INSPECTION TECHNICAL PROCEDURE

I-114

STRUCTURAL STEEL INSPECTION

May 13, 2002
Revision 0

Reviewed by: _____ Date: _____
Verification and Confirmation Official

Approved by: _____ Date: _____

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1.0 PURPOSE

The purpose of this procedure is to assess the Contractor's activities in constructing steel structures. Important-to-safety steel structures are designed to withstand the forces of normal and abnormal operations and anticipated transients. To ensure the performance objectives are met, the Contractor has committed to construct the important-to-safety steel structures according to committed standards referenced in the programs and related documents incorporating the Contractor's construction plans. These documents include the Safety Requirements Document (SRD), the Quality Assurance Manual (QAM), and the Integrated Safety Management Plan (ISMP). The Contractor translates the design into drawings and construction specifications describing the details of structural steel construction and verification.

This inspection procedure assesses the adequacy and effectiveness of the following:

- Procedures implementing steel construction
- Activities applied to steel construction
- The training and qualification of personnel implementing the program and procedures
- Records system demonstrating the management and accomplishment of the required steel construction activities.

2.0 OBJECTIVES

This procedure verifies the Contractor has developed and implemented effective programs for (1) implementing commitments for constructing steel structures; (2) managing and providing oversight to ensure that construction of steel structures and related quality control (QC) have been adequately addressed by specifications, drawings, and procedures; (3) managing and providing oversight to ensure the as-constructed condition of steel structures is according to the design; and (4) recording important-to-safety steel construction activities.

This inspection procedure is one component of a complete construction inspection program. This inspection procedure and others will be used, as needed, to ensure that construction activities are being conducted as required by authorization basis commitments and Contractor procedures. During the construction phase, a significant portion of this inspection procedure is expected to be accomplished at least once for the Contractor and each major subcontractor involved with the activities addressed by this procedure. However, the entire procedure is not expected to be completed during any one inspection or every time the inspection procedure is used.

3.0 INSPECTION REQUIREMENTS

3.1 Adequacy and Effectiveness of Construction Implementing Procedures

3.1.1 The inspector should verify the Contractor and any subcontractors with construction responsibilities in the area of important-to-safety steel structures have approved procedures describing administrative controls and work processes implementing the design requirements. (QAM, Policy Q-05, Sections 3.1.1 and 3.3; ISMP, Table 1-3, item 5; and SRD, Safety Criterion (SC) 4.1-2 and 7.3-5)

3.1.2 The inspector should verify procedures prescribe adequate methods of QC inspection to ensure the as-built condition of steel structures meets specified engineering requirements and drawings. As part of the assessment of the QC inspection procedures, ensure the procedures include or reference appropriate quantitative or qualitative acceptance criteria for determining the prescribed activities have been accomplished satisfactorily. (QAM, Section 3.3.2, Policy Q-05.1, Section 3.5.1; ISMP, Table 1-3, items 5 and 8; and SRD SC 4.1-2 and 7.3-7)

3.1.3 The inspector should verify procedures require equipment used for process monitoring or data collection to be calibrated and maintained. Note: Calibration and control measures are not applicable for rulers, tape measures, levels, and other such coarse measurement devices that provide adequate accuracy as received from the manufacturer. (QAM, Policy Q-12.1, Sections 3.1.2 and 3.2; ISMP, Table 1-3, items 5 and 8; and SRD, SC 7.3-5 and 7.3-7)

3.1.4 The inspector should verify the Contractor has established procedures for ensuring craft and QC inspection personnel performing important-to-safety structural steel installation and testing activities are qualified to perform their assigned work. (QAM, Policy Q-02.2, Section 3.3.2; and ISMP, Table 1-3, item 2)

3.2 Adequacy and Effectiveness of Construction Activities

The inspector should verify structural steel construction work is being accomplished under controlled conditions using approved instructions, procedures, and checklists prepared at a level of detail based on the importance and complexity of the work process being performed. (QAM, Policy Q-05.1, Section 3.1.1; SRD, SC 7.3-5; and ISMP, Table 1-3, item 5)

3.3 Adequacy and Effectiveness of the Training and Qualification of Personnel

The inspector should verify craft and QC personnel involved in performing structural steel construction and inspection activities are qualified to perform their job functions. (QAM, Policy Q-02.2, Sections 3.2.2, 3.3.1, and 3.3.3; and SRD, SC 7.3-3)

3.4 Adequacy and Effectiveness of the Records System

The inspector should verify the records of as-built structural steel installation and testing are as specified, reviewed by the Contractor for accuracy and assurance that the recorded information meets project requirements, approved, and stored and maintained sufficient to support technical and contractual requirements. (QAM, Policy Q-17.1, Sections 3.1.2, 3.3.1 and 3.6.1; SRD, SC 4.0-3, 4.1-2, and 7.3-4; and ISMP, Section 8 and Table 1-3, item 4)

4.0 INSPECTION GUIDANCE

For each inspection element, the inspector should (1) obtain a copy of the Contractor's procedures and the related industry codes and standards the Contractor committed to, (2) become familiar with the contents of the procedures and standards, and (3) assess whether the procedures and implementation of the procedures adequately conform to the applicable commitments. The SRD, SC 4.1-2, refers to American Nuclear Society (ANS)/American Institute for Steel Construction (AISC) Standard N690-94, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities."

Suggested sample selections are included in the section below. Follow the suggestions or choose samples more appropriate for the inspection because of construction progress, completion of Contractor's QA/QC reviews, or inspector experience. Use judgment in determining sample selection, focusing on examining the most important aspects of the particular activity being inspected. The intent is to establish a high level of assurance that the end product meets requirements.

4.1 Adequacy and Effectiveness of Construction Implementing Procedures

4.1.1 The inspector should review the implementing procedures for important-to-safety structural steel construction. Verify the procedures have been approved and specify the work processes and management controls for the major construction activities, which are listed in Sections 4.1.1.1 through 4.1.1.9 below. Ensure the procedures adequately address each major construction activity and the requirements of ANS/AISC Standard N690-94.

4.1.1.1 The inspector should select a sample of procurement documents (specifications and drawings) that address at least five different types of important-to-safety steel structures and/or components. Verify these documents specify the following:

- The shape, size, dimension, and type and grade of material conforms to one of the approved specifications, e.g., American Society for Testing and Materials [ASTM] Standards A6 and A36. (ANS/AISC Standard N690-94, Section Q1.4.1)

- The certified mill test reports or certified report of tests made by the fabricator or qualified testing laboratory is provided. (ANS/AISC Standard N690-94, Section Q1.4.1)

4.1.1.2 The inspector should ensure the construction procedures/specifications for important-to-safety steel structures and/or the procurement documents reviewed for Section 4.1.1.1 above require the following:

- Access is controlled to the storage area to maintain the quality of the materials received
- An adequate marking system is used to maintain the identity of material in storage
- Material is protected from the environment and weather, as appropriate. Structural steel should be protected from corrosion
- Nonconforming material is segregated.

4.1.1.3 The inspector should ensure the construction procedures/specifications for important-to-safety steel structures require the following:

- Fit-up tolerances for length, depth, and straightness of structural members and bolt holes are specified. (ANS/AISC Standard N690-94, Section Q1.23.11)
- Limits for contact bearing for column compression joints are provided. (ANS/AISC Standard N690-94, Section Q1.25.4)
- Base plate elevation and degree of levelness are provided. (ANS/AISC Standard N690-94, Section Q1.25.5)

4.1.1.4 The inspector should ensure the construction procedures/specifications for important-to-safety steel structures require the following:

- Finish for column bases is specified. (ANS/AISC Standard N690-94, Section Q1.21.3)
- Finish of thermal cut edges is specified. (ANS/AISC Standard N690-94, Section Q1.23.1)

4.1.1.5 The inspector should determine whether the Structural Concrete Inspection, Inspection Procedure I-113, has recently been performed at the site. If not, review the construction procedures to determine if anchor bolts, embedded weldments, and anchor plates are according to those procedures/specifications. In addition, assess whether the procedures/specifications adequately address the following:

- The minimum edge distance for bolts, studs, or bars with shear loading is specified. (American Concrete Institute [ACI] Standard 349-97, Appendix B – Steel Embedments, Section B.5.1.2.1)
- Expansion anchor testing is specified. (ACI Standard 349-97, Appendix B – Steel Embedments, Section B.7.4)

4.1.1.6 The inspector should ensure the construction procedures/specifications for important-to-safety steel structures require the following:

- Maximum and minimum edge distance for slotted, oversize, and standard bolt holes is specified. (ANS/AISC Standard N690-94, Sections Q1.16.5.1-3 and Q1.16.6)

- Maximum and minimum hole size for standard, oversize, short slotted, and long slotted holes for bolted connections is specified. (ANS/AISC Standard N690-94, Section Q1.23.7)

- Minimum spacing requirements for bolt holes are provided. (ANS/AISC Standard N690-94, Section Q1.16.4)

- Calibration of torque wrenches is specified.

Also, the construction procedures/specifications for important-to-safety steel structures should include specifications for high-strength bolts, including tightening to a bolt tension (using torque wrenches or turn-of-the-nut method) and minimum thread engagement. **(Not Committed)**

4.1.1.7 The inspector should determine whether the inspection procedure for Structural Steel Welding, I-115, has recently been performed at the site. If not, review the construction procedures for structural steel welding according to that procedure. In addition, assess whether the procedures adequately address the following:

- Identification of welders and weld operators (ANS/AISC Standard N690-94, Section Q1.7.4)

- Weld procedure qualification (ANS/AISC Standard N690-94, Section Q1.17, which references American Welding Society [AWS] D1.1-96)

- Control of welding material. (ANS/AISC Standard N690-94, Section Q1.17, which references AWS Standard D1.1-96)

4.1.1.8 The inspector should ensure the construction procedures/specifications for important-to-safety steel structures require the following tolerances:

- Length of structural materials (e.g., girders). (ANS/AISC Standard N690-94, Section Q1.23.11.1)

- Depth or width of structural materials (e.g., girders). (ANS/AISC Standard N690-94, Section Q1.23.11.2)

- Straightness of structural members. (ANS/AISC Standard N690-94, Section Q1.23.11.7)

4.1.1.9 The inspector should determine whether the construction inspection procedure for Nondestructive Testing, I-120, has recently been performed at the site. If not, review the construction procedures/specifications for structural steel according to that procedure. In addition, assess whether the procedures/specifications adequately address the following:

- Minimum examination of welds. (ANS/AISC Standard N690-94, Section Q1.26.2)

- Inspection sampling for full-penetration and partial-penetration welds. (ANS/AISC Standard N690-94, Sections Q1.26.2.1 and Q1.26.2.2)

4.1.2 The inspector should review the QC inspection procedures for important-to-safety structural steel construction. Verify that the procedures are approved and provide adequate QC inspections and inspection methods to ensure that the major construction activities are completed according to drawing and procedure requirements and include or reference appropriate quantitative or qualitative acceptance criteria. The major construction activities are listed in Sections 4.1.2.1 through 4.1.2.9 below with guidance on the activities that should be in the QC procedures. Note: Sections 4.1.2 and 4.1.3 should be performed together.

4.1.2.1 The inspector should verify the QC inspection procedures for important-to-safety steel structures are adequate to ensure the following:

- The material received meets the design specification (e.g., shape, size, dimension, and material type and grade). The procedure should reference ANS/AISC Standard N690-94, Sections Q1.4.1, Q1.4.2, and Q1.4.3, for acceptance criteria, as appropriate.

- The certified mill test report or certified reports of test made by the fabricator or a qualified testing laboratory is provided. (ANS/AISC Standard N690-94, Section Q1.4.1)

4.1.2.2 The inspector should verify the QC inspection procedures for important-to-safety steel structures ensure the following.

- Access is controlled to the storage area
- A marking system is used to maintain the identity of material in storage
- Material is protected from the environment and weather, as appropriate
- Nonconforming material is segregated.

4.1.2.3 The inspector should verify the QC inspection procedures for important-to-safety steel structures ensure the following:

- Fit-up tolerances for length, depth, and straightness are not exceeded. The procedure should reference ANS/AISC Standard N690-94, Section Q1.23.11, for acceptance criteria, as appropriate.

- Limits for contact bearing for column compression joints are not exceeded. The procedure should reference ANS/AISC Standard N690-94, Section Q1.25.4, for acceptance criteria.

- Tolerance for base plate elevation and degree of levelness is not exceeded. The procedure should reference ANS/AISC Standard N690-94, Section Q1.25.5, for acceptance criteria.

4.1.2.4 The inspector should verify the QC inspection procedures for important-to-safety steel structures ensure the following:

- The edges of column bases have the required finish. The procedure should reference ANS/AISC Standard N690-94, Section Q1.21.3, for acceptance criteria, as appropriate.

- The finish of thermal cut edges is within the acceptance criteria. The procedure should reference ANS/AISC Standard N690-94, Section Q1.23.3.1, for acceptance criteria.

4.1.2.5 The inspector should follow the applicable section of the inspection procedure for Structural Concrete Inspection, I-113. The procedure should reference ACI Standard 349-97, for acceptance criteria, as appropriate.

4.1.2.6 The inspector should verify the QC inspection procedures for important-to-safety steel structures ensure the following:

- Maximum and minimum edge distance for slotted, oversize, and standard bolt holes is not exceeded. The procedure should reference ANS/AISC Standard N690-94, Sections Q1.16.5.1-3 and Q1.16.6, for acceptance criteria, as appropriate.

- Required hole size for standard, oversize, short slotted, and long slotted holes for bolted connections is not exceeded. The procedure should reference ANS/AISC Standard N690-94, Section Q1.23.7, for acceptance criteria, as appropriate.

- Minimum bolt hole spacing requirements are not exceeded. The procedure should reference ANS/AISC Standard N690-94, Section Q1.16.4, for acceptance criteria, as appropriate.

- Torque wrenches are calibrated.

Also, the inspector should verify QC procedures ensure that high strength bolt requirements are met, including tightening to a bolt tension (using torque wrenches or turn-of-the-nut method) and minimum thread engagement. **(Not Committed)** Refer to ANS/AISC Standard N690-94, Section Q1.23.8, for information.

4.1.2.7 The inspector should determine whether the inspection procedure for Structural Steel Welding, I-115, has recently been performed at the site. If not, review the construction procedures for structural steel according to that procedure. In addition, assess whether the QC procedures adequately address the following:

- Identification of welders and weld operators. The procedure should reference ANS/AISC Standard N690-94, Section Q1.7.4, for acceptance criteria, as appropriate.

- Weld procedure qualification. The procedure should reference AWS Standard D.1.1-96. Section 4, for acceptance criteria, as appropriate.

- Control of welding material. The procedure should reference AWS Standard D1.1-96, Sections 5.3.1.4 and Section 5.3.2, for acceptance criteria, as appropriate.

4.1.2.8 The inspector should assess whether the QC inspection procedures for important-to-safety steel structures address the following:

- Structural materials (e.g. girders) are the required lengths. The procedure should reference ANS/AISC Standard N690-94, Section Q1.23.11.1, and AWS Standard D1.1-96, for acceptance criteria, as appropriate.

- Structural materials (e.g. girders) are the required depths. The procedure should reference the appropriate material specification (e.g., ASTM Standards A6 and A36) for acceptance criteria.

- Structural members are straight within the allowed tolerance. The procedure should reference ASTM Standard A6 and ANS/AISC Standard N690-94, Section Q1.23.11.7, for acceptance criteria, as appropriate.

4.1.2.9 The inspector should determine whether the construction inspection procedure for Nondestructive Testing, I-120, has recently been performed at the site. If not, review the construction procedures for structural steel according to that procedure. In addition, assess whether the QC procedures adequately addresses the following:

- The minimum visual examination of weld length. The procedure should reference AISC Standard N690-94, Section Q1.26.2, for acceptance criteria, as appropriate.

- Required inspection sampling for full-penetration and partial-penetration welds. The procedure should reference AISC Standard N690-94, Sections Q1.26.2.1 and Q1.26.2.2, for acceptance criteria, as appropriate.

4.1.3 When determining the adequacy of the QC procedures according to Section 4.1.2 of this procedure, the inspector should also determine whether the procedures require that test equipment or instruments used for process monitoring or data collection identified in Sections 4.1.2.1, 4.1.2.3, 4.1.2.6, and 4.1.2.8 are calibrated and maintained. The

calibration standards should be traceable to industry recognized criteria (e.g., the National Bureau of Standards). **(Not Committed)**

4.1.4 The inspector should review the procedures establishing the requirements for the qualification of craft and inspection personnel and determine whether the procedures conform to the requirements of QAP, Section 2.2.

4.2 Adequacy and Effectiveness of Construction Activities

Before work observation inspections are performed in the field, the inspector should review the procedures and industry standards that apply to the work to be observed to ensure familiarity with the requirements and acceptance criteria pertinent to the planned observations. Based on the preliminary design submitted by the Contractor and the SRD, SC 4.1-2, the applicable standard is ANS/AISC N690-94, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities." During field observations, carry a copy of the sections of the procedure and industry standards pertinent to the planned observations and verify work is being accomplished using procedures of the proper revision.

The major construction activities for steel structures are listed in Sections 4.2.1 through 4.2.8 below with guidance for inspecting each activity. Ensure the Contractor is adequately implementing the construction procedure for each activity.

During the field observations, The inspector should interview and obtain the names of a sample of the craft and QC personnel performing the observed activities to assess whether their knowledge of the job and procedures is satisfactory. The sample size will be determined by the number of Contractor personal performing the activity but should not be less than one or more than four of each discipline (craft and QC personnel). Information on these same personnel will be used pursuant to Section 4.3 below to determine the adequacy of their experience and training.

4.2.1 To assess if structural steel construction work is being accomplished under controlled conditions using approved instructions, procedures, and checklists, the inspector should perform the following, as applicable, for the activities ongoing at the time of the inspection:

4.2.1.1 Select four receiving inspection reports for structural steel and verify the following:

- Material received meets the design specification including shape, size, dimension, and material type and grade. The material specified should conform to one of the standard specifications approved by ANS/AISC Standard N690-94, Sections Q1.4.1, Q1.4.2, or Q1.4.3.

- Certified mill test reports or certified reports of test made by the fabricator or a qualified testing laboratory is provided.

4.2.1.2 Select two receiving reports for four types of structural material (e.g., girders, plate, weld filler metal, fasteners, expansion anchors, and steel embedments) and for each report independently verify the following:

- Access to the storage area is controlled
- Material is identified with a marking system. The system is effective with legible marking (tags that are easily read and not subject to weather) to identify material
- Protection from environment and weather is provided, as appropriate. Materials are not subject to harmful dust, rain, grease, corrosion, etc.
- Nonconforming material is segregated, as necessary.

4.2.1.3 Select three recently completed or in progress steel structures (Quality Level 1 or 2) and verify the following:

- Fit-up tolerances are not exceeded. (ANS/AISC Standard N690-94, Section Q1.23.11)
- Clearances are not exceeded. (ANS/AISC Standard N690-94, Sections Q1.25.4 and Q1.25.5)

4.2.1.4 Select one (Quality Level 1 or 2) steel structure and verify the following:

- Column bases have the required finish. (ANS/AISC Standard N690-94, Section Q1.21.3)
- Thermal cut edges have the required finish. (ANS/AISC Standard N690-94, Section Q1.23.3.1)

4.2.1.5 Determine whether Inspection Technical Procedure I-113, "Structural Concrete Inspection," has recently been performed at the site. If not, review the construction procedures for anchor bolts, embedded weldments, and anchor plates according to that procedure.

4.2.1.6 Select one (Quality Level 1 or 2) steel structure and verify the following:

- Maximum and minimum edge distance for slotted, oversize, and standard bolt holes is not exceeded. (ANS/AISC Standard N690-94, Sections Q1.16.5.1, Q1.16.5.2, or Q1.16.5.3, as applicable, and Tables Q1.16.5.1 and Q1.16.5.3)
- Bolt hole size for standard, oversize, short-slotted, and long-slotted holes for bolted connections is not exceeded. (ANS/AISC Standard N 690-94, Section Q1.23.7)

- High-strength bolts are ASTM Standard A325 or A490 (ANS/AISC Standard N690-94, Section Q1.23.8). The bolts are tensioned (using torque wrenches or turn-of-the-nut method) as specified and the nuts are installed with at least minimum thread engagement. **(Not Committed)**

- Minimum bolt hole spacing requirements are not exceeded. (ANS/AISC Standard N690-94, Section Q1.16.4)

- Torque wrenches are calibrated as required by the construction specification.

4.2.1.7 Determine whether the inspection procedure for Structural Steel Welding, I-115, has recently been performed at the site. If not, review the construction procedures for structural steel welding according to that procedure. In addition, select four welded connections in a Quality Level 1 or 2 steel structure and verify the following:

- A number, letter, or symbol identifies the welders and weld operators; and the identifier is used to identify the work. (ANS/AISC Standard N690-94, Section Q1.7.4)

- The weld procedures are qualified according to AWS Standard D1.1-96, Section 4. (ANS/AISC Standard N690-94, Section Q1.17)

- Welding material is controlled according to AWS Standard D1.1-96, Sections 5.3.1.4 and 5.3.2. (ANS/AISC Standard N690-94, Section Q1.17)

4.2.1.8 Select one Quality Level 1 or 2 steel structure and verify the following:

- The length of structural materials (e.g., girders) meets requirements. (ANS/AISC Standard N690-94, Section Q1.23.11.1)

- The fabrication tolerances of welded structural members conform to the provisions of AWS Standard D1.1-96. (ANS/AISC Standard N690-94, Section Q1.23.11.1)

- The depth or width of structural materials (e.g., girders) are according to the material specification. (ANS/AISC Standard N690-94, Section Q1.23.11.2)

- Bolt hole locations are according to design requirements. (ANS/AISC Standard N690-94, Section Q1.23.11.3)

- Structural members consisting primarily of a single rolled shape are straight within the appropriate tolerances allowed by the ASTM Specification A6. (ANS/AISC Standard N690-94, Section Q1.23.11.7)

4.3 Adequacy and Effectiveness of the Training and Qualification of Personnel

During the observation of work activities (Section 4.2, above), carry a copy of the procedures specifying the Contractor's requirements for education and experience levels, training, and certification (if applicable). The inspector should interview four craft and four QA/QC personnel involved in performing structural steel related activities and record which jobs they were performing. Verify that the personnel are sufficiently knowledgeable of procedure requirements and review the training and qualification records for those individuals to determine if they meet the requirements.

4.4 Adequacy and Effectiveness of the Records System

The inspector should select a sample of ten (10) records that were generated during the conduct of structural steel receiving, storage, fit-up and alignment, bolting, welding, and testing activities, and records of qualification for craft and QA/QC personnel selected during the performance of Section 4.3 above. Verify that those records were approved by proper authority and were stored and maintained in a way that demonstrates conformance with procedural requirements.

5.0 REFERENCES

ACI Standard 349-1997, *Standard Code Requirement for Nuclear Safety-Related Concrete Structures*, American Concrete Institute, 1997.

ANS/AISC Standard N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*, American Nuclear Society/American Institute for Steel Construction, 1994.

ASTM Standard A 325-1990, *Standard Specification for High-Strength Bolts for Structural Steel Joints*, American Society for Testing and Materials, 1990.

AWS D1.1-1996, *Structural Welding Code*, American Welding Society, 1996.

Integrated Safety Management Plan (ISMP), BNI-5193-ISP-01, Rev. 5, BNI Inc., Richland, Washington, 2000.

Quality Assurance Manual, 24590-WTP-QAM-QA-01-001, Revision A, BNI Inc., Richland, Washington, 2000.

Safety Requirements Document (SRD), BNI-5193-SRD-01-02, Rev. 3, Volumes I and II, BNI Inc., Richland, Washington, 2000.

6.0 LIST OF TERMS

ACI	American Concrete Institute
AISC	American Institute for Steel Construction

ANS	American Nuclear Society
ASTM	American Society for Testing and Materials
AWS	American Welding Society
ISMP	Integrated Safety Management Plan
RPP-WTP	River Protection Project Waste Treatment Plant
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
SC	safety criteria
SRD	Safety Requirements Document

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