MAINTENANCE AND SURVEILLANCE TESTING

PROGRAM APPLICABILITY: 2600

NOTE: REFERENCES IN THIS PROCEDURE TO 10 CFR PART 70.61 THROUGH 70.76 (IROFS and ISAs) DO NOT APPLY TO 10 CFR PART 40 and 76 LICENSEES/CERTIFICATEES. SEE 10 CFR PART 70.1 (d),(e), and PART 70.60.

88025-01 INSPECTION OBJECTIVE

To determine whether general maintenance activities, surveillance tests and calibrations are conducted in accordance with 10 CFR Part 70, Subpart H and license/certificate requirements and approved procedures. To determine specifically whether the management measures associated with maintenance are sufficient to ensure that items relied on for safety (IROFS) and other safety-related equipment will be available and reliable to perform their intended functions. To determine whether emergency utility services and process monitoring instrumentation are maintained and calibrated as required.

88025-02 INSPECTION REQUIREMENTS

02.01 Maintenance Work Control

a. Work control procedures. Determine whether work control procedures are adequate in defining the review and approval sequence for obtaining a work order.

b. Pre-job planning: Determine the adequacy of pre-job planning for complex corrective maintenance activities, recurring failures, or failures resulting in reportable events.

c. Review work package: Determine the adequacy of work packages (work request, maintenance procedure, tag-out, etc.) prepared for maintenance activities.

d. Maintenance observations: Determine whether maintenance work activities on systems and processes important is conducted according to the regulatee's requirements and procedures. Systems and processes important to safety (items relied on for safety {IROFS}) are specified in license/certificate requirements and the independent safety analyses (ISAs).

e. Post-maintenance testing: Determine whether that appropriate post-maintenance testing and calibrations (as specified by license/certificate requirement, ISAs, IROFS or regulatee procedures) are performed prior to returning the component or system to operational status.

f. Review completed work package: Determine whether the maintenance activities are reviewed by maintenance and operations supervision upon completion prior to returning equipment to service.

02.02 Surveillance and Calibration Testing

a. Surveillances: Observe/determine whether surveillance tests for several IROFS are conducted according to the procedures and at the required frequency. Systems and processes important to safety (IROFS) are specified in license/certificate requirements and the ISAs.

b. Calibrations: Observe/determine whether calibrations for several IROFS are conducted according to the frequency, requirements and procedures.

c. Criticality Alarm Monitoring Systems The criticality safety monitoring system is inspected/calibrated as required by license/certificate requirements.

02.03 Program Review

If the inspector's observation or review of maintenance work, surveillance testing or calibrations identifies a compliance problem, consideration should be given to perform a programmatic review in addition to the performance review.

88025-03 INSPECTION GUIDANCE

Note: Guidance offered below is specific to Inspection Requirements in Section 02 above: The guidance in Section 03.01 corresponds to the inspection requirements in 02.01, etc.

03.01 Maintenance Work Control

a. Work control procedures. Work control procedures usually require the use of a "work order" or similar document. Administrative control procedures should define the review and approval sequence for obtaining this document and require that maintenance activities on IROFS or in the proximity of critical or vital equipment be performed under the work order system. Work orders usually include the following essential elements:

Identification of work activity
Work group(s) involved
Foreman in charge
Ignition source controls
Fire watch requirements
Special work controls
Foreman signature
Operating staff review signature
Operations supervision approval signature

Work control procedures should define the criteria under which work in process areas or on or near IROFS will be permitted.

Troubleshooting. Regulatees should have procedures for controlling troubleshooting activities such as removing and returning IROFs to service, use of lifted leads and jumpers, and post activity testing. Although a regulatee should have a procedure that addresses the general plan of the troubleshooting activity, it is not always necessary that all of the steps performed as part of a troubleshooting activity be defined in a step-by-step procedure. However, documentation of troubleshooting activities should provide evidence that the activity was performed properly.

Also ensure that the regulatee is not using troubleshooting to circumvent the requirements of the standing maintenance procedures and policies, nor is troubleshooting being used as means to implement a work-around for a problem instead of repairing it.

b. Pre-job planning. For complex corrective maintenance activities, recurring failures, or failures resulting in reportable events, evaluate the adequacy of pre-job planning by reviewing available records or questioning responsible licensee personnel to determine if the licensee performed the following pre-job planning activities:

1. Reviewed plant machinery history or industry operating data for similar equipment failures.

2. Reviewed vendor technical manuals and incorporate appropriate vendor recommendations into maintenance procedures.

3. Obtained engineering support, when needed, to address complex maintenance issues.

4. Prepared written procedures, where necessary, to perform complex maintenance activities.

5. Reviewed post-maintenance and/or post-modification system test alignments and control for exiting those alignments.

6. Used formal root-cause analysis methods, as necessary, to identify the causes of maintenance failures.

7. Identified special skills or qualifications, special tools and equipment, or spare parts needed to perform the maintenance activity.

8. Assessed the total equipment out of service to determine the overall effect on safety of performing the planned maintenance activity.

c. Review work package. Determine if the work package (work request, maintenance procedure, tag-out, etc.) prepared for the maintenance activity addressed the elements listed below.

1. The procedure conforms to the regulatee*s administrative requirements for format, approval, and control.

2. The procedure addresses the interface activities associated with the maintenance/ repair/replacement of a component such as lockout/tagout, removing a component from service, process line breaks, radiation work permits, release from operations, equipment status control, return to service, and post-maintenance testing.

3. Inspection hold points, independent verification points, or appropriate peer reviews are identified in the procedure or in a documented plan and are appropriate for the activity.

4. Supplementary reference materials, such as drawings and technical manuals, are adequate, controlled, and up to date.

5. The work activities are described in a level of detail that is commensurate with the complexity of the maintenance activity. Skills normally possessed by qualified maintenance personnel may not require detailed step-by-step procedures for simple tasks.

6. Consideration is given to cleanliness requirements and personnel hazards such as chemical, radiological, temperature, pressure, and electrical hazards.

7. Provisions for fire protection, and security are included. Work involving welding, open flame, or other ignition sources, should require 1) special authorization, 2) a special survey or evaluation of the proposed work area to identify nearby flammable material, vital cable runs, critical process equipment, etc., 3) and a fire watch. If the maintenance activity is to be performed in the proximity of flammable material, vital cable runs, etc., the fire watch should have the capability of communicating with the appropriate organization (process control area, fire brigade). The individual performing the fire watch should know what actions to take in the event of a problem.

8. Instructions and quality control checks are included to verify that environmentally qualified (EQ) equipment is properly protected against moisture intrusion when reassembled and that proper EQ material, especially elastomers, have been installed.

9. Provisions for control of equipment, including lifted leads, jumpers, bypasses, and mechanical blocks are included.

10. Interfacing activities with the operations/production and safety/health physics personnel are verified. Where applicable, safe work procedures, job hazard analysis, and/or radiological, NCS or chemical hazards should be referenced.

11. Provisions for obtaining formal approval from operations are included, as well as methods for notifying operations when affected systems are removed from service, ready to be restored to normal service, or if problems are encountered.

12. Provisions for material, parts, and tool accountability to ensure loose items are not inadvertently left inside equipment after the work is complete.

13. Provisions for procedure or standard task prerequisites, such as scaffold engineering evaluations and requests, breach of fire/air/radiation barriers, and radiation protection requirements, are included.

14. Replacement parts for a given job will be properly controlled and identified for its end-use.

d. Maintenance observations. Select a number of corrective and preventive maintenance activities that are in progress, preferably those that are related to problem components or systems. For the maintenance activities selected, verify the following:

1. Maintenance personnel assigned understand the scope of the task and are familiar with the procedures.

2. Up-to-date written procedures are being implemented in the field, and that steps in the procedures are carried out sequentially, unless otherwise specified.

3. Applicable parts of items 02.02.c are satisfied for the work in progress.

4. The maintenance personnel are qualified for their respective tasks.

5. Supervisory oversight of the work is adequate.

6. QC personnel assigned are knowledgeable of the task.

7. Apparent cause of failure appears to be addressed by appropriate corrective action, including measures to prevent recurrence.

8. Appropriate health physics support available.

e. Post-maintenance testing (PMT). Procedure contents should normally include testing provisions following maintenance. Written procedures should be available for performing maintenance, calibration, and surveillance requirements for nuclear criticality safety (NCS) control systems and IROFS identified in the ISAs. There should be records to confirm that the work was performed. For each testing activity selected, identify the affected systems and/or components, and review the following:

1. The applicable licensing basis and/or design-basis documents to identify the safety functions of the affected systems and/or components.

2. The associated maintenance activity, to identify the safety functions that may have been affected by that activity.

3. The regulatee*s test procedure to verify that the procedure adequately tests the safety functions affected by the maintenance activity. Verify that the acceptance criteria in the procedure is consistent with information in the applicable licensing basis and/or design-basis documents. Verify that the procedure has been properly reviewed and approved.

Either witness the test and/or review the test data, to verify that:

12. The performance of the affected systems and/or components satisfies the procedure*s acceptance criteria.

2. The effects of testing on the plant have been adequately addressed.

3. The measuring and test equipment (M&TE) is calibrated, and is within its current calibration cycle.

4. The M&TE is within its required range and accuracy.

5. The applicable prerequisites described in the test procedure are satisfied.

6. The affected systems or components are removed from service in accordance with approved procedures.

7. The test is performed in accordance with the test procedure and other applicable procedures.

8. Any lifted leads or jumpers, both electrical and pneumatic, are controlled and restored.

9. The test data/results are accurate, complete, and valid.

10. The test equipment is removed after testing.

11. After completion of testing, equipment is returned to the positions/status required to maintain the system operable, in accordance with the current operating mode using approved procedures.

12. Any problems noted during testing are appropriately documented.

Note: Regulatee PMT is often conducted by performing a related, existing surveillance procedure for operability determination. Inspectors should assure that the testing performed not only provides a snapshot of structures, systems and components (SSC) operability, but actually evaluates the adequacy of the maintenance or repairs to the SSC being tested.

Note: As a minimum, perform a review of the completed test procedure and the recorded data. However, for most inspection samples the inspector should also attend the prejob briefing, witness the test when it*s performed, and attend any post-test critiques, as applicable.

f. Review completed work package. Evaluate the work request, maintenance procedure, tag-out, etc., for the selected work activity to determine whether:

1. Required administrative approvals were obtained and the equipment was formally released for maintenance before beginning the work.

2. Limiting conditions for operation specified by license/certificate or procedural requirements were met while the component or system was removed from service, as applicable.

3. Approved procedures were used if the activity appeared to exceed the normal skills possessed by qualified maintenance personnel.

4. Quality control (QC) inspections were made in accordance with the regulatee*s requirements, and QC records were completed.

5. Functional testing and calibrations were completed and test data was reviewed by supervision and verified to meet all regulatee acceptance criteria before returning the equipment to service.

6. Personnel who performed the tests were properly qualified and trained for special tests.

7. Activities performed by outside contractors were controlled in accordance with the regulatee*s approved quality assurance program or a regulatee—approved QA program commensurate with the activity. Attention must be given to assuring that contractors receive appropriate instruction and familiarization with regulatee procedures and appropriate supervision by plant personnel.

8. System failures that necessitated the maintenance were evaluated and reported in accordance with license requirements, if required.

9 Corrective and preventive maintenance records were updated, assembled, and stored as part of the maintenance history.

10. M&TE used was identified within calibration date limits, and appropriate for its end-use.

12. Parts and materials used were identified and at least met the specifications of the original equipment. Commercial grade dedication was completed where required.

13. Special processes were controlled and documented.

14. System lineups were made and verified before returning the system to service. Retests were completed and any out-of-specification test results were appropriately addressed.

03.02 Surveillance and Calibration Testing

a. Surveillances: The license/certificate will specify which IROFS and systems mportant to safety require periodic surveillance tests. The systems which may be included for such tests are:

- Criticality safety monitoring system
- Mechanical process systems
  - fuel receiving, storage, handling, transfer, and
  - feed preparation and hull handling, or
  - fissile material receiving, storage, handling, transfer, and
  - fuel manufacturing
- Chemical process systems
- Process offgas systems
- Confinement barriers and systems
- Ventilation systems
- Emergency utility services
  - electrical supply systems
  - water supply systems
  - compressed air supply systems
  - lighting systems
  - fire protection system
  - safety communications and alarms systems

Determine whether surveillance tests are performed at the required frequency for IROFS and for systems important to safety. This assures availability and reliability of IROFS and NCS control.

Procedures should be developed, reviewed, and approved under the regulatee's procedural control system. The procedures should specify:

- prerequisites and preparation for the test,
- functional tests of instruments in conducting the surveillance test,
- acceptance criteria,
- operational checks to be made before returning equipment to service
- deficiency reports documented for failures

Examine those procedures related to the tests selected for observation. Determine whether surveillance tests required by the license/certificate are conducted using properly approved procedures.

Examine the technical content of procedures for the selected surveillances to determine that satisfactory tests will be conducted. The objective is to determine whether the procedure will satisfy the applicable license/certificate requirement. The surveillance requirement and the bases of the license/certificate requirements, or description in the safety analysis report or the application, should be used to aid in this determination. Examine the procedure and check-off sheets to determine if valve lineup, or other similar requirements, appear correct for the test activity and the return of the component or system to service.

Determine whether, for tests selected above, that test results conform with license/certificate requirements, and that test results have been reviewed and approved by appropriate supervision. The test results should be reviewed and approved by someone other than the person performing the test or the person directing the test.

Other significant surveillance test attributes for consideration include the following:

1. Preconditioning does not occur.

2. Effect of testing on the plant has been adequately addressed by control room and/or engineering personnel.

3. Acceptance criteria is clear and demonstrates operational readiness and is consistent with the supporting design calculations and other licensing documents.

4. Measuring and test equipment range and accuracy are consistent with the application and has current calibration. Verify the plant equipment calibration is correct, accurate, properly documented and the calibration frequency is in accordance with regulatee procedures and commitments.

5. Test is performed in sequence and in accordance with written procedure.

6. Jumpers installed or leads lifted during testing are properly controlled.

7. Test data is complete, verified and meets procedure requirements.

8. Test frequency was adequate to demonstrate operability (meets license requirements), and reliability.

9. Test equipment is removed after testing.

10. After completion of testing, equipment is returned to the positions/status required for the performance of its safety function.

11. For test results that do not meet the acceptance criteria, results of an adequate operability determination are acceptable.

12. For selected safety related instrumentation and control surveillance test verify that reference setting data has been accurately incorporated to the test procedure.

b. Calibrations.

The systems to which this procedure applies are the same as listed in 03.02 a.

Determine whether calibrations are performed at the required frequecy for IROFS and systems important to safety. This assures availability and reliability of the IROFS and NCS controls.

During the review of calibration procedures and calibration records determine whether provisions are included to acknowledge that applicable license/certificate requirements for limiting conditions for operation are in effect. Determine whether the service status of the system was in conformance with the applicable limiting conditions of operation specified in license/certificate requirements.

Examine the technical content of procedures for the selected surveillances to determine that satisfactory calibration of monitoring components will result. In the review of procedures, look at a sample of stepwise instructions to determine if the following considerations have been included:

- appropriate signal compensations are included,
- point of signal insertion is specified,
- calibrations are appropriate to the range and use of equipment.

Determine whether procedures used to calibrate the monitoring component selected contain:

- review and approval requirements of license/certificate conditions,
- acceptance values for trip settings that conform to license/certificate requirements, and
- detailed stepwise instructions
- deficiency reports documented for out-of-tolerances

The objective is to determine whether the procedure will satisfy applicable license/certificate requirements. The surveillance requirements and the bases of the license/certificate requirements, or description in the safety analysis report or the application, should be used to aid in this determination. Examine the procedure and check-off sheets to determine if valve lineup, or other similar requirements, appear correct for the calibration activity and the return of the component to service.

During the review of raw data calibration records, determine whether "as-found-settings" are also recorded. Determine whether trip points of components selected conform to applicable license/certificate requirements.

Review the qualifications of individuals having responsibility for performing calibrations against the regulatee requirements and the company policy regarding personnel qualification requirements.

For gauges, instruments, or other measuring/testing devices used as primary standards in the calibration of plant equipment, determine whether:

- calibration frequency was met and accuracy verified as prescribed by internal procedures or license/certificate requirements,
- accuracy is traceable to the National Bureau of Standards or other independent testing organization,
- storage and control of the selected devices is proper.
- information tagged on the testing equipment conforms to that in calibration records.
- the M&TE was in calibration at the time of use.
  the M&TE is calibrated against standards that have an accuracy that is better than or equal to the instrument being calibrated.

c. Criticality Alarm Monitoring Systems. By observation, discussion, and document review, determine whether the system is designed to permit component and system operability testing periodically and after maintenance. Determine whether maintenance and testing of the entire alarm system are done and that such tests are announced.

The criticality accident alarm system is expected to be designed to permit component and system operability testing periodically and after maintenance. The regulatee is expected to have procedures in place to require tests and checks equivalent to the initial installation tests following significant modification or repair to the system.

Determine by observation, discussion, and document review that the audibility of the criticality alarm signal was above background noise level, as specified in applicable ANSI standards or other regulatory requirements, throughout all areas to be evacuated or that other signals, such as lights or beacons, provide operator warning.

All tests and corrective actions should be recorded. Maintenance, surveillance, and test records for the alarm system are expected to be maintained.

03.03 Program Review

If it has been determined that a programmatic review of the maintenance program is needed due to observed compliance issues, the inspector should perform an in depth review of the program supporting the maintenance program including management systems, management support, audits and program reviews, training of maintenance personnel, and corporate policy and procedures affecting maintenance.

Maintenance Program. Review the regulatee's maintenance program to ensure that the following have been adequately addressed for the IROFS:

- Methods for identifying components and equipment that need regular preventive maintenance (PM), inspections, and tests.
- Methods for identifying frequency and methods of PM, inspections, and tests.
- Procedures for a corrective maintenance program to handle unexpected repairs/breakdowns, etc.
- Training program for maintenance and inspection personnel.
- Development of written maintenance, inspection, and testing procedures for each type of equipment included in the PM list.
- Documentation of maintenance and inspection activities.
- A mechanism to update the maintenance and inspection program through the incorporation of management-approved recommendations coming out of the nuclear chemical process safety program inspection elements, hazard identification and assessment studies, incident investigation and audit programs pertaining to maintenance and inspection.
- The requirements for maintenance and calibration of control systems for nuclear criticality, chemical, radiological and fire safety have been established per written procedures as required.
- The configuration control program is used to control replacement parts.

The method for identifying IROFS components and equipment that need PM and inspection should be appropriate, given the hazards identified in the ISA, as well as the level of complexity of the operations. It could be based on applicable codes, manufacturers' recommendations, recommended practices by professional/ trade organizations, company policy, etc.

Written PM and corrective maintenance procedures should be available as part of the maintenance and inspection program. The inspector should review selected changes in the written procedures for content and clarity. Where applicable, these procedures should follow recognized industry standards, codes, and guidelines. These should be available when the procedure is outside the skills of competent journeymen.

Accurate records of all maintenance and inspection activities, such as tests/inspections, breakdowns, equipment failure, repairs and replacement, should be available. This data should be used, where appropriate, for in-depth analyses of the IROFS (e.g., trending, tracking maintenance activities, predictive maintenance activities, etc.). Findings from the equipment reliability studies, if done, should be used to make adjustments in frequencies and maintenance practices. See Appendix A for a list of typical information in equipment maintenance/test records.

The facility should have a mechanism to ensure that recommendations pertaining to maintenance and inspection activities (from the ISAs, nuclear chemical process safety program inspection programs such as hazard identification and assessment, incident investigation, audit programs, and results of equipment reliability studies) are incorporated into the maintenance program. A tracking system should be implemented to ensure that recommendations are addressed on a timely basis. The inspector should cross-check with the features of the tracking system described in the hazard identification and assessment element.

The plant is expected to have a maintenance and calibration program for all applicable IROFS, including nuclear criticality, chemical, radiological and fire safety control systems that are identified in the ISAs. These IROFS could include instrumentation, such as temperature and level monitors, or physical systems such as barriers, constraints, neutron absorbers, etc. For these systems, nuclear criticality, chemical, radiological and fire safety depends on continued maintenance and/or surveillance of the systems and calibration of the instrumentation. The ISA summary should identify the maintenance and calibration requirements for these systems.

A scheduling and tracking system should be implemented such that maintenance and calibration activities are planned and those that have been performed are tracked. Records should be available that identify when maintenance and calibration actions were performed on the safety systems.

Since nuclear criticality, chemical, radiological and fire safety depends on these safety systems, all changes to the systems must be carefully considered to avoid unanticipated consequences. This includes simple replacement of parts or "improvements." In some cases, specific materials or geometries involved in the system are important to safety but these features may not be obvious to maintenance personnel. Problems have arisen in the past with use of unauthorized replacement parts that served the purpose, but reduced the safety margin afforded by the original design. Allowable replacement parts should be documented in procedures (preferably the maintenance procedure for the safety system). All other changes to the safety system, including use of non-authorized replacement parts, should be approved by the appropriate safety/design manager prior to installation. A configuration control system should be in place to control these replacement parts.

88025-04 RESOURCE ESTIMATE

An inspection performed using this inspection procedure is estimated to require 30 hours of inspector resources. This estimate is only for the direct inspection effort and does not include preparation for and documentation of the inspection.

88025-05 REFERENCES

Center for Chemical Process Safety, *Guidelines for the Technical Management of Chemical Process Safety*, American Institute of Chemical Engineers, New York, 1989, Chapter 8, Process and Equipment Integrity, pp. 85 - 97.

Center for Chemical Process Safety, *Plant Guidelines for Technical Management of Chemical Process Safety*, American Institute of Chemical Engineers, New York, 1992, Chapter 8, Process and Equipment Integrity, pp. 149 - 198.

OSHA, *Process Safety Management of Highly Hazardous Chemicals*, 29 CFR 1910.119 (j), "Mechanical Integrity."

EPA, *Risk Management Programs for Chemical Accidental Release Prevention*, 40 CFR Part 68, Section 68.32, "Prevention program - maintenance (mechanical integrity)."

Chemical Manufacturers Association, *Responsible Care®, Process Safety Code of Management Practices*, Washington, 1990, Practices 12 "Standards, Codes, and Regulations", 14 "Mechanical Integrity."

END

Appendix:
A. Typical Information in Equipment Maintenance/Test Records

APPENDIX A

TYPICAL INFORMATION IN EQUIPMENT MAINTENANCE/TEST RECORDS

The following list includes information that may be included in equipment maintenance/ test records:

a. Name of person(s) performing maintenance activity

b. Name of person verifying quality of maintenance work performed

c. Process section

d. Service/ equipment description

e. Description of location - provide isometric drawing number if available

f. Identity of process fluids in equipment

g. Manufacturer's name and equipment serial number

h. Materials of construction

i. Operating conditions (e.g., temperature, flow, pressure, etc.)

j. Applicable codes and standards (e.g., ASME, API codes, etc.)

k. Maintenance history:

   1. as received condition of equipment

   2. work done on equipment - including all inspections and tests, part replacements

   3. any changes in testing frequency recommended to operations

l. Previous test/inspection and next test/inspection dates

m. Testing, inspection, or preventive maintenance schedules

n. Corrective maintenance performed on each piece of safety related equipment

END