  - Significant event reports
  - Follow operating manuals instructions
  - Follow abnormal Incidents and transient procedures
  - Follow radiation protection procedures
  - Maintenance procedures
  - Work protection
  - Use of jumpers
  - Ensure minimum staff complement

USE OF JUMPERS

POLICY

Any action that temporarily places a system, equipment of computer software in a condition which differs from the design configuration shall be termed a jumper.

Jumpers shall be verified, approved, recorded, tagged, and reviewed. Appropriate codes and standards, applicable to the type of jumper, will be met.

Operating policies and principles will be followed at all times.

Regardless of the proposed duration of a jumper, a DNGS Manager's (Station, Production or Technical) prior approval is required for jumpers on:

1. Special safety systems.
2. Reactor regulation systems
3. Pressure boundary systems if the changes do not meet all code requirements applicable to the affected system.

A Shift Supervisor shall authorize the application of all jumpers.

Long-term jumpers will be investigated for possible permanent design change.

If a jumper is in effect at turnover from Construction, a jumper record shall be initiated, unless the jumper will be removed by Construction prior to pre-operational checks starting in the field.

RESPONSIBILITIES

1. Station Manager/Production Manager/Technical Manager

    - Approve jumpers on Special Safety Systems or jumpers that impair or affect the normal functioning of the Regulating system.
    - Approve temporary patches or repairs to pressure boundaries that do not conform to code requirements.

2. Responsible Engineer

   - Review the application of jumpers on systems to ensure that the integrity and design intent of a system is not adversely affected.
   - Review jumper if extension of duration required.
   -

3. Shift Supervisor
   - Ensure that all jumper record forms have been verified.
   - Authorize the installation and removal of all jumpers.
   - Ensure appropriate operating documents are updated to reflect the installation and removal of jumpers.
   - Ensure appropriate testing is done after installation and removal of jumpers.
   - Ensure that jumper records are reviewed by appropriate operating personnel in order for them to remain familiar with jumpers in effect.
   - Ensure that jumpers are reviewed at intervals with the objective of removing jumpers no longer needed.
   - Ensure jumper application is reviewed (temporary vs permanent change) on jumpers that exceed their review date.

FUNCTION OF MAINTENANCE MANAGER

- The main functions for Maintenance Manager are:
  - Surveillance & routine testing
  - Maintenance program
  - Calibration of measuring & test equipment
  - Housekeeping & house cleaning
  - On site manufacturing
  - Computer software management support
  - Spare Parts

FUNCTION OF MAINTENANCE MANAGER

- In addition to the forgoing responsibilities the Maintenance Manager has special functions related to maintenance. (details of maintenance programs will be covered in module 4)