
INSPECTION PROCEDURE 88200 APPENDIX E

INSPECTION OF PIPING SUPPORTS AND RESTRAINTS AT FUEL CYCLE FACILITIES

Effective Date: May 28, 2025

88200.E-01 INSPECTION OBJECTIVES

- 01.01 To determine if safety-significant piping supports and restraints work is being performed in accordance with regulatory requirements, the licensing basis, specifications, drawings, and work procedures.
- 01.02 To determine if the applicant/licensee's system for preparing, reviewing, and maintaining records relative to safety-significant piping supports and restraints activities reflects work accomplishment consistent with specifications and procedures.
- 01.03 To determine if the as-built condition of safety-significant piping supports and restraints meets the specified design requirements, specifications, and drawings. For installation of safety-significant piping, refer to Appendix D of this inspection procedure (IP).
- 01.04 To determine if the implementation of the management measures related to work activities for safety-significant piping supports and restraints associated with items relied-on for safety (IROFS) is effective and to verify that deviations from requirements are appropriately resolved.

88200.E-02 INSPECTION REQUIREMENTS

- 02.01 For the safety-significant items and services (SSIS) selected for inspection of piping supports and restraints, determine whether procedures exist in the following areas, are compatible with the management measures program for IROFS, and prescribe adequate methods to meet the licensing basis and construction specifications, where applicable:
 - a. pre-installation activities
 - b. installation activities
 - c. dynamic pipe supports
 - d. rigid, constant, and variable-type supports
 - e. component supports
 - f. configuration management
- 02.02 Determine whether the applicant/licensee has an established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements, as applicable in their licensing basis, in the area of safety-significant piping supports and restraints construction activities, and for ensuring that examination, inspection, and if required, test personnel associated with performing tests and inspections of safety-significant activities are qualified and/or certified to perform their assigned work.

02.03 Ascertain whether the following safety-significant piping supports and restraints activities, as required by licensing commitments and applicable construction codes, are being controlled and accomplished in accordance with documents reviewed in Inspection Requirement 02.01, above:

- a. as-built activities
- b. pre-installation activities
- c. installation activities
- d. dynamic pipe supports
- e. rigid, constant, and variable-type supports
- f. component supports
- g. configuration management

02.04 Review the documentation generated for the safety-significant piping supports and restraints construction activities, as required by the licensing basis. Determine whether the applicant/licensee/contractor system for documenting safety-significant work is functioning in accordance with requirements. Records should be complete, reviewed by quality control, engineering personnel, or designee, as required, and readily retrievable.

- a. receipt inspection and material certification
- b. installation inspection
- c. nonconformance/deviation record(s)
- d. training/qualification records of craft, and quality inspection personnel (as required)
- e. configuration management records

88200.E-03 INSPECTION GUIDANCE

General Guidance

Inspectors should review the facility description in the integrated safety analysis, integrated safety analysis summary, or equivalent and be familiar with the SSIS being constructed at the site. The purpose of these as-built inspections is to verify that the assumptions and critical attributes reviewed during the licensing review process remain valid; the design was appropriately translated to construction specifications; the licensee/applicant constructed the facility in accordance with these specifications; and any modifications performed comply with the licensee's configuration management program and do not impact any NRC licensing decisions.

Inspectors should also be familiar with the licensee's management measures and/or quality assurance program, if applicable, and the licensing basis associated with these measures. It is not the objective of this IP to verify the adequacy of the applicant/licensee's management measures program, but inspectors should be prepared to identify potential gaps in the implementation of management measures for future inspections. Inspectors should complete this appendix by inspecting the attributes listed in this appendix for as-built piping supports and restraints work with a focus on SSIS, such as IROFS, or regulatory requirements, as applicable. Inspectors should also coordinate this appendix with inspection of piping (Appendix D of this IP) for efficiency.

Inspectors should contact the applicant/licensee prior to the onsite inspection to help determine what samples are to be inspected. Observation during in-progress activities, like construction, installation, and testing, is desirable but not required. If necessary, inspectors may select

completed systems for inspection. Inspectors should not attempt to inspect all available samples but may expand if significant concerns with the applicant/licensee's control of installation/construction arise in this functional area.

Inspectors should collect applicant/licensee procedures, specifications, and work completion records in advance. If unable to review these documents in advance of the onsite inspection, then the licensee should be notified that these documents, and any other relevant documents, should be available when the inspector(s) arrives at the site.

Inspectors should choose one or more safety-significant piping supports and restraints and review the areas listed in Inspection Requirements 02.01 through 02.04 to the extent practical and may use their judgment in determining which areas to concentrate on if time is limited.

Definitions:

Pipe supports include pipe hangers, restraints, supports, shock and sway suppressors, etc. that directly support the pipe. Pipe whip restraints, such as structural steel or concrete barriers that do not normally contact the pipe, are not covered by this procedure.

- a. Dynamic Pipe Supports. A pipe support assembly or restraint, with a hydraulic or mechanical control unit-designed to prevent unrestrained pipe motion during an earthquake or vibratory pipe movements brought on by the actuation of a water hammer, steam hammer, pump/start/stop, or safety and relief valve. Thermal expansion of piping is not restrained by dynamic supports (snubbers, shock suppressors, etc.).
- b. Rigid, Constant, and Variable-Type Supports. Pipe support assemblies used for mounting pipes without hydraulic or mechanical control units (hangers, base supports, saddle supports, spring hangers, sliding and rolling supports, etc.).
- c. Component Supports. Metal elements that transmit loads between plant components and the building structure whose function includes carrying the weight of components or providing them with structural stability.
- d. Component Standard Supports. Pipe support assemblies consisting of one or more units usually referred to as catalog items and generally mass-produced (anchors, guides, restraints, rolling or sliding supports, spring hangers, snubbers, sway braces, vibration dampeners, clamps, etc.).

03.01 Inspection Requirement 02.01

- a. Review construction specifications related to safety-significant piping supports and restraints and ascertain whether the specified technical requirements conform to the commitments contained in the licensing basis.
- b. Review piping supports and restraints procedures and as applicable, verify they specify provisions for adequate onsite engineering direction, are appropriate and adequate related to procurement and use of materials, specify adequate control of hold points, and provide adequate controls for design changes and incorporation of design changes into as-built drawings.

- c. Determine if appropriate and adequate procedures in the following areas are compatible with the management measures program, and prescribe adequate methods to meet the construction specifications, where applicable:
 - 1. pre-installation activities
 - 2. installation activities
 - 3. dynamic pipe supports
 - 4. rigid, constant, and variable-type supports
 - 5. component supports
 - 6. configuration management
- d. For the procedure review, consider the following attributes:
 - 1. Controls to ensure that the type and classification of pipe supports and restraints comply with approved drawings and/or specifications and meet licensee commitments.
 - 2. Instruction and precautions to ensure that welding, cutting, forming, heat treating, and machining are performed in a manner that will prevent the impact properties of the material from being degraded below specified values.
 - 3. Means to ensure that bolts, nuts, and washers (including lubricant, if used) are of the proper type, size, and material, with required identification markings; are correctly installed; and, where required, bolt pre-loading (torquing), minimum bolt embedment, and thread engagement criteria are imposed.
 - 4. For IROFS, determine if procedures are compatible with the management measures program, and prescribe adequate methods to meet the construction specifications.

03.02 Inspection Requirement 02.02

- a. Review applicant/licensee's established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements in their licensing basis, as applicable, in the area of safety-significant piping supports and restraints construction activities.
- b. Review audit program to verify if examinations and inspections are performed in accordance with applicant/licensee's requirements and if test personnel associated with performing tests and inspections of safety-significant piping supports and restraints construction activities are qualified and/or certified to perform their assigned work.
- c. Verify records establish that required audits, as applicable, were performed and that deficiencies identified during audits were tracked and corrected.

03.03 Inspection Requirement 02.03

Ascertain whether the following activities, as required by licensing commitments and applicable construction codes, are being controlled and accomplished in accordance with the requirements of the documents reviewed in 02.01, above:

a. As-Built Activities

1. By direct observation, interviews, or independent evaluation of work performance, works in progress, and/or completed work, determine whether activities regarding pipe support and restraint systems are being accomplished, in accordance with NRC requirements, the licensing basis, and licensee procedures. The intent is to determine whether pipe supports and restraints are being installed according to properly approved drawings, either the original design drawings or properly approved revisions.
2. Obtain as-built/final design-pipe support structural drawings and compare several selected supports with the actual installation. Determine pipe-anchor locations on the as-built drawings. These anchor locations are designed to restrict individual pipe movement in all directions. Visually examine these anchors and compare them with the drawings, to ensure agreement as to their location and function.
3. Discrepancies observed may result from in-process changes, such as those initiated in the field. If in process changes are involved, determine whether the licensee has properly controlled and documented these changes on a current basis for engineering review, approval, and subsequent incorporation into final as-built drawings.
4. If design revisions are in process, these changes should be properly handled in accordance with established procedures. Appropriate standards can be used as a guide in this area. In general, where changes to previously verified designs have been made, design verification is typically required for the changes, including evaluation of the effects of those changes on the overall design.
5. Changes may be made to these supports and restraints, during construction, that are different from the original design. 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 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 incorporate such changes.
6. The inspectors 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.
7. The inspectors 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 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.

8. Most of the welding, cutting, and forming operations covered by this procedure pertain to component-support structures, support members, and brackets, and do not require preheat treatment or post weld heat treatment. However, those pipe supports, support flanges, or support brackets that are directly welded to safety-significant piping may be subject to preheat and/or post-heat treatment. Applicable heat treatment procedures are necessary for this type of installation. Records of heat treatment (time, temperature) should be generated and reviewed for building code compliance.

b. Pre-installation Activities.

1. Pre-installation checks are made to ensure hydraulic units are not installed if there is evidence of excessive leakage of hydraulic fluid (possible damage or deterioration of seals), physical damage, or corrosion of polished sliding surfaces. (Not required if hydraulic snubbers are not used.)
2. Pre-installation check on variable-type supports is performed for obvious damage, rust, or other conditions that may interfere with their proper operation.
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. Any pre-installation field repairs or adjustments to the units are performed in accordance with the manufacturers' instructions and specifications, to ensure that performance requirements are met.
5. Installation equipment such as torque wrenches and other testing and measuring devices are properly controlled, calibrated, and adjusted at specified periods.
6. Personnel engaged in the installation of pipe supports and restraints have received adequate training to perform special processes contained in relevant work performance and IPs.

c. Installation Activities.

1. If installation activities are on-going at the time of the inspection, observe portions of the installation activities to verify the following:
 - (a) The latest issue (revision) of applicable drawings or procedures is available to the installers.
 - (b) Appropriate personnel approve significant modifications to supports, before implementation.
 - (c) The use of jacks or rigging to pull piping into position for hanger installation or welding does not exceed cold-spring allowances for that particular material, size, and length of pipe run.
 - (d) Clearances existing between the pipe and restraints are as specified.

2. If installation activities are on-going at the time of the inspection, observe portions of the installation and testing of concrete anchor bolts for component-support elements to verify that anchor-bolt type, diameter, embedment length, shoulder-to-cone measurements, and torque requirements meet installation requirements.
- d. Dynamic Pipe Supports. Inspect installed restraints (if possible, select different load classifications and at various degrees of accessibility) and determine, by visual examination, whether the following conditions meet applicable requirements:
1. Components are free from corrosion or other signs of deterioration.
 2. Support plates, extension rods, and connecting joints are not bent, deformed, loose, or otherwise out of specification.
 3. Bolts, nuts, washers, locking devices, and other fasteners are tight and secure and are of the correct type, size, and material, with required identification markings. Where required, bolt-tension specification requirements have been met through the use of properly calibrated bolt-torquing wrenches and torque multipliers.
 4. Bleed holes are open and free from foreign material.
 5. Lubricants and sealants are applied as specified and there does not appear to be excessive leakage.
 6. Seals are not deteriorated (if visually observable without dismantling).
 7. Connecting joints, moving parts, piston shafts, seals, etc., are free from foreign material such as concrete, dropped paint, excessive dust and dirt, or other material that may obstruct proper operation.
- e. Rigid, Constant, and Variable-Type Supports.
1. Inspect installed spring-hanger assemblies covering different load ratings and observe the following:
 - (a) Hanger rods for supporting (2 inch) pipe are not less than (3/8 inch) diameter, and for (2 1/2 inch) pipe or larger, not less than (1/2 inch) diameter, or as required by construction code.
 - (b) Spring hangers are provided with indicators to show the approximate "hot" or "cold" position, as appropriate.
 - (c) Spring hangers enclosed in spaces that will be subjected to high ambient temperatures during facility operation have suitable service ratings to accommodate the expected operating-temperature range.
 2. Inspect installed pipe supports of different sizes (load rating) and at various degrees of accessibility. Determine, by visual examination, whether the following conditions exist:
 - (a) No deformation or forced bending is evident.
 - (b) No deterioration or corrosion is evident.

- (c) Where pipe clamps are used to support vertical lines, shear lugs are welded to the pipe (if required by installation drawings) to prevent slippage.
 - (d) Movements of pipe from vibration, thermal expansion, etc., will most likely not cause contact with other pipes, supports, equipment, nor components. (As best as can be determined after installation, but before initial operation.)
 - (e) Sliding or rolling supports are provided with material and/or lubricants suitable for the environment and compatible, sliding-contact surfaces.
- 3. Inspect small bore or instrumentation lines that have been designed by a simplified seismic criterion. Determine, by visual examination, whether the following conditions meet applicable requirements:
 - (a) The functional restraint direction is proper and in accordance with the design drawings.
 - (b) The gaps between the piping and support appear adequate to allow thermal axial expansion.
 - (c) The gaps between the piping and support are not excessive for dynamic loads.
- f. Component Supports. Inspect installed component supports, including, if possible, multiple pipe supports, and ascertain, by visual examination, whether the following conditions exist:
 - 1. Component-support elements are located and installed as specified on the drawings.
 - 2. The surfaces of welds meet applicable code requirements. Check weld surfaces for grooves, abrupt ridges, valleys, undercuts, cracks, discontinuities, or other detrimental indications that appear to exceed code limitations.
 - 3. Materials used in the construction of the component supports have been certified by reviewing material test reports or a certificate of compliance.
 - 4. Where special bolting materials are specified, check for compliance with specifications including preload (torquing) requirements.
 - 5. Support clearances are as specified.
- g. Configuration Management. For the activities observed during Inspection Requirement 02.03., verify if changes occurred during these construction activities, the applicant/licensee properly controlled and documented these changes for engineering review, approval, and subsequent incorporation into the final as-built drawings, as applicable. Verify these actions were completed in accordance with their procedures and management measures.

03.04 Inspection Requirement 02.04

Ascertain whether for the safety-significant piping supports and restraints construction activities, the applicant/licensee/contractor system for documenting safety-significant work is functioning in accordance with requirements.

- a. Receipt Inspection and Material Certification. Select records applicable to the receipt of lots or shipments. Select records applicable to the storage, and storage inspection of lots or groups of piping supports and restraints and associated items.
1. Records confirm that required material characteristics, performance tests, nondestructive tests, environmental qualification tests, and other specification requirements are met.
 2. Receipt inspection and storage records indicate that, where appropriate, defective or incorrect components, parts, and materials are controlled and prevented from installation and possible use.
 3. Documentation has been prepared and maintained as required by receipt inspection and documentation storage instructions.
- b. Installation Inspection.
1. Records confirm that specified materials and components were installed as specified and that the required construction inspections were performed, and acceptance criteria are defined.
 2. Review licensee and contractor requirements covering the span of records for piping supports and restraints. Determine the initiation point for those records sampled and, importantly, the effectiveness of those responsible for reviewing the records for accuracy and completeness and ensuring that the recorded information meets documentation requirements. To determine the effectiveness of the licensee or contractor system for documenting work in this area, verify that:
 - (a) Type and classification of pipe support or restraint comply with appropriate drawings and specifications.
 - (b) Location, spacing, and critical clearances meet licensee's specifications and have been verified by construction quality control inspections.
 - (c) The required scope of licensee construction quality control inspections was met.
 - (d) Weld identification/location corresponds to respective weld card, drawing, work order, or other welding documentation.
 - (e) Welding material used corresponds to the material specified.
 - (f) Welders were qualified to the welding procedures used and welding procedures were qualified in accordance with licensing basis and building code requirements.
 - (g) The records confirm that for welding activities where attachments are welded directly to piping, the welding specifications used are the same or equivalent to the ones used for pipe welding, including preheat, post weld heat treatment, and nondestructive examinations.
 3. Review and evaluate pertinent quality records in a sampling of the areas listed below. Determine whether:

- (a) Adequate preparation, control, review, and evaluation of these records have been made.
 - (b) Records reflect that appropriate requirements have been met.
 - (c) The system of records is functioning properly.
- c. Nonconformance/Deviation Record(s).
 - 1. Records include current status of these items. Nonconformance reports include the status of corrective action or resolution, (e.g., determine whether adequate corrective action is being taken when test results are not within tolerance or acceptance criteria.)
 - 2. For the inspection, review and evaluate a sampling of reports applicable to nonconformances or deviations. Determine whether:
 - (a) Records are complete and promptly reviewed by qualified personnel.
 - (b) Records have been routinely processed, evaluated in a timely manner and controlled through established channels, for resolution of the root-cause as well as the immediate problem.
 - (c) Records are properly identified and stored, indicate current status, and can be retrieved in a reasonable time.
 - (d) Nonconformance reports include the status of corrective action or resolution, and adequate justification is provided for use-as-is disposition.
- d. Training/Qualification Records of Craft, and Quality Inspection Personnel. Records establish that quality inspection personnel, as applicable, are adequately qualified for their assigned duties and responsibilities and that craft personnel have been trained in their assigned tasks. Records are complete and current and show which activities inspectors are qualified to perform.
- e. Configuration Management Records. Review and evaluate a selected sample of configuration management records, and determine whether:
 - 1. Records associated with design and field changes, as well as related work and IP changes, reflect that timely review and evaluation of design and field change documents have been performed by personnel who are qualified.
 - 2. Records of periodic inspections ensure that only the most recent approved documents, including design changes, were used in the field.
 - 3. Design changes are subject to adequate design control, including consideration of the impact of the change on the overall design and on as-built records.
 - 4. Records of nonconformances to design requirements include preparation of a nonconformance report even if the nonconformance is resolved through the design-change process.

03.05 Additional Guidance

Note: Personnel Interviews. Informal interviews with field-craft and inspection personnel may be randomly conducted to determine how well employees know the requirements of their work activity. Ascertain whether a sufficient number of adequately qualified quality control inspection personnel, if required, are at the construction site, commensurate with the work in progress, and adequately performing their assigned duties through the established organizational structure.

- a. Prevalent Errors and Concerns. Areas in which the inspector should be alert to potential generic issues. This section is included to provide background for inspectors on past piping supports and restraints issues related to construction experience at previous projects. (Note - These are not listed in order of their perceived importance to safety.) These areas include:
1. Welders not properly qualified to applicable code, and records not properly maintained.
 2. Personnel qualification records, including indoctrination, training, examinations, and certifications, either not being maintained, invalid, or nonexistent for some employees.
 3. Field-design work (redesign, modifications) not being processed through appropriate review and approval route.
 4. Nonconformance reports not being processed fully in accordance with established procedures.
 5. Personnel assigned to licensee audit function not appropriately trained in the assigned audit areas nor independent from areas audited.
 6. 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 follow-up action.

88200.E-04 RESOURCE ESTIMATE

This appendix is intended to provide inspection requirements and guidance applicable to a wide variety of potential construction projects at both existing and new fuel cycle facilities (FCFs). These projects may vary greatly in scope, complexity, and potential risk to public health and safety. Recommended inspection scope and hours for a specific new FCF will be documented in the principal inspection plan (PIP) for that facility developed in accordance with Inspection Manual Chapter (IMC) 2694, "Fuel Cycle Facility Construction and Pre-Operational Readiness Review Inspection Program."

Additionally, this IP can be used to provide additional inspection guidance for plant modification inspections at existing facilities but is not required to be implemented for these projects. Use of this appendix, or sections of this appendix, for modifications at existing FCFs, would be done on a case-by-case basis, in accordance with IMC 2600, Appendix B, "NRC Core Inspection Requirements."

88200.E-05 PROCEDURE COMPLETION

This IP is complete when the applicable appendices or applicable appendix sections are completed for the facility, as determined by the PIP. Inspectors are not expected to complete every activity in the appendices of this IP. Instead, inspectors should prioritize inspection activities based on 1) importance of the activity to safety, 2) availability of the onsite activity at the time of the inspection, and 3) available inspection resources. This appendix does not need to be completed if there are no SSIS covered by this appendix at a FCF.

88200.E-06 REFERENCES

Refer to licensing basis requirements for applicable codes and standards for each fuel facility.

Inspection and Enforcement (IE) Bulletin 73-04 (and revision), "Defective Bergen-Paterson Hydraulic Shock Absorbers"

IE Bulletin 75-05, "Operability of Hydraulic Shock and Sway Suppressors"

IE Bulletin 78-10, "Bergen-Patterson Hydraulic Shock Suppressors Accumulator Spring Coils"

IE Bulletin 79-02 (and revisions), "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts"

IE Bulletin 79-07, "Seismic Stress Analysis of Safety-Related Piping"

IE Bulletin 79-14 (and revisions), "Seismic Analysis for As-Built Safety-Related Piping Systems"

IE Bulletin 81-01 (and revision), "Surveillance of Mechanical Snubbers"

IE Circular 76-05, "Hydraulic Shock and Sway Suppressors"

IE Circular 76-07, "Damaged Components of Bergen-Paterson Hydraulic Test Stand"

IE Circular 79-25 (and supplement), "Shock Arrestor Strut Assembly"

IE Circular 81-05, "Self-Aligning Rod End Bushing for Pipe Supports"

IE Information Notice 79-01, "Bergen-Paterson Hydraulic Shock and Sway Arrestors Reported Failures"

IE Bulletin 73-03 (and revision), "Defective Hydraulic Shock Suppressors and Restraints"

The following references describe problems at nuclear power facilities and are for background information only:

IE Information Notice 79-10, "Nonconforming Pipe Support Struts"

IE Information Notice 79-28, "Overloading of Structural Elements Due to Pipe Support Loads"

IE Information Notice 82-12, "Surveillance of Hydraulic Snubbers"

END

List of Attachments:

Attachment 1: Revision History Table

Attachment 1: Revision History for IP 88200 Appendix E

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional Non-Public Information)
	ML24215A336 05/28/25 CN 25-014	Initial issuance. Discipline specific appendix developed to provide technical inspection guidance for new construction and major modifications activities for fuel facilities with varying technologies, size, licensing requirements, etc.	N/A	N/A