

# NRC INSPECTION MANUAL

DQASIP

## INSPECTION PROCEDURE 70301

### OVERALL PREOPERATIONAL TEST PROGRAM REVIEW

PROGRAM APPLICABILITY: 2513

#### 70301-01 INSPECTION OBJECTIVES

Ascertain that the applicant's administrative controls over preoperational testing have been developed in accordance with FSAR commitments and regulatory requirements.

#### 70301-02 INSPECTION REQUIREMENTS

##### 02.01 Test Program

- a. Verify that the applicant has prepared a description of the preoperational test program. General areas of testing should be identified and responsibilities should be assigned for the following:
  1. flushing and cleaning of NSS and auxiliary systems, and components
  2. hydrostatic tests of piping, vessels, and systems designed to contain pressurized or radioactive fluids
  3. instrument calibration
  4. system turnover from the constructor
  5. functional demonstration of equipment in all modes throughout its operating range, including applicable flow tests
  6. electrical, mechanical, and instrument and control testing
- b. Verify that the applicant's test program includes requirements for testing consistent with FSAR commitments:
  1. tests to be performed have been identified and sequenced.
  2. For each of the identified tests, the following information should have been identified:
    - (a) test objectives
    - (b) summary of the test

- (c) necessary prerequisites
  - (d) acceptance criteria
- c. Verify by review of administrative documentation that the applicant has specified the format and content of preoperational test procedures sufficient to satisfy the guidance contained in IP 70300.

#### 02.02 Test Organization

- a. Verify that the required qualifications of key personnel in the test program are formally specified in writing.
- b. Verify that the responsibilities of key personnel in the test program are formally specified in writing.
- c. Verify that the method and responsibility for appointing key personnel in the test program are formally specified in writing.
- d. Verify that the lines of authority and responsibilities of test personnel are formally specified in writing.
- e. Where interfaces exist between organizations involved in the test program, verify that organizational responsibilities are clearly established in writing.

#### 02.03 Test Program Administration

- a. Verify that formal methods have been established for the test organization to receive (from construction or other organizations) the jurisdiction over systems, components, and instrumentation before beginning to test those items.
- b. Verify that formal administrative measures have been established for jurisdictional control of system, component, or instrumentation status before, during, and subsequent to testing. Administrative measures should provide for:
  - 1. control of system status before testing.
  - 2. return of systems components or instrumentation to construction forces (if necessary to support modifications or repairs).
  - 3. control of system status subsequent to testing, including measures necessary to prevent invalidation of test results.
- c. Verify that formal administrative measures have been established governing the conduct of testing including:
  - 1. method for verifying a test procedure is current before its use
  - 2. methods to ensure personnel involved in the conduct of a test are knowledgeable of the test procedures
  - 3. methods to change (both major and minor) a test procedure during the conduct of testing
  - 4. criteria for interruption of a test and continuation of an interrupted test
  - 5. methods to coordinate the conduct of testing

6. methods to document significant events, unusual conditions, or interruptions to testing
  7. methods for identifying deficiencies, documenting their resolutions, and documenting retesting
  8. method for providing the current test procedure and marked-up drawings showing current modification status to the operators before test commencement
- d. Verify that formal methods have been established to control scheduling of test activities.
  - e. Verify that a formal program for evaluation of test results has been established. The program should provide for the following:
    1. the test data are properly reduced to meaningful and understandable form
    2. the test results are checked and compared with previously determined performance standards or limits
    3. deficiencies are clearly identified and appropriate corrective action has been proposed, reviewed, and completed
    4. after corrective actions or modifications have been completed, tests or portions of a test have been rerun as necessary to ensure that tests on the as-built system are adequate
    5. the results of the evaluations were reviewed and approved by appropriate licensee personnel and/or contractor personnel, including the person(s) responsible for approving the original test procedures

#### 02.04 Document Control

##### a. Test Procedures

1. Verify that formal administrative measures have been established which control the test procedure processes for review, approval, and issuance.
2. Verify that formal administrative measures have been established which control revision of approved procedures. The controls should specify:
  - (a) review by same persons and/or groups as the original procedure
  - (b) approval by same persons and/or groups as the original procedure
  - (c) issuance of revisions and control of obsolete procedures
3. If operating procedures, surveillance procedures, etc., are to be used during preoperational testing, administrative controls for the preoperational test program procedures must ensure that they receive the same reviews and approvals required for preoperational test procedures.
4. Verify that responsibilities have been assigned in writing to ensure that the procedure controls identified in items 02.04a1 and 02.02 above will be implemented.

b. Engineering Drawings and Vendors' Manuals

1. Verify that administrative controls have been established which require that current approved drawings, including P&IDs will be provided to the plant site in a timely manner during this test program.
2. Verify that master indexes are available for drawings and manuals which indicate their current revision numbers.
3. Verify that a mechanism exists which ensures that affected test procedures will be updated when manual or drawing revisions occur.

02.05 Design Changes and Modifications

a. Design Change Control

1. Determine that a formal method has been established for initiating, reviewing, and approving requests for design changes and modifications to equipment that has been turned over to the test group for preoperational testing.
2. Verify that the review process, including assignment of responsibility, provides for assuring that all proposed plant changes are reviewed for potential FSAR and unreviewed safety question impact.
3. When the review process above identifies the need for a change to the FSAR and/or proposed technical specifications, verify that procedures and responsibilities are established to ensure that the changes will be made.
4. Determine that controls have been established to ensure that design changes will be subjected to measures commensurate with those applied to the original design.
5. Verify that a formal method has been established to bring proposed or implemented design changes to the attention of the test group for incorporation into the test program.

b. Temporary Modifications, Jumpers, and Bypasses

1. Verify that written administrative controls have been established for controlling temporary modifications, jumpers, and bypasses.
2. Verify that the controls require that a formal log be maintained of the status of jumpers, lifted leads, control equipment, temporary trip points, etc.
3. Verify that the controls assign responsibility for maintaining the log.
4. Verify that installed jumpers or lifted leads will be readily identifiable by their physical appearance.
5. Verify that controls are established to account for installation and removal of spool pieces, strainers, blank flanges, and valve internals where testing requires modification to fluid systems.
6. Verify that the controls assign responsibility for determining when independent verification is required during the installation or removal of temporary bypasses or fluid system modifications.

7. Verify that the controls assign responsibility for determining when functional testing of equipment is required following installation or removal of temporary jumpers, lifted leads, or fluid system modifications.

#### 02.06 Plant Maintenance/Preventive Maintenance During Preoperational Testing

- a. Plant Maintenance. Verify that the following items have been included in the administrative procedures in effect during preoperational testing:
  1. Plant maintenance is required to be performed in accordance with defined administrative controls.
  2. Methods have been established for initiating, reviewing, approving, and scheduling maintenance.
  3. Methods have been established for controlling replacement materials and parts that are designated for use in safety-related maintenance activities.
  4. Controls have been established which require that only qualified personnel will perform maintenance activities.
  5. Maintenance administrative controls have been established which include the following:
    - (a) criteria for determining when maintenance procedures will be provided
    - (b) method for preparing maintenance procedures
    - (c) requirements for reviewing and approving maintenance procedures
    - (d) methods of determining when training of personnel in the use of maintenance procedures is required
    - (e) a formal method to ensure that appropriate approvals will be obtained before performing any maintenance activity
    - (f) inspection of maintenance work including final inspection of a completed task
    - (g) testing of structures, systems, or components, following maintenance to reestablish the validity of preoperational tests
    - (h) control of test and measurement equipment utilized in maintenance activities
- b. Preventive Maintenance Program. Verify that controls for preventive maintenance and equipment protection during and following preoperational testing have been established including:
  1. periodic surveillance as required
  2. protection from environmental extremes
  3. implementation of periodic maintenance and calibration programs
  4. maintenance of cleanliness

- c. Maintenance Records. Verify that administrative controls have been established which require preparation and retention of maintenance records.

#### 02.07 Equipment Protection and Cleanliness

- a. Verify that a formal program for housekeeping activities during preoperational testing has been established. The program should include provisions for:
  - 1. implementation of cleanliness zones, keyed to the progress of construction and testing
  - 2. control of facilities and equipment including cleanliness, environment, and fire protection/prevention
  - 3. periodic inspection to ensure the adequacy of housekeeping
- b. Verify that responsibilities have been assigned in writing to ensure that the control methods identified above will be implemented.
- c. Verify that a program for maintaining the appropriate degree of cleanliness of nuclear plant components and piping during preoperational testing has been established.
- d. Verify that water chemistry controls have been established for fluid system undergoing preoperational testing, including:
  - 1. water quality requirements
  - 2. layup of systems and components
  - 3. sampling requirements
  - 4. procedures to be followed for "out-of-specification" conditions

02.08 Test and Measurement Equipment. Verify by review of administrative procedures that controls have been established for special test equipment and all instrumentation used to provide data to show an acceptance criterion has been met or to ensure significant limitations are not exceeded that include:

- a. a listing of controlled test equipment, the calibration requirements, and the calibration history
- b. controls for storage and issuance to preclude use of test equipment which has not been calibrated within the specified interval
- c. requirements for recording test equipment identity and calibration date in test procedures to permit retest if equipment is subsequently found out of calibration
- d. controls for ensuring that installed instrumentation has been calibrated before being used to provide data to show an acceptance criterion has been met

#### 02.09 Training

- a. Verify that training requirements have been established in writing for all personnel involved in the following areas of the test program:
  - 1. test procedure preparation

2. test procedure approval
  3. test performance and documentation
  4. test results review and approval
- b. Verify that the required training includes the following:
1. administrative controls for testing
  2. QA/QC for testing
  3. technical objectives

## 70301-03 INSPECTION GUIDANCE

### 03.01 Test Program

- a. Regulation 10 CFR 50.34 requires the applicant to provide a description of the preoperational test program in the FSAR. Facility documents should implement the commitments for that program given in the FSAR. Guidance quoted in 10 CFR 50 should be interpreted to mean Regulatory Guide 1.68.
- b. The applicant should be able to demonstrate that the planned test program is consistent with FSAR commitments and Regulatory Guide 1.68. If it does not conform to FSAR commitments the applicant must change the FSAR or bring the test program into conformance. Omissions, exceptions, or proposed simulations in the test program that do not conform to Regulatory Guide 1.68 should be justified or brought to the attention of NRR for evaluation and resolution with Reactor Licensing. For each identified test, the objectives, major test steps, necessary prerequisites, and acceptance criteria should be identified so that the intent of the specified testing is clearly understood. This information may be included in the FSAR and referenced in appropriate test program documents.
- c. ANSI N18.7; Regulatory Guide 1.68, Appendix C; and NUREG/CR-1369 provide guidance for the preparation of preoperational testing procedures. Section 14 of the FSAR should also describe the preparation of these procedures. Test program administrative procedures controlling preparation of test procedures should be consistent with this guidance and FSAR commitments.

03.02 Test Organization. Section 14 of the FSAR will normally specify the organizational requirements necessary to support the preoperational test program. Qualifications and resumes of key personnel may be included. The applicant's administrative documents should identify specific qualifications and responsibilities of key personnel in the test program. Qualification requirements may be specified by reference to FSAR commitments.

Where contractor/vendor personnel are participating in the test program, their responsibilities and qualifications should be specified. Interfaces and boundaries should be defined between the applicant's operations group, construction forces, A-E and vendor personnel, and the startup organization. Some facilities use the assistance of various outside organizations to support preoperational testing; these working relationships should be defined in administrative procedures.

### 03.03 Test Program Administration

- a. Methods for turnover control should include measures for partial as well as complete turnover of a system or component. Where the applicant's operations and test organizations are separate, jurisdictional control upon turnover should be specified. Contents of a "turnover package" should be specified.
- b. Criterion XIV of Appendix B to 10 CFR 50 requires the applicant to establish controls to indicate the status of tests performed and to identify items which have passed required tests. Administrative procedures should require the use of logs, marked-up drawings, and tags on systems or components to implement these controls.
- c2. Methods to ensure personnel are knowledgeable may include pre-test briefings and signoff sheets.
- c3. Minor changes, which do not affect intent of the test procedure or acceptance criteria, may be made "on the spot" by obtaining the approval of two members of the plant staff, at least one being a Shift Supervisor, subject to subsequent review by the original approving body. Minor changes, hence, will not require the interruption of testing and are used to resolve items such as typographical errors, minor changes to sequence of test steps, etc. Major changes will require interruption of testing and the acceptance by the original approval body before testing continues. The application should define major and minor changes in administrative documents.
- c4. Criteria for stopping a test should be provided. A test should not be allowed to continue until prerequisites have been reestablished and documented in test notes, data sheets, or logs.
- c6. Logs should be maintained and retained as part of each test. They should contain historical information relevant to the conduct of the test and document interruptions; equipment deficiencies should be identified; and prerequisites, valve lineups, etc., should be reestablished.
- d. Test schedules should exist that support the schedule given in the FSAR Chapter 14. Responsible individuals should be charged with maintaining and implementing the test program schedule.

#### 03.04 Document Control

- a1. Section 14 of the standard FSAR will normally describe the review, change, and approval procedures for test procedures. The implementing instructions must provide the specific review and approval requirements for test procedures and test results.
- a2. A procedure for issuance of revised procedures and disposal of obsolete procedures must be sufficient to ensure that all testing will be accomplished in accordance with the most recently approved revision of the procedure. If page changes to a procedure are issued, the applicant must have a cover sheet list of effective pages, etc., to enable the user of the procedure to account for the pages of the procedure.
- b3. Some mechanism must be provided to ensure that all affected test procedures are updated as necessary to reflect any design changes. There may be a requirement that the responsible test engineer check all referenced drawings or vendor manuals for the latest revisions before testing, or there may be a cross-reference file which lists all procedures that reference a particular drawing so that each affected procedure would be updated when drawing changes come in.



### 03.05 Design Changes and Modifications

- a. Design Change Control. Section 14 of the FSAR normally should describe the measures for incorporating any needed system modifications or procedure changes, based on the results of the tests (e.g., failure of equipment to meet performance specifications or finding that system operation differs from FSAR description). Section 2.2 of ANSI N45.2.11 and Section 4 of ANSI N45.2-1977 identify many of the actions that should be covered by the program procedures.
  - a1. After responsibility for components, systems, or structures has been turned over to the test group, a formal system is necessary to handle the design change and modification requests which will result from such things as: (1) unsatisfactory qualification or preoperational test results; (2) failure of structures, systems or components to meet functional requirements. Each change request should be documented in such a manner that the applicant can ensure himself that appropriate reviews will be conducted and approvals obtained before effecting the change. The applicant should have a formal system for reviewing all routine work requests to ensure that they do not involve an unreviewed design change.
  - a2. The applicant is responsible for constructing the plant as described in
  - a3. the FSAR and subsequently operating it in accordance with the technical specifications. Design changes and modifications must be reviewed to ensure that the plant is being built as described in the FSAR, that safety questions have been reviewed, and that the technical specifications reflect the as-built plant.
  - a4. Normally during preoperational testing the same design organization(s) responsible for construction will process design changes and modifications that are generated as a result of preoperational testing. For this case, design control measures should have been previously inspected and reinspection is not necessary.
  - a5. Preoperational test procedures are frequently written well in advance of actual testing and could be written before the actual turnover of equipment to the test group. It is essential that measures are established to ensure that design changes and modifications will be incorporated into the test program.
- b. Temporary Modifications, Jumpers, and Bypasses
  - b1. Control of temporary modifications, jumpers, and bypasses becomes important at the time formal preoperational testing (verification of conformance to design criteria) begins. Otherwise, the performance of components, structures, or systems cannot be ensured subsequent to testing.
  - b4. Installed jumpers should be easily identified when electrical equipment is inspected (e.g., made of long brightly colored strands of wire). Lifted leads should be uniquely tagged for ease of identification. ANSI 18.7-1976 (Section 5.2.b) provides additional guidance.
  - b5. Installation of temporary strainers or removal of check valve internals is not evident to a casual observer. Controls such as logs, physical tags, etc., may be necessary. ANSI 18.7-1976 (Section 5.2.6) provides additional guidance.
  - b6. Installation of electrical jumpers in crowded panels, the lifting of leads in congested areas, removal of check valve internals, etc., may warrant independent verification by a knowledgeable person to ensure that some safety function was not inadvertently negated through error. ANSI N18.7-1976 (Section 5.2.6) provides additional guidance.

- b7. The nature of a bypass mechanism may be such that a functional test of the system(s) will be required after installation or removal, to ensure that a function was not inadvertently negated.

03.06 Plant Maintenance/Preventive Maintenance During Preoperational Testing

- a. Plant Maintenance. The FSAR is normally silent on maintenance controls during preoperational testing; however, it is important that administrative controls be established for all plant maintenance. Maintenance performed during preoperational testing affects equipment reliability and performance during operations and therefore must be controlled. The guidance provided in ANSI N18.7 for establishing administrative control requirements for maintenance during plant operations is equally applicable to the preoperational testing phase.
- a1. Plant maintenance must be performed in accordance with defined administrative controls in order to ensure that a planned maintenance activity can be performed safely without invalidating preoperational testing that is in progress or that has been completed.
- a2. To initiate requests for maintenance the applicant may, for example, use some sort of consecutively numbered work request forms with snap-out carbon copies for distribution to designated recipients.

The methods for reviewing, approving, and scheduling maintenance should ensure that responsible plant supervision determines that:

- appropriate work procedures (technical manuals or locally prepared procedures) are available
  - appropriate inspection hold points have been identified
  - required testing of equipment subsequent to maintenance is specified
  - the maintenance is scheduled so as not to impact on the validity of preoperational testing
- a3. The inspector should look for controls that ensure that the quality of materials and spare parts issued to the maintenance personnel and used in performing safety-related maintenance activities will be at least equivalent to those specified in applicable codes, standards, design requirements, material specifications, etc., committed to in the FSAR as applicable during construction. Requirements for the handling, storage, and shipping of replacement parts are contained in 10 CFR 50, Appendix B, Criterion XIII.
- a4. Controls are required to ensure that workers performing special processes are qualified in accordance with applicable codes and standards. Personnel performing other maintenance on safety-related equipment should be trained or qualified according to the facility training program.
- a5. Nuclear safety is not of immediate concern for maintenance performed during preoperational testing; i.e., limiting conditions for operation do not apply and there is no requirement to demonstrate operability per technical specification requirements before returning equipment to service. One concern is that appropriate procedures (technical manuals or locally prepared procedures) are available to ensure that the performance of safety-related equipment will not be impaired by improper maintenance. Another concern is that when maintenance is

performed, subsequent to or during preoperational testing, test results could be invalidated unless retesting is performed. For certain critical or complicated maintenance, it might be appropriate for the plant safety committee to review the maintenance procedures.

Formal controls must be established to ensure that appropriate plant supervision determines the adequacy of detailed work procedures and the need for special work procedures. Guidance and responsibilities for preparation, review, and approval of maintenance procedures should be provided.

The inspector should look for provisions to ensure that a supervisory representative from the operations and the testing group, grant approval immediately before performing a plant maintenance activity so as not to jeopardize the validity of preoperational testing.

Provisions should be available to ensure that appropriate inspections by means of examination, observation, or measurement will be conducted of maintenance work in progress. Individuals other than those actually performing the work should perform the inspections. Hold points (beyond which work will not progress until appropriate inspections are performed) should be incorporated into inspection plans and maintenance procedures where applicable.

When maintenance is performed that could invalidate previously obtained preoperational test results, provisions should ensure that appropriate retesting will be conducted.

Procedures for controlling and performing the retest should be specified.

- b. Preventive Maintenance. Verify that measures have been established to ensure that preventive maintenance requirements and schedules will be developed and implemented on equipment transferred from the construction to the test or operations groups. These schedules and responsibilities should be developed at the time construction relinquishes responsibility for equipment. The schedules and requirements should be refined and changed as experience is gained with the equipment.

Equipment should be protected from extreme temperatures, dust, or moisture. The inspector should look for items such as use of motor heaters, requirements for periodic rotation of motors, lubrication schedules, recalibration of process instrumentation, etc. The duration of a preoperational test program may require extensive implementation of a facility's periodic maintenance and recalibration program well in advance of plant operation.

- c. Maintenance Records. Section 13.6 of the standard FSAR establishes record retention requirements. ANSI N45.2.9 provides guidance for records requirements and retention periods. Criterion XVII of Appendix B to 10 CFR 50 establishes requirements with regard to required records and record retention.

### 03.07 Equipment Protection and Cleanliness

- a. Regulatory Guide 1.39 endorses ANSI N45.2.3 as applicable during the preoperational test phase. Cleanliness zone requirements are provided by ANSI N45.2.3.

Regulatory Guide 1.38 endorses ANSI N45.2.2 as applicable during the preoperational test phase. Paragraph 2.7 defines the levels of cleanliness required. Paragraph 6 gives additional criteria for storage of equipment, and more

importantly, paragraph 6.5 makes all the storage requirements applicable to items which have been installed.

- b. Identification methods may include tagging, marked-up drawings, ribbons, etc. "Re-entry" controls for any activity that would open the boundaries of a cleaned system to foreign material should be defined.
- d. Water quality requirements for various conditions (temperatures) of preoperational testing should be specified. Makeup water, storage tank water, and process water quality should be specified.

Procedures for system layup should include water treatment, use of nitrogen blankets, recirculation requirements, and fill/drain requirements, where applicable.

Water chemistry controls may be applicable to carbon steel and stainless steel components.

#### 03.08 Test and Maintenance Equipment

- a. Control of Test and Measurement Equipment. Sections 17.1.12 and 17.2.12 of the Standard FSAR and Section 6.8.1 of the Standard Technical Specifications speak to measures appropriate for the control of test and measuring equipment. Section 5 of ANSI N18.7, Section 13 of ANSI N45.2, and Appendix A of Regulatory Guide 1.33 provide guidance appropriate for control of test and measurement equipment. Control of test and measurement equipment during preoperational testing should be consistent with the commitments and guidance contained in these documents.

It is not intended that special calibration and control measures are needed for rulers, tape measures, levels, and other similar-type devices where normal commercial practices provided adequate accuracy.

If test equipment or installed equipment that requires no calibration is in use, the licensee may identify it with a "No Calibration Required" sticker and establish appropriate administrative controls.

03.09 Training. Chapter 14 of the Standard FSAR describes the Test Program and should state the required training or indoctrination of those persons involved in the test program.

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