

NRC INSPECTION MANUAL

IIPB

INSPECTION PROCEDURE 50100

HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

PROGRAM APPLICABILITY: 2509

50100-01 INSPECTION OBJECTIVES

01.01 To determine whether quality assurance (QA) plans, instructions, and procedures for inspection of safety-related heating, ventilating, and air conditioning (HVAC) systems have been established in the facility QA Manual.

01.02 To determine whether the technical requirements detailed or referenced in the facility Safety Analysis Report (SAR) associated with safety-related HVAC systems have been adequately addressed in the construction specifications, drawings, and work procedures.

01.03 To determine through direct observation and independent evaluation of work, whether the installation of safety-related HVAC systems are in compliance with NRC requirements, licensee commitments, and applicable codes.

01.04 To review samples of safety-related HVAC system records to determine whether the licensee is adequately preparing, reviewing, and maintaining a system of quality records; whether the records reflect work accomplished consistent with NRC requirements and SAR commitments; and whether the records indicate any potentially generic problems, management control inadequacies, or other weaknesses that could have safety significance.

Inspection Schedule

<u>Inspection</u>	<u>May Be Started</u>	<u>Must Be Started</u>	<u>Must Be</u>
02.01, 02.02, 02.03	6 months before	Before start of work	Before work is 10% complete
02.04	After work	Before work	Before work is
02.05	During work	Before work	Prior to plant

50100-02 INSPECTION REQUIREMENTS

02.01 Review of Contractor QA Manual. For each onsite contractor with QA/QC responsibilities relating to HVAC systems, complete the inspection requirements of Inspection Procedure 35100. Also ensure that the contractor has established a program for ensuring that all craft, NDE, and inspection personnel associated with the installation of safety-related HVAC systems have been trained, or otherwise qualified to the work procedures involved.

02.02 Review of QA Implementing Procedures. Review the facility QA Manual and implementing procedures to determine whether:

- a. Adequate inspection procedures have been established for the HVAC activity, including scope and frequency of inspections, acceptance criteria, documentation and reporting requirements, followup actions, and resolution of findings by the appropriate organization.
- b. Provisions have been made to ensure that those engaged in conducting inspections are qualified and have been adequately trained in inspection techniques and in the design and construction aspects of the HVAC systems. Provisions must ensure that inspectors do not have direct responsibility for work in the areas being inspected.
- c. Means have been established to verify that the technical requirements, including material and component specifications (including traceability and marking requirements for bolts, nuts, and other fastener items), acceptance criteria and required documentation have been specified in and are subsequently extracted from the design and procurement documents and included in appropriate work and QC inspection procedures.
- d. Provisions have been made to ensure that electrical components installed in the HVAC systems have or will be properly qualified in accordance with IEEE-323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, or other appropriate requirements.
- e. Means have been established to verify that any significant design and field changes from approved drawings are adequately controlled and processed commensurate with the original design.
- f. Provisions have been established to ensure that quality requirements are met (including documentation that quality requirements of materials and components are met before installation or use). Particular attention should be given to assure that provisions exist for site functions accepting and releasing supplier-delivered items for installation or use to be informed of corporate office disposition of supplier technical documentation forwarded by the supplier (or the site) for engineering review and acceptance.
- g. Safety-related/nonsafety-related boundaries and equipment are clearly defined and delineated.

02.03 Review of Work Procedures

- a. Determine whether procedures and instructions (e.g., drawings, specifications, manufacturer's instructions, etc.) pertaining to the installation of HVAC ductwork, seismic supports, and other safety-related aspects of the installation are reviewed and approved by AE/licensee personnel.
- b. Verify that the approved procedures and instructions are appropriate and adequate for proper installation and inspection of the HVAC systems. In particular, verify whether these controls incorporate the following:
 - 1. Controls to ensure that the type and classification of seismic supports for the HVAC ductwork comply with approved drawings and/or specifications.
 - 2. Provisions for ensuring that required pre-installation and in-process inspections are performed at the appropriate time for HVAC safety-related equipment.
 - 3. Means to ensure that bolts, nuts, and washers (including lubricant if used) for supports are of the proper type, size, and material with required markings, are correctly installed, and, where required, bolt preloading (torquing), minimum bolt embedment, and thread engagement criteria are imposed.
 - 4. Provisions to ensure the proper location of equipment, dampers, filters, etc.

02.04 Observation of Work and Work Activities. By direct observation, interviews, and independent evaluation of work performance, work in progress, and completed work, determine whether activities relative to HVAC systems are being accomplished in accordance with NRC requirements, SAR commitments, and licensee procedures and specifications.

- a. Personnel Interviews (Installation Practices). Select appropriate personnel (three or four) engaged in the installation of seismic supports, ductwork, isolation dampers or additional HVAC equipment to confirm the following:
 - 1. Predefined and approved procedures are followed when it becomes necessary to relocate any seismic support or other safety-related equipment from its original location specified on drawings.
 - 2. Any pre-installation field repairs or adjustments to the HVAC equipment are performed in accordance with the manufacturer's instructions and specifications to ensure that proper materials, replacement parts, and supplies are used, and performance requirements are met and are reviewed by engineering for acceptance.
 - 3. Pre-installation checks are made to ensure that bolts, nuts, and other fastener items are available and are of the correct type, size and material with required identification markings.

4. Personnel engaged in the installation and inspection of supports, ductwork, and other HVAC equipment have received adequate training to understand and perform work contained in relevant work and inspection procedures and instructions.

b. Installation Activities

1. Witness portions of the installation activities of HVAC systems servicing two plant areas to verify the following:
 - (a) The latest issue (revision) of applicable drawings or procedures is available to the installers and is being used.
 - (b) Modifications to supports are approved by appropriate personnel before implementation.
2. Witness portions of the installation and testing (if required) of concrete anchor bolts to verify that anchor bolt type, diameter, embedment length, shoulder-to-cone measurement and torque requirements (where applicable) meet installation requirements.
3. Determine whether required inspection activities are in process and observe for adequacy. In particular, whether QC inspection of welder qualification procedures and welding of supports is conducted.

c. As-Installed Equipment. Observe the completed installation of the following equipment for proper location, configuration, identification, and damage. The basis for this determination shall be the SAR system description, piping and instrumentation diagrams (P&IDs), specifications, and installation drawings. Select a minimum of five items from the list below.

1. seismic support for ductwork (required)
2. ductwork (required)
3. isolation dampers
4. recirculation test loops around fans and isolation dampers
5. radiation, smoke, and toxic chemical monitor
6. pressure drop instrumentation across filter banks
7. instrumentation for the detection of excess ambient temperature
8. fresh air intake elevation from grade level
9. fans and motors
10. air handling units

11. exhaust vents

12. filters

02.05 Review of Records

- a. Review licensee/contractor documentation requirements covering work performed for HVAC systems. Determine the effectiveness of the document review systems by comparing records against requirements for accuracy and completeness. The following should be performed to determine this effectiveness.
 1. Review the documentation on two of the following Class 1E electrical components and verify environmental qualification per IEEE-323-1974 or other appropriate requirements.
 - (a) fan motor
 - (b) HVAC control panels
 - (c) electrical operators for isolation valves or dampers
 - (d) electrical cable
 2. Review the documentation on two of the following components and verify seismic qualification per IEEE-344-1975, Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, or other appropriate requirements.
 - (a) fans with motor assemblies
 - (b) service water cooling coils
 - (c) backdraft dampers
 - (d) isolation dampers and valves
 3. Review the documentation on two of the following mechanical components and verify conformance to the applicable positions of Regulatory Guide 1.52.
 - (a) HEPA filters (position 3.d)
 - (b) charcoal filter (position 3.i)
 - (c) joining compounds, dampers, and gaskets (position 2.e)
 4. Review a representative sample (three to five) of receipt inspection checklists to assure that inspections complied with the intent of the inspection procedures.
 5. Review inspection records and determine that required inspection of various aspects of the HVAC systems and supports were conducted.

6. Select one inspection of the HVAC systems and one of the related supports and assess adequacy of the inspection effort and the inspection record.
- b. Review approximately 10 nonconformance reports for items of HVAC systems to determine whether:
 1. The records are being properly identified, stored, and can be retrieved in a reasonable time.
 2. The records are legible, complete, and indicate that reports are promptly reviewed by qualified personnel for evaluation and disposition of the immediate problem as well as for generic implications and trending.
 3. The records adequately document current status of nonconformances or deviations and corrective action.
 4. Resolution of nonconformances demonstrates good engineering practice.
 - c. Review relevant portions of licensee and contractor audit reports concerning the installation of safety-related supports and HVAC systems. Review two to four reports to determine whether:
 1. The required audits have been performed in accordance with schedule and functional areas in established audit plans.
 2. Audit findings have been reported in sufficient detail to permit a meaningful assessment by those responsible for corrective action, final disposition, and trending.
 3. The licensee/contractor has taken proper and timely followup action on those matters in need of correction.

50100-03 INSPECTION GUIDANCE

General Guidance

- a. HVAC systems have many functions. Among them are the control of the spread of airborne radioactivity; removal of radioactivity, noxious and toxic gases; and control of ambient temperature and humidity. The latter function is becoming increasingly important with the expanding use in safety-related systems of "solid state" electrical equipment, which is particularly sensitive to temperature. LERs are on file which document significant calibration errors because of ambient temperature effects.
- b. The HVAC systems serving the following areas should be considered for inspection.
 - containment
 - control room
 - switchgear and battery room
 - access control area

HVAC equipment room
computer room
spent fuel pool area
spent fuel cooling pumps room
radwaste areas
auxiliary building
turbine building
service water pump house
diesel generator area
ECCS pump room
auxiliary feedwater pump room

Some portion of the HVAC systems (i.e., ducts, supports, filters, fans, valves, air handling units, etc.) should be inspected from a minimum of four areas shown above. Emphasis should be given to inspections occurring in the containment and control room. It is not the intent to require additional work, but rather to require that the work observation and record review inspections not be limited to just one or two HVAC systems. (For example, the document review under Section 02.05a.1 of an HVAC control panel could be done for panels located in the control room HVAC system while the review for another piece of equipment such as a fan motor could be done for fans located in the containment HVAC system.) The listing provides most of the areas in which safety-related HVAC systems may be located. However, it should be recognized that this listing is not all inclusive and that differences do exist between BWR and PWR plants and even between individual plants within a given plant type. The inspector should review Chapter 9.4 of the SAR for system description so that all areas having safety-related HVAC systems are considered for inspection. Also, whether equipment is located in hazardous or another environmental area will bear on the review of equipment qualification documentation.

- c. Description of the HVAC systems is contained in Section 9.4 of the SAR. Other portions of the SAR which contain useful information are Sections 3.2 (Safety Classification of Structures, Components and Systems), 3.9 (Seismic Qualification), and 17.1 (Quality Assurance). The inspector should then utilize these SAR sections during the review of the licensee's implementing construction specifications, drawings, work procedures, and QA implementing procedures. The NRC inspector also should review Regulatory Guide 1.52 "Design, Testing, and Maintenance Criteria for Engineered Safety Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," for in-depth technical details needed for the inspection.
- d. Because installation work on the HVAC systems is normally carried out over an extended period of time, a series of inspections may be needed to fully complete this procedure. Additionally, some licensee contracting arrangements may be such that several different contractors will be involved in the installation work. If this is the case, selected parts of this procedure may have to be repeated in order to adequately cover the total effort. Regional evaluations and appropriate adjustments to this procedure may be necessary to ensure inspection continuity during the extended period of time involved and to accommodate the various contracting arrangements encountered.

- e. Findings from this inspection activity should address each element as being satisfactory, being unresolved and requiring resolution, or being in violation and requiring correction. When significant inadequacies are identified in specifications or procedures indicating weaknesses within the preparing technical organization, the inspector should so inform cognizant regional supervision. The issue should be addressed at the appropriate level of licensee management.
- f. Particular attention should be given to the traceability of material and equipment to prevent the use of incorrect or defective materials, parts and components. The inspector should review 10 CFR 50, Appendix B, Criterion VIII, Identification and Control of Materials, Parts and Components and applicable codes and specifications. The inspector should verify that measures have been established by the licensee for identification and control of materials, parts and components, and for traceability to the approved design basis and to the source. The inspector should assure that required identification of the item is maintained by heat number, part number, serial number or other appropriate means, either on the item or on records traceable to the item, as required, and that required markings are on the item.

The inspector should note markings on material and equipment and verify that the markings represent material and equipment as specified by the design drawings and specifications. In the case of fasteners, compliance with the applicable material specification (e.g., ASTM or ASME material and grade) should be verified by required markings on bolts and nuts and certified material test reports or certificates of conformance as required by the applicable procurement drawings and specifications and/or by the applicable codes and specifications. In the case of vendor-supplied equipment assemblies containing fasteners, samples should be inspected to verify compliance with approved vendor drawings and specifications and other information such as materials used for equipment qualification tests and/or analyses. Caution should be exercised to ensure that the required markings on material and equipment, including fasteners, not only exist but that the markings indicate the correct material and grade as specified.

03.01 Specific Guidance

- a. Inspection Requirement 02.02.g. The inspector should determine specific steps the licensee has taken, or plans to take, to ensure that only qualified personnel are permitted to perform work associated with the installation of HVAC systems. This effort may tie in with the review of the licensee's audit plan specific to this area of work.
- b. Inspection Requirement 02.04a. Interviews must be performed expeditiously so as to minimize the worker's time away from jobs in progress. Only those licensee/contractor employees who can provide first-hand knowledge or experience in the area of interest, and appear willing to share the information, should be interviewed.
- c. Inspection Requirements 02.04b. and c. Various degrees of accessibility may require the erection of scaffolds or long ladders for the examination of some components. The IE inspector should use judgment in regard to this type of

assistance from the licensee or contractor. If possible, the IE inspector should schedule inspections so that existing scaffolds, etc., could be used.

The observation of welding activities should be accomplished and coordinated with other welding observations conducted under IP 55100.

- d. Inspection Requirement 02.04c. The intent is to determine whether components are being installed according to properly approved drawings— either the original design drawings or properly approved revisions; and, if revisions are in process, that these changes are properly handled in accordance with established procedures.

Appropriate standards can be used as a guide in this area. For example, ANSI N45.2.11 requires that where changes to previously verified design have been made, design verification shall be required for the changes, including evaluation of the effects of those changes on the overall design. Further, N45.2 states that records which correctly identify the as-built condition of items in the nuclear facility shall be maintained and stored for the life of the particular item while it is installed in the nuclear facility. Additionally, 10 CFR 50, Appendix B, Criterion III, states in part, that design and field changes shall be subject to the same design control procedures as the original design.

Numerous changes may be made to seismic supports during construction. Such changes will result in the accumulation of various types of design change documents and/or marked-up drawings. Since these changes reflect as-built conditions, they should be adequately controlled so that they will be readily available for use with affected original design documents during future evaluation on the effect other design changes have on the overall design. Additionally, the as-built process should result in proper and timely updating of the original/master drawings and specifications to incorporate such changes.

The importance of accurate as-built drawings and their use in confirming that safety-related systems have been properly installed cannot be overemphasized. One other NRC inspection procedure is relevant to as-built drawings; that is, "Verification of As-Builts," IP 37051, which requires a review of plant as-built drawings one year before OL issuance.

- e. Inspection Requirement 02.05c. The inspectors should bear in mind that the NRC's inspection sample covers only a very small portion of the records involved. Thus, substantive errors or departure from requirements identified in NRC's sample, raise the issue of whether the licensee is adequately controlling the process. In this connection, particular attention should be given to reviewing the adequacy of those records dealing with the QA audits. Problems noted in this area should be viewed as prime indicators of the licensee's involvement in the work and the effectiveness with which the licensee maintains control over the work in progress.
- f. Inspection Requirement 02.05. When reviewing the environmental qualification of various safety-related components, be sure that the environmental conditions (i.e., temperature, pressure, radiation, chemical sprays, duration, and operational

requirements) that the component was exposed to during testing encompasses the environmental conditions specified for that particular location in plant for both normal and accident conditions.

Note that a certificate of conformance by itself is not sufficient unless it is accompanied by test data and information on the qualification program.

03.02 Prevalent Errors and Concerns. This section is included to provide background on past problems of a generic nature that have been identified and certain areas that should be more closely scrutinized to give NRC early information on potential problems.

- a. Personnel qualification records, including indoctrination, training, examinations, and certifications either not being maintained, invalid, or nonexistent for some employees.
- b. Field design work (redesign, modifications) not being processed through appropriate review and approval route.
- c. Nonconformance reports not being processed fully in accordance with established procedures.
- d. Personnel assigned to licensee audit function not appropriately trained in the assigned audit areas nor independent from areas audited.
- e. Material and equipment traceability not adequate to prevent the use of incorrect items. Markings on material and equipment should represent that specified by the design drawings and specifications.
- f. Licensees and contractors conduct some audits on schedule but may postpone or omit others entirely. Although audits are carried out to some extent and may be adequately performed, in many instances the audit findings and recommendations are ignored or are filed without appropriate consideration or followup action.
- g. Refer to IE Information Notice No. 82-43. "Deficiencies in LWR Air Filtration/Ventilation Systems," for a history of deficiencies in air filtration systems.
- h. Additional deficiencies relative to control room habitability were published as report WASH-1234. Similar reviews and observations of deficiencies were subsequently reported by the Electric Power Research Institute (see EPRI Report NP-309, March 1977, entitled, "Human Factors Review of Nuclear Power Plant Control Room Design"). Examples of the problems noted include excessive leakage in air ducts, nonfunctioning and/or leaky air regulating dampers, inadequate access and lighting for system testing, improper in-flow distribution, inoperable equipment for monitoring system performance, and access doors without proper seals and locks.

50100-04 REFERENCES

10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants"

10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants"

Facility SAR

END