



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

# NRC INSPECTION MANUAL

NMSS

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## INSPECTION PROCEDURE 88103

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### MAINTENANCE OBSERVATIONS

PROGRAM APPLICABILITY: 2630

#### 88103-01 INSPECTION OBJECTIVE

To ascertain whether the facility is implementing a program relating to maintenance activities that is in conformance with Technical Safety Requirements (TSRs), regulatory requirements, commitments in the application, and industry guides or standards.

To verify that maintenance activities for Q, AQ, and other safety significant structures, systems, and components (SSCs) are being conducted in a manner that results in reliable safe operation of the plant and plant equipment.

#### 88103-02 INSPECTION REQUIREMENTS

02.01 Corrective Maintenance Program. For the facility's corrective maintenance program, verify that:

- a. Written procedures have been established for initiating requests for routine and emergency maintenance.
- b. Criteria and responsibilities have been established for review and approval of maintenance requests, including emergency maintenance requests.
- c. Criteria and responsibilities have been established that form the basis for designating the activity as safety related or not safety related.
- d. Criteria and responsibilities have been designated for performance of inspections of maintenance activities.
- e. Provisions and responsibilities have been established for the identification of appropriate inspection hold points related to maintenance activities.
- f. Methods and responsibilities have been designated for performing functional testing of SSCs after maintenance work and/or before their being returned to service.

- g. Administrative controls for maintenance activities require that the following records will be prepared, assembled, and reviewed for transfer to records storage:
1. approvals of maintenance requests
  2. identification of the personnel who performed the maintenance task
  3. identification of the personnel who inspected the maintenance work
  4. cause of the malfunction or failure that necessitated the maintenance work, including generic implications of the failure
  5. description of the corrective action taken
  6. identification of the post-maintenance functional testing performed
  7. identification of personnel who performed the post-maintenance testing
  8. identification of replacement parts or materials used
  9. identification of test and measuring equipment used
- h. Responsibility has been established to assemble and review the records identified in 02.01.g.1 above, for transfer to record storage.
- i. A program has been established for reviewing completed corrective maintenance records to assess the adequacy of the preventive maintenance program, to identify repetitive failures of parts and components, and to identify design deficiencies.
- j. Responsibilities have been assigned to ensure implementation of records review identified in 02.01.h above.
- k. Work control procedures have been established to require special authorization for activities involving welding, open flame, or other ignition sources and to take cognizance of nearby flammable material, cable trays, or critical process equipment.
- l. Work control procedures have been established to require a firewatch, with capability for communication with the control room, if an activity identified in 02.01.k above is to be performed in the proximity of flammable material, cable trays, or vital process equipment.
- m. Revisions to TSRs, nuclear criticality safety evaluations/approvals (NCSE/As), and other application requirements have been incorporated into procedures and included in the master program.

02.02 Equipment Control Program. Verify that methods and responsibilities for equipment control have been clearly defined. Specifically verify that:

- a. Procedures have been established to specify that the operating staff grants permission to release equipment or systems for maintenance.

Before granting permission for removal of equipment for service, the operating staff is required to verify that the equipment or system can be released without violating TSR or NCSA/E requirements. Additionally, the

staff shall determine how long the equipment may be out of service. Granting of such permission shall be documented.

- b. Equipment that is environmentally qualified should be identified as such before maintenance and sufficient controls should exist to ensure it is returned to that status on reassembly.
- c. When testing of redundant components or systems is required by TSRs or NCSA/Es, such testing shall be documented.
- d. The status of equipment and systems will be clearly identified.
- e. Procedures have been established and responsibility has been assigned for determining when independent verification has been implemented correctly.
- f. Procedures and responsibility have been established for returning equipment to service.
- g. Revisions to TSRs and NCSA/Es have been incorporated into procedures and included in the master program.

02.03 Preventive Maintenance Program. Verify that a written preventative maintenance (PM) program for Q, AQ, and other safety related SSCs has been established to include:

- a. Responsibility for the program.
- b. Master schedule for preventive maintenance.
- c. Documentation and review of completion of preventive maintenance activities.
- d. Responsibilities and methods for establishing PM frequencies.
- e. Responsibility for periodic upgrading based on system or component failures.
- f. Methods for incorporating revisions to TSRs and NCSE/As into procedures and the master program.

02.04 Special Processes Program

- a. Verify that administrative controls for special processes have been established as follows:
  - 1. a requirement that only qualified procedures will be used
  - 2. a requirement that only qualified personnel will be used
  - 3. a requirement that a current file of special processes will be maintained to include qualification records of procedures and personnel
  - 4. criteria to establish when the use of mock-ups or other special training will be required
- b. Verify that responsibilities have been assigned to ensure that the requirements identified in 02.04.a will be accomplished.

02.05 Cleanliness Controls Program

- a. Verify that procedures have been developed for cleaning safety related components and systems.
- b. Verify that procedures have been established for maintaining the cleanliness of previously cleaned systems.
- c. Verify that the cleanliness classifications of plant systems have been established.
- d. Verify that responsibilities for implementing the requirements of 02.05.a and b have been established.

02.06 Housekeeping Controls Program. Verify that administrative controls and responsibilities for general housekeeping have been established to include:

- a. Defining housekeeping zones.
- b. Controlling housekeeping during work activities.

02.07 Maintenance Inspection Activities. Verify by making observations, conducting reviews, and interviewing maintenance personnel, that the facility's maintenance activities result in the reliable operation of plant SSCs and are performed in accordance with regulatory requirements. Inspect day shift and back shift maintenance activities and attempt to balance the inspections among the various functional areas (i.e., mechanical, electrical, instrument and control).

Include a periodic (approximately every other month) indepth examination of a planned major maintenance activity to assess the maintenance process from its inception to its completion.

- a. To ensure maintenance of SSCs was effective, verify that the facility:
  1. Ensured the operability of plant systems and components after the completion of maintenance.
  2. Properly tested and calibrated equipment before returning it to service.
  3. Properly returned to service any equipment being maintained and its associated system, including independently verifying the alignment of valves and breakers.
  4. Properly reassembled electrical equipment that is environmentally qualified after completing maintenance, surveillance, and testing.
  5. Used correct parts and tools.
  6. Fulfilled the requirements for inspections and tests as required by applicable American Society of Mechanical Engineers (ASME) Codes for code repairs and replacements.
  7. Used approved procedures that – given the skills of the workers involved – were adequate to achieve desired results: incorporated appropriate recommendations of the equipment vendor; and addressed special maintenance activities (including emergency contingencies) such as using a freeze seal or plug. Procedures included appropriate

quality control or independent verification hold points where necessary to ensure that critical work steps were performed adequately.

8. Ensured that workers, including contractors, received sufficient training to ensure that the maintenance activity was completed satisfactorily. Ensured that training addressed actions to be taken in the event of emergencies such as freeze seal failures.
  9. Ensured that contract workers received a level of supervision and quality assurance monitoring equivalent to that afforded facility workers.
  10. Periodically reviewed the equipment history and maintenance records for safety significant plant equipment, to identify repetitive failures or other adverse trends that may indicate ineffective or inadequate maintenance. Updated the equipment maintenance history and performance trend records to reflect the maintenance activity.
- b. Verify the following activities were conducted in a manner sufficient to ensure the safety of personnel and prevent damage to plant SSCs:
1. Obtained approvals and determined that appropriate safety tagout boundaries were established before initiating the work. The operations department and the maintenance workers communicated appropriately throughout the maintenance activity.
  2. Established and implemented appropriate ignition, fire prevention, and personnel safety controls.
  3. Established and implemented adequate radiological controls, including radiation work permits and appropriate as-low-as-reasonably-achievable (ALARA) reviews.
- c. Verify that the following activities were conducted in a manner sufficient to ensure adequate control of plant risk and, where appropriate, compliance with TSR and/or NCSA/E requirements:
1. TSR limiting conditions for operation (LCO) were met. If the LCO was entered to perform elective maintenance, verify that unavailability of equipment taken out of service was not excessive and that activities were given appropriate priority.
  2. Systems and their redundant trains were operable in accordance with TSR and NCSA/E requirements.
  3. Adequate operations oversight was provided for maintenance or modification activities performed on or near equipment that is still in service. Contingency guidance was provided to operations personnel when sensitive maintenance activities were being performed.

02.08 Maintenance Prioritization. Review outstanding job orders to ensure that the backlog of Q, AQ, and other safety related maintenance activities is being appropriately managed.

## 02.09 Effectiveness of Facility Controls

- a. Evaluate the effectiveness of the facility's controls in identifying, resolving, and preventing problems by reviewing such areas as corrective action systems, root cause analysis, safety committees, and self assessment in the area of maintenance.
- b. Determine whether there are strengths or weaknesses in the facility's controls for the identification and resolution of the reviewed issues that could enhance or degrade plant operations or safety.

## 88103-03 INSPECTION GUIDANCE

### General Guidance

The objectives and key ingredients of an acceptable plant maintenance program are discussed in Section 5.2.8 of ANSI 3.2-1994. The inspection requirements identified in this procedure are primarily based on the guidance contained therein. The applicant's commitments relative to this standard and other standards should be reviewed to establish inspection acceptance criteria. The gaseous diffusion plants have committed to specific portions of ANSI 3.2-1994, as described in the application. Only inspection guidance not contained in Section 5.2.8 of ANSI 3.2 is provided below.

The inspector's goal is to observe a few routine maintenance activities each month and perform an in-depth examination of a major maintenance activity on a periodic basis using the guidance in this inspection procedure. Include observing some back shift maintenance activities, when appropriate. Do not observe an insignificant maintenance activity just to meet the above stated goal. If the facility is not performing significant maintenance activities, perform other inspection activities.

Consider safety significance when selecting maintenance activities for observation. Choose components that have experienced problems or activities, such as inadequate training or procedures, that have resulted in maintenance problems. Evaluate the rate of failures, not just the number of failures.

### Inspection Priorities

Concentrate on inspection of maintenance activities rather than the program or procedures. The inspector may decide to observe only selected portions of maintenance activities. In those instances, the inspector may wish to discuss them with maintenance personnel to obtain information about aspects of the job that the inspector did not observe, including radiological controls, fire prevention controls, and materials used. Question maintenance personnel to determine if they are familiar with their assigned maintenance task. If the maintenance activities are performed efficiently and the plant equipment performs reliably and is capable of performing its intended functions, the facility's program and procedures will likely be adequate. Therefore, there may be no need for the inspector to further examine the facility's process or procedures. However, if the inspector notes problems during the observations or if plant equipment is not sufficiently reliable (or not maintained operable), the inspector may wish to examine the facility's program, processes, and procedures to determine the cause of the problems.

## Troubleshooting Activities

Periodically observe "Troubleshooting" activities. While observing troubleshooting activities, give particular attention to the use of jumpers and the possibility of LCO violations. Verify that equipment was not removed from service without proper authorization, that the activity was appropriately controlled, that the activity was successfully completed, and that the equipment was properly restored to its normal configuration after completing the activity.

The facility is expected to have general procedures to control troubleshooting activities such as removal and return of equipment to service, use of lifted leads and jumpers, and post activity testing. Although the facility should have a procedure that addresses the general plan of the troubleshooting activity, it is not always necessary that all the steps performed as part of a troubleshooting activity be defined in a step-by-step procedure.

## Post-maintenance Verification

Verify that SSCs returned to service after the performance of maintenance are capable of performing their intended function. This can be accomplished by:

- Observing the equipment in operation (instrument responding to changes in plant conditions).
- Observing the tests performed on the equipment, providing they are performed with the system in a normal lineup.
- Independently verifying the alignment of valves and switches.
- Verifying that the applicable TSR or NCSA/E surveillance tests are re-performed after the maintenance activity is complete.

## Engineering Support

Verify that the facility has provided an appropriate level of engineering support for maintenance activities. Not all maintenance activities require engineering involvement, but timely engineering support should always be available to the maintenance staff. Areas where engineering can provide valuable assistance include: evaluating when a repair would constitute a design change; specifying replacement parts; performing root cause analyses; and evaluating performance trends. Delays in responding to requests for support, repetitive equipment failures, and superficial root cause analyses could indicate inadequate engineering support.

## Specific Guidance

### 03.01 Corrective Maintenance Program

- g. The requirements for developing and maintaining maintenance records are discussed in Section 3 of the TSRs, Section 6 of the Safety Analysis Report (SAR), and Section 5.2.15 of ANSI 3.2-1994.
- k. Regulatory Guide (RG) 1.120, and the SAR referenced fire protection program identify fire protection/prevention requirements that should be included in work control procedures for maintenance activities.

Records of these activities may be documented in the maintenance procedures, on the work request or trouble ticket, or in other documents. The inspector should establish that the system developed by the applicant provides for generation of the required records in some manner.

03.02 Equipment Control Program. Section 5.2.6 of ANSI 3.2-1994 provides guidance relative to equipment control.

03.03 Preventive Maintenance Program. Lubricants, filters, and other expendables should be clearly identified.

03.04 Special Processes Program. Section 5.2.21 of ANSI 3.2-1994 provides guidance relative to control of special processes. NQA-1, 1989, and the plant Quality Assurance Plans provide guidance and state requirements relative to qualification of personnel responsible for inspection and testing activities.

03.05 Cleanliness Controls Program. ANSI N45.2.1-1976 and NQA-1, 1989, provide guidance relative to cleanliness of fluid systems and components.

The facility should establish standard flushing procedures, identify authorized solvents, and provide other guidance as necessary to establish and maintain the required degree of cleanliness of safety-related components and systems.

03.06 Housekeeping Controls Program. ANSI N45.2-1973 and NQA-1 provide guidance relative to general housekeeping requirements.

03.07 Maintenance Inspection Activities. Be aware that the scope of SSCs included in these inspections includes safety-related SSCs as well as non-safety-related SSCs that may be needed to satisfy NRC regulatory requirements or facility commitments. The particular SSCs may vary depending on the site. Select SSCs for inspection based on discussions with facility personnel and a review of facility commitments.

The intent of the periodic indepth inspection is to provide an overall assessment of the effectiveness of the maintenance process, and to supplement the routine maintenance observations. The indepth examination will inspect the maintenance activity from its inception to its completion. This would include the activity (e.g., hot bearing, high vibration, engineering recommendation) that initiated the maintenance action, maintenance planning, maintenance work, restoration of the system, and post-maintenance testing.

- a.1 To assess the operability of the system and components selected, review and assess the material condition, the availability of the system, safety features, and the results of surveillance and post maintenance tests. The list of outstanding work requests will help assess the operability of equipment.
- a.2 Determine that in testing equipment, the facility tests important attributes of the equipment that may have been affected by the maintenance, and not just those that are tested by performing the surveillance test required in the TSR or NCSE/As. Verify that post-maintenance test deficiencies are appropriately evaluated and corrected before returning the equipment to service. Post-maintenance testing and TSR surveillance testing are usually two distinct activities. If only the TSR surveillance is used after maintenance, then a close examination that the attributes of the equipment affected by the maintenance activity have been tested by the TSR surveillance is appropriate.



- a.3 Determine that activities for returning equipment to service follow the guidance provided by the staff in NUREG-0737, Item I.C.6, "Guidance on Procedures for Verifying Correct Performance of Operating Activities."
- a.4 Determine that maintenance activities include adequate controls to ensure that vapor barriers, gaskets, and seals are restored to the environmentally qualified condition.
- a.5 Verify that the replacement parts are either identical to the original part or that the substitute part had a proper engineering evaluation and has been found to be a suitable substitute. Care must be taken to ensure that any replacement commercial grade hardware meets original design requirements (i.e. strength, corrosion resistance, etc.). Verify that special tools (such as torque wrenches) were used where specified in the maintenance procedures or design specifications.
- a.6 If the equipment is subject to the ASME codes, then any maintenance activity performed on the equipment may void the results of ASME code tests or inspections. The facility must ensure that appropriate ASME code pre-service or in-service tests are re-performed as necessary to ensure code requirements are maintained. Determine if the equipment being maintained is subject to the ASME codes by reviewing the facility testing programs. Verify that any required ASME code pre-service or in-service inspections or tests were performed as part of the maintenance activity. This could include, for example, testing to re-establish baseline data following the overhaul or repair of a code pump or a UF<sub>6</sub> cylinder.
- a.7 Although it is appropriate for the facility to obtain and review vendor technical information, it is not required that all vendor recommendations be incorporated into the facility's maintenance program. If the facility determines that a vendor recommendation is not appropriate, the facility may decide to disregard it. However, if equipment problems result in unacceptable loss of essential function, determine if vendor recommendations that could have precluded the problems were adequately implemented.

Determine that: adequate emergency contingency procedures are available in the event of freeze plug failure; maintenance and operations personnel have been trained in the use of these procedures; and, that personnel at the site of the freeze plug maintain adequate communication with the control room.

- a.8 Some special processes such as non-destructive examination and welding have formal qualification requirements. If the maintenance task being reviewed involves these activities, verify that the personnel performing the activity are qualified. Other maintenance activities such as use of freeze plugs may or may not have specific qualification requirements. Question maintenance supervisors or management to determine if they have established any qualification requirements for the maintenance task being reviewed. If they have, verify by reviewing qualification records, or by questioning the maintenance personnel performing the task, that these qualification requirements have been met.
- a.9 Contract personnel must conform to equivalent requirements as do plant maintenance personnel. Contract personnel who work directly for regular plant staff maintenance supervisors are subject to oversight under the facility's established quality assurance program. However, the facility may also contract with outside vendors to complete specific tasks and to provide their own quality assurance program. In those cases, the facility

must verify that the contractors have an adequate quality assurance program. Ensure that the facility has audited the contractor's quality assurance program and that the facility has determined that the contract personnel are following their own quality assurance requirements.

- a.10 While conducting monthly observations of maintenance practices, review engineering support, root cause analysis, and equipment performance trends. To identify weaknesses in these areas, examine equipment and maintenance history records and other appropriate records such as facility event reports for indications of repetitive failures, inadequate root cause determinations and ineffective corrective action implementation.

Also verify that the facility's engineering staff helped resolve technical problems (where necessary) encountered while performing maintenance activities and that the maintenance activity does not constitute an unauthorized design change.

- b.1 Attempt to verify that maintenance personnel have adequately coordinated the work with operations personnel. Verify that the maintenance personnel have obtained the necessary approval from the operations department (such as the building or plant shift supervisor) on the work package or procedure prerequisite. Question the on-shift plant operating crew to verify that the operators are aware of all continuing maintenance activities that might affect plant operation. This activity would include any activity that reduces the number of redundant safety systems available in the event of an accident, or any activity that could cause a plant transient.

- c.1 While verifying that the activities are not violations of the LCO, determine if the activity involves a voluntary entry into an LCO. Although voluntary entry into an LCO is allowed, ensure that these situations are appropriately managed by the facility and assessed for overall impact on plant risk. The facility's work control or equipment control program should ensure that redundant and diverse equipment is operable, and that the work activities are given appropriate priority. In addition, PM activities should be planned and coordinated to preclude frequent entry into individual LCO's. Repeatedly entering and exiting an LCO may indicate a maintenance or an equipment performance problem.

The NRC Inspection Manual, Part 9900, provides guidance for the inspector on the subject of voluntary entry into LCOs to perform maintenance.

03.08 Maintenance Prioritization. Failure to promptly evaluate significant operability concerns or frequently removing important equipment from service to correct minor deficiencies may indicate improper prioritization. Verify that degraded but operable components are repaired in an expedited manner consistent with the need for the equipment to stay in service to perform its safety function.

#### 03.09 Effectiveness of Facility Controls

- a. When safety issues, events, or problems are reviewed, the adequacy of the results of facility controls may be assessed by determining how effective the facility was in performing the following:
  - 1. Initial identification of the problem.

2. Elevation of problems to the proper level of management for resolution (internal communications and procedures).
  3. Root cause analysis.
  4. Disposition of any operability issues.
  5. Implementation of corrective actions.
  6. Expansion of the scope of corrective actions to include applicable related systems, equipment, procedures, and personnel actions.
- b. The determination of whether there are strengths or weaknesses in the facility's controls will be limited to those issues, events, or problems reviewed in detail. The evaluation will not draw sweeping conclusions about the facility's overall control programs but will be very specific in identifying any facility strengths or weaknesses encountered with the individual items reviewed.

NOTE: For additional inspection guidance on facility controls, please refer to IP 40500, "Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems."

88103-04 RESOURCE ESTIMATE

An inspection performed using this inspection procedure is estimated to require 40 hours of inspector resources. This estimate is only for the direct inspection effort and does not include preparation for and documentation of the inspection.

END