

BUILDINGS AND STRUCTURES

Effective Date: April 1, 2026

PROGRAM APPLICABILITY: IMC 2573

75001.01-01 INSPECTION OBJECTIVES

To verify that safety-related (SR) and non-safety-related, safety-significant (NSRSS) buildings and structures can perform their required safety functions (RSFs).

75001.01-02 INSPECTION REQUIREMENTS

02.01 Vertical Slice Inspection of Quality Assurance:

Verify the licensee, manufacturer, or project vendor is effectively implementing its quality assurance (QA) and quality control (QC) requirements, in accordance with the quality assurance program (QAP) for activities associated with SR and NSRSS (i.e., safety-significant) buildings and structures. Inspection guidance for this section (02.01) is provided in IP 75001, and IP 75001, Appendix A.

02.02 Buildings and Structures:

Verify that the safety-significant buildings and structures are constructed in accordance with the design requirements, applicable codes and standards, approved drawings and procedures, and the safety analysis report (SAR). Inspection guidance is provided in Attachment 1, "Inspection Guidance for Buildings and Structures."

Verify that a design report exists and concludes that the deviations between the drawings used for construction and the as-built building or internal structures have been reconciled and will maintain their structural integrity under the design basis loads.

02.03 Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). Only applicable for construction under a combined operating license (COL).

Verify the inspections, tests, and analysis (ITA) related to buildings and structures are performed and that the acceptance criteria (AC) in the COL are met.

02.04 Operational Program Inspections:

None.

75001.01-03 INSPECTION GUIDANCE

General Guidance

The purpose of this inspection procedure is to provide insights into the quality of work being performed in the inspection area for buildings and structures. These insights will support the Advanced Reactor Construction Oversight Program's (ARCOP) continual assessment process described in Inspection Manual Chapter (IMC) 2572, "Assessment of Advanced Reactor Construction Projects."

The specific buildings and structures selected for inspection, and the depth and breadth of each inspection, may vary widely between inspections and will depend on the building or structure risk significance, the timing and location of the inspection, and the construction activities completed or in progress at the time of inspection.

Each inspection using this IP will constitute at least one inspection sample, regardless of how many sections are implemented during the inspection. As described in IMC 2572 and IMC 2573, "Inspection of the Advanced Power Reactor 'Quality of Reactor Plant Construction' Strategic Performance Area," the number of inspection samples needed to complete inspections in the inspection area are determined by the specified range of inspection samples listed in the project-specific inspection scoping matrices and on the results of the continual assessment process.

This IP is used for various advanced reactor designs and is scalable and flexible. Completion of every section/step of this IP is not expected or required for individual inspections or to complete the ARCOP construction inspection program (ACIP) for a project. Inspectors should perform the inspection activities in the following sections and in Attachment 1 of this IP, as available.

Inspection samples shall be selected in accordance with the ARCOP project-specific inspection scoping matrices, as described in IMC 2573.

In addition to the guidance below and in Attachment 1, inspectors may refer to other IPs as necessary to aid in completing the inspections in this procedure for buildings and structures.

Specific Guidance

03.01 Quality Assurance Implementation

The inspectors should refer to IP 75001, "Inspection of Manufacturing and Construction Quality for Advanced Power Reactor Structures, Systems, and Components," and IP 75001, Appendix A, "Implementation of the Quality Assurance Program," for inspection guidance. The inspectors should select a sample of QA attributes to inspect during each inspection based on the scope and content of the planned inspection, the prior completed samples, and indication of potential issues for a particular attribute.

03.02 Buildings and Structures

Refer to Attachment 1 of this IP for specific guidance and areas of inspection and inspection attributes for the construction of buildings and structures.

Review the nonconformances and deviations between the construction documents and the as-built building or structure. Verify they have been reconciled and that the as-built building or structure will maintain structural integrity under the design basis loads.

03.03 ITAAC Verification (Only applicable for construction under a COL.)

Review the licensee's plan for completion of applicable ITAAC associated with the work activities being inspected. Review the activities that the licensee intends to credit for future ITAAC closure. For example, if the licensee intends to rely on a specific quality control (QC) observation during the installation of an SSC, then the inspector should review a sample of these QC observations to determine whether the activity was performed in accordance with applicable quality and technical requirements.

03.04 Operational program inspection activities

None.

75001.01-04 RESOURCE ESTIMATE

The number of inspection samples and inspection hours are identified in the site-specific inspection scoping and planning matrix.

75001.01-05 PROCEDURE COMPLETION

Completion of this IP is based on 1) completing the minimum required inspection samples identified in the site-specific inspection scoping matrix and 2) an assessment pursuant to IMC 2572 that the construction activities for structures are being accomplished with quality in accordance with the licensing basis requirements.

75001.01-06 REFERENCES

NOTE: References specific to Attachment 1 are included in the Attachment 1 reference. Refer to licensing basis requirements for applicable codes and standards for each facility.

END

Attachments:

Attachment 1: Inspection Guidance for Buildings and Structures
Attachment 2: Revision History for IP 75001.01

Attachment 1: Supplemental Inspection Guidance

I. Purpose:

To provide guidance for inspection of buildings and structures per Section 02.02 of the main body of this IP. Some of the sections and guidance in this attachment may not apply to all facilities. ITAAC are only applicable to facilities constructed under a COL. The guidance section of this attachment is arranged in the 7 sections listed below. Guidance sections should be performed concurrently when possible.

Section 1: Procedures

Section 2: Key Site Parameters, Dimensions, and Volumes

Section 3: Foundations

Section 4: Structural Concrete

Section 5: Structural Steel

Section 6: Water Barriers for Foundations and Buildings

Section 7: Records, Interface Concerns, Past Problems

II. Objectives

- a. Assess the adequacy of licensee, manufacturer, or project vendor's controls for performing and documenting work activities associated with the construction of safety-significant foundations, buildings, and structures.
- b. Verify that as-built site parameters, characteristics, and key building critical dimensions, volumes, materials, and separation satisfy design specifications, requirements, and relevant ITAAC, if applicable
- c. Determine if work activities associated with the construction of safety-significant foundations, buildings, and structures are being performed in accordance with regulatory requirements, the licensing basis, specifications, drawings, and work procedures.
- d. Verify that the as-built condition of safety significant foundations, buildings, and structures meets the specified design requirements, specifications and drawings and whether records reflect that completed work is consistent with the applicable drawings, specifications and acceptance criteria.
- e. Determine that the implementation of the quality assurance program related to work activities was effective and to verify that deviations from requirements were effectively resolved.

III. Guidance

Section 1: Procedures

Inspection of procedures should not be a standalone inspection sample. Instead, guidance in this section should be used while inspecting the other sections.

Construction procedures should be reviewed, along with specifications, drawings, design reports, and other relevant documents, to ensure that the work activities discussed in Sections 2 through 6 below are being performed in compliance with the procedural controls and design criteria. The inspector should also review quality control procedures, design reports, and applicable codes and standards.

- a. Verify that contractors performing safety-significant work have approved implementing procedures that describe administrative and procedural controls, approved work processes, and project-specific inspection requirements.
- b. Verify that procedures clearly prescribe acceptable methods of quality control inspection to ensure that the as-built condition meets specified design requirements, drawings and specifications.
- c. Verify that procedures on the reconciliation of construction deviations are reasonable and acceptable. Guidance in Appendix C to SRP Section 3.8.4 "Design Report–Seismic Category I Structures," provides insights for this activity.
- d. Verify that procedures include appropriate quantitative and/or qualitative acceptance criteria for determining that the prescribed activities have been accomplished satisfactorily.
- e. Verify that equipment used for process monitoring, tests, and/or data collection is calibrated and maintained in accordance with approved calibration procedures and vendor requirements.
- f. Verify that procedures ensure that craft and quality control inspection personnel performing installation and testing activities are qualified to perform their work.

Section 2: Key Site Parameters, Dimensions, and Volumes

- a. Review the key site parameters that are specified for the design of safety-related aspects of structures, systems, and components in the applicable licensing basis.

Due to the difficulties in performing work on completed foundations and in conducting effective post-installation foundation inspections, accurate measurement of existing site soil parameters is critical. Consider using a civil engineer for these inspection activities. Engineering design features and programmatic controls for foundation work should be reviewed. Consider the possible effects from groundwater intrusion and weather on the foundation preparation. Adequate drainage control measures should be established to ensure that the exposed surface will not be degraded by water accumulation.

Verify that the existing site foundation characteristics fall within the design parameters.

Verify that the required values for average allowable static bearing capacity and maximum allowable dynamic bearing capacity for normal plus safe shutdown earthquake, typically expressed in pounds per square foot, have been met at the excavation depth.

Verify that any measures performed to address unsuitable soils have been performed or installed in accordance with approved drawings, specifications, and procedures. These measures may consist of soil removal and replacement, surface densification, soil mixing/grouting, or the installation of a ground improvement system consisting of aggregate piers or rigid inclusions.

- b. Review the key dimensions and volumes listed in the design documents, DCD, or SAR. Once the key dimensions have been identified, assess the method and controls the licensee used to verify that the as-built dimensions conformed to the licensing basis.

Inspectors should ensure that the licensee has adequate controls in place for dimensional requirements to ensure they are met. If possible, observation of field measurements may be conducted to verify that work is being performed in accordance with appropriate procedures. The observation of field crews recording data should ensure that they are verifying daily logs for accuracy and systematically assuring that the construction layout conforms to plans. A review of field data should also be conducted to ensure that it is being correctly translated into permanent records. Ensure that any identified deviations are documented in accordance with the licensee's quality assurance program.

Verify that records document that the completed work meets the design specifications and acceptance criteria.

Verify that measuring and surveying activities and associated calculations are conducted in accordance with the licensee's quality assurance program requirements.

Verify that surveying and measuring equipment is properly maintained, calibrated, or certified by a qualified measuring and test equipment (M&TE) program.

Verify that personnel performing surveys or measurements are qualified and knowledgeable.

Section 3: Foundations

Selection of an appropriate foundation depends on the geotechnical characteristics of the underlying soil or rock, groundwater conditions, and the foundation preparations. The bearing capacity and settlement estimates will dictate the type of foundation based on foundation loads and subsurface conditions. Alternatives include shallow foundations bearing directly on competent material, or deep foundations such as drilled piers or piles which transfer loads through weaker soil layers to more suitable material below. Acceptable foundation options should be based on the results of a thorough geotechnical investigation. These options and associated design recommendations should be documented in a geotechnical engineering report prepared by a licensed design professional.

Historically, domestic nuclear power plants have relied on reinforced concrete mat foundations bearing on competent soil or rock. Competent material, however, may not exist

at the base of the foundation, requiring the use of deep foundations or excavating below the bearing elevation of the foundation mat and backfilling with compacted fill to ensure that the correct elevation for the structure base is achieved. Regardless of the type of foundation, the quality and capacity of the bearing medium should be verified during construction to provide assurance that the foundation will perform its design function.

Experience has shown that the most severe deficiencies in foundation work occur because of improper backfilling procedures and inadequate construction control. These include allowing lift thicknesses that are inconsistent with equipment capabilities and thicker than allowed by the specifications; failing to require that the fill be built up uniformly in a well-defined pattern; placing backfill in adverse weather; and failing to perform sufficient field density testing in all areas. It is therefore important to observe backfill placement activities to ensure that work is being accomplished in accordance with design requirements. In-process testing, including in-situ testing, should also be observed to ensure that acceptable compaction prior to placement of subsequent lifts is being controlled by qualified personnel and that appropriate records are being reviewed and approved by cognizant engineers.

For cast-in-place deep foundations, a major concern is the quality of the concrete within the pile or drilled pier. Poor construction practices may result in defects which impact the structural integrity of a pile or drilled pier and its capacity to carry load. Common defects may include necking of the shaft, honeycombing, soil intrusion, segregation of concrete aggregates, bleed-water channels, low strength concrete, concrete laitance, and cold joints. Since visual inspection of deep foundation elements is limited, non-destructive testing (NDT) methods such as cross-hole sonic logging, sonic echo, or impulse response testing are typically specified to verify the structural integrity of cast-in-place piles or drilled piers.

a. Backfill operations

Verify that the specifications and design drawings define the type, characteristics, and compaction efforts of material to be used for backfilling and that the licensee has controls in place for periodically verifying that the material meets the specifications.

Verify that the characteristics and type of compaction equipment used is as specified.

Verify that procedures define the maximum loose-lift thickness (typically 6 to 12 inches) for placement of backfill material and that ongoing quality control inspections verify conformance with this requirement.

Verify that the field density testing is performed by qualified testing personnel using the correct methodology and calibrated test equipment since backfill material characteristics can change during delivery and storage. Also verify that current proctor test results accurately reflect the material being placed. Changes in backfill material may require new proctor laboratory testing even though the material still meets design specifications.

Verify that the frequency and location of the quality acceptance in-place density tests is specified and adhered to.

b. Shallow foundations (e.g., footings and mats).

For foundations bearing on rock, verify that the soundness of the exposed rock is checked and determined to be solid and in an unfractured condition by qualified personnel.

Ensure that if the removal of rock below foundation level is required, the resulting excavation is backfilled in a controlled manner with approved materials.

For foundations bearing on soil or backfill material, verify the supporting material is checked by qualified personnel to ensure compliance with specified requirements.

c. Deep foundations (e.g., piles and drilled piers).

Deep foundations typically consist of piles or drilled piers. The distinction between the two is not well defined in all cases. However, drilled piers typically have diameters 30 inches or greater while piles generally have smaller cross sections.

Drilled piers are foundation elements that are constructed by drilling through weaker soils to competent material capable of supporting the building loads and filling the drill shaft with concrete.

Piles are slender foundation elements that are installed in soil to support the building loads. They may be installed by impact driving, jacking, vibrating, jetting, drilling, grouting, or combinations of these techniques. There are a variety of different types of piles. They may be made of steel, concrete, or composite construction. Acceptable pile types for a specific project should be addressed in the geotechnical engineering report and construction specifications.

A structural concrete mat slab is typically installed between building walls and columns, and deep foundation elements to transfer and distribute loads between the superstructure and the piles or piers. Reinforcing steel from the deep foundation elements is typically continued from the piles or piers and embedded into the slab to positively connect the building superstructure to the foundation elements and facilitate load transfer.

Verify that the installation of piles or drilled piers is supervised by qualified personnel.

If required to determine or confirm pile capacities, verify that pile load tests are performed in accordance with the construction specifications and procedures.

For driven piles, verify that the type and rated energy of the pile driving hammer meets specified requirements.

For driven piles, verify that any required pile dynamic analysis is performed in accordance with the construction specifications and procedures.

Verify that any required pile splices are completed in accordance with the construction specifications and procedures. For welded splices, refer to Section 5, "Structural Steel," for additional guidance.

Verify that the location, diameter, and plumbness of drilled pier shafts are checked to be within specified tolerances.

Verify that probe holes, if specified, are drilled below the base of drilled pier shafts to ensure no voids exist below the base.

If temporary casings, permanent casings, or liners are specified for drilled pier shafts, determine if installation is in accordance with construction specifications and procedures.

If slurry is used to maintain the integrity of drilled pier shafts, verify material properties conform to specified requirements.

If temporary casings are used, verify the casings are withdrawn in a controlled and uniform manner during concrete placement to ensure structural integrity of the drilled pier.

If specified, verify that any void space between liner or permanent casing and drilled pier excavation is filled with grout in accordance with the construction specifications and procedures.

If specified, verify that downhole inspection of drilled pier shafts is performed and the results are documented in accordance with applicable requirements.

For drilled piers bearing on rock, verify the quality and the slope of the supporting rock are inspected prior to concrete placement to ensure conformance with specified requirements. For drilled piers socketed into rock, also verify that the quality of the rock within the socket and the roughness of the socket walls are inspected.

Verify that drilled piers are inspected prior to concrete placement to confirm that the amount of loose material and/or water present in the shaft are within specified limits.

For cast-in-place concrete piles or drilled piers, verify installation of reinforcing steel and concrete placement meet specified requirements. Refer to Section 4, "Structural Concrete," for additional guidance.

For steel or composite piles, verify material properties conform to project requirements. Refer to Section 5, "Structural Steel," for additional guidance.

If required for completed piles or drilled piers, verify any integrity testing is performed in accordance with the construction specifications and procedures.

Section 4: Structural Concrete

The construction procedures should be reviewed, along with design control document (DCD) or safety analyses report (SAR), applicable specifications, drawings, and other design documents to ensure that the work activities are being properly performed in compliance with the procedural controls and design details. Review the pertinent QC procedures, applicable codes and standards, and Regulatory Guides. Independently assess whether QA verification of concrete work is adequate to ensure compliance with construction specifications, requirements, and commitments. The American Concrete Institute (ACI) "Manual of Concrete Inspection," may be used as a general reference. However, licensee-approved design details and procedural controls govern the conduct of structural concrete placement and related construction activities.

Ensure the following activities are being controlled, inspected, and accomplished in accordance with the requirements of licensee procedures and regulations:

a. Reinforcing Steel and Embedment Placement

Verify the following items:

- Reinforcing steel, embedments, and permanent formwork are controlled and installed in accordance with the applicable specifications, codes, drawings, and procedures. Reinforcing steel and embedments are located properly in the structure and in the forms, are secured and free of concrete or excessive rust, and have proper clearances.

The areas where embedded plates with anchors are to be set in concrete should have the specified and designed amount of projection into concrete to provide adequate anchorage. Excessively congested areas with reinforcing steel will make concrete placement and consolidation difficult to control. Reinforcing steel bending is properly performed and controlled. Embedded piping or conduit should be capped or plugged prior to concrete placement.

- For containments using post-tensioned tendons, inspect the installation of trumpets, bearing plates, and tendon sheathing. Inspect the following before concrete is placed:
 - Trumpets, bearing plates, and sheathing are installed within specified tolerances and are clean and free of damage.
 - Tendon sheathing joints are mortar-tight.
 - Sheathing vents and drains are installed as specified.

b. Reinforcing Steel Splices

Verify the following (particularly for techniques other than the code endorsed “lapping” requirements):

- Process and crews are qualified.
- Each splice is defined by materials used, location, crew, type of splice, and heat number (if applicable).
- Sampling and testing are performed at proper frequency. Acceptance criteria are defined and confirmed as being satisfied.
- Inspections are performed during and after splicing by qualified inspection personnel.
- For mechanical splices, review the instructions issued by the vendor. This document usually specifies the proper performance of all mechanical splicing operations. Verify whether vendor instructions were properly implemented.

When cadwelding operations are being performed, observe that specified materials (sleeves, powder, packing) are stored in accordance with specifications, codes, drawings, and procedures, and that cadwelding fixtures are in good condition. The reinforcing steel to be cadwelded should be cleaned shortly before cadwelding to

remove all non-adhering rust. The reinforcing steel ends should be aligned and butted within the tolerances specified.

Observe the placement of sleeves and the use of a marking system to ensure centering. When the firing is complete and packing removed, examine the sleeve and reinforcing steel to ensure that metal is showing at the vent, no slag at the tap hole, and each end of the sleeve shows proper fill (allowable void area not exceeded).

Ascertain whether each cadweld sleeve is identified. Select a sample of the installers to verify qualifications meet procedures and requirements. Interview two cadwelding inspectors to determine whether they are familiar with the details of cadwelding requirements; also determine whether inspections of cadwelding conform to the specified frequency, whether QC inspection records are being maintained, and whether records are traceable to the location and identification of the sleeve.

- If applicable, verify that mechanical and/or welded splices of reinforcing steel meet the requirements of AMSE BPV Code Section III, Division II, Article CC-4000.

c. Concrete Liner Plate and Embed Erection and Fabrication

Verify the following:

- Plate and other materials are controlled in accordance with specifications, codes, drawings, and procedures.
- Forming, fitting, and aligning are controlled in accordance with specifications, codes, drawings, and procedures.
- Stud-welding is performed by qualified personnel in accordance with approved procedures.
- Examination and testing are in accordance with the specifications, codes, drawings, and procedures.
- Refer to IP 75001.WELD "Inspection of Welding," for further welding inspection information.

d. Concrete Batching and Delivery

Verify the following:

- The batch plant is qualified in accordance with specifications, codes, drawings, and procedures, and producing concrete of the specified mix design. Scales and meters are calibrated. Equipment performs properly—rotation speed, timing, and blade wear are not excessive. Assure that the materials and concrete mix are free of deleterious material, and that there is no contamination between materials in storage, transportation, or process. Assure that batch records are generated, controlled, and that they indicate placement location, mix, volume, date, time, and special instructions.

Concrete batch plants providing concrete for use at nuclear facilities may be certified to the National Ready Mixed Concrete Association (NRMCA) program. This certification provides evidence that a registered professional engineer has reviewed the facility and has seen evidence that certain necessary capabilities exist to produce quality concrete. Any other batch plant certification should include the inspection attributes listed in the NRMCA checklist which is used to inspect the facility prior to any recommendation for certification.

- Materials are properly qualified and traceable to approved sources. Storage and handling are not detrimental to the concrete materials, e.g., cement is protected from moisture and aggregate is not subject to excessive mixing of sizes or contamination.
- Batch water quality requirements are met, and water is adjusted to account for moisture content of aggregates. Aggregate moisture content tests are representative of actual stockpile conditions.

The moisture content determination of aggregates becomes very important if the aggregate stockpiles are exposed to the elements.

- Transporting equipment is suitable, reliable, and in an acceptable condition.
- Established time limit between mixing and placement has not been exceeded, or if the time limit is waived by the purchaser, then verify that no excess water is added and the slump is verified prior to placement.
- Temperature limits have not been exceeded.
- Slump test results are being used at the batch plant to maximize placeability in more uniform batching, as detailed in the design specifications. If water additions are required, remixing in the truck conforms to the appropriate standards (e.g., ASTM C94) addressing the uniformity of mix. There should be precautions on the amount of re-tempering water additions allowed in consideration of the water-cement ratio as called out in the design specifications for the concrete.

The practice of withholding water at the batch plant and then tempering at the point of placement should consider the results of air content and slump measurements taken at the point of placement.

- Scales should be calibrated and inspected for reliable working order. Verify that each truck is measured and each trip receives proper ticketing and documentation.

e. Concrete Placement.

For large placements, e.g., basemats, containment domes, and/or other structures, generally continuous placement is a design requirement. However, due to unexpected events, a continuous placement may not be possible. In such a case, contingency preparations should include approved procedures for stopping a concrete placement; a time limit to restart the placement; profile and preparation of the joint interface; and, if reinforcement dowels are needed, approved size and bend profile, and ready availability of the dowels onsite. In addition, verify that the contingency planning, preparations, and engineering requirements have been reviewed by qualified personnel for technical adequacy.

Verify the following:

- Pre-placement planning and training has been completed as required to assure good quality construction and to protect against unplanned construction joints.
- The pre-placement inspection performed by QC has been completed before any concrete is placed.

Quality control pre-placement inspections must not be unnecessarily rushed by advancing concrete work, especially during large slab or basemat placements. When possible, verify the actual as-built condition of reinforcing steel with respect to the engineering drawings. If deviations exist, verify that proper engineering evaluations have been performed.

- The equipment to deliver concrete to the actual placement location is suitable and sized for the work—conveyors, lines, pumps, buckets, etc.

Consider the potential for segregation of aggregates due to mishandling. Segregation can lead to fine particles to settle at the bottom, and large particles to surface at the top. In addition, excessive vibration of concrete will lead to unacceptable aggregate segregation after placement.

- The placement has been cleaned, and joint preparation is as defined in the construction specification.
- Batch tickets are reviewed for verification of proper mix, transport time, placement location, and amount of temper water being added at the truck delivery point.

Check time of concrete receipt for truck transported centrally mixed concrete. Also verify the amount of water added, if permitted, and mixing time. Be sure that the placement is in accordance with specifications using required equipment to prevent the occurrence of excessive air voids.

- Placement drop distances do not exceed specification requirements and do not result in segregation.

Concrete should not strike forms or bounce against reinforcing bars causing segregation of aggregates.

- Vibrators are approved, tested for frequency, and are used properly by trained individuals.

There should be a sufficient number of vibrator operators and vibrators, which should be checked for proper operation before starting to place concrete. Vibrators less than 3 inches diameter are generally designed to operate at about 7000-8000 vibrations per minute when immersed in concrete. Large vibrators, used in heavy section concrete placement, operate at about 6000 vibrations per minute. Vibrators less than 3 inches in diameter can be operated by one man; 4 inches or larger vibrators are 2-man tools. Proper vibrator operation involves duration of vibration, distance between vibrator insertions, and depth of insertions. The vibrators should be handled and operated vertically and never "cast" away from the operator horizontally and then retrieved. Concrete should be placed horizontally, in about 12-inch lifts, and

never allowed to pile much higher in one area of the form than another. The vibrator should penetrate through the new concrete well into the previously placed layer to avoid any "layer cake" effect. Occasional contact of a vibrator with the forms is permissible, and with the reinforcement is desirable. Form vibration is generally not desirable, and care should be taken that reinforcement is not displaced by vibrators, or by people walking on the reinforcing steel. Vibrators should not be used to move concrete laterally.

Care should also be taken not to concentrate vibratory action in a specific area. Overly working and vibrating concrete into reinforcing-congested areas can cause segregation of aggregates in the mix. To assure that all aggregate remains suspended in the mix, the concrete should only be exposed to two or three vertical passes with the vibrating equipment for shallow pours. Deeper poured sections may require more vibration, but the vibratory equipment should not be allowed to rest or remain in one area for extended times and the exposure to vibration per vertical foot of wet concrete should be similar to the shallow pour.

- Special attention is given to areas of high reinforcing or embedment steel congestion to preclude areas of voids or honeycombing.
- Records are produced and reviewed, and indicate mix, location, time placed, water additions, and temperature of the concrete mix and ambient conditions.
- Inspection during placement is performed as required.
- Adequate planning and preparations are complete and procedures are in place and available to address unexpected events (e.g., batch plant malfunction, equipment and personnel accidents, and weather-related emergencies).
- Procedures and specifications are followed if work is stopped and resulting restart occurs.

f. In-Process Testing

Verify the following:

- Concrete temperature, slump, air content, and unit weight are being determined at the proper location and frequency as required in the design specifications.
- Sample collection and testing techniques conform to the procedures specified in the ASTM standards, or equivalent.
- Test specimen samples, for concrete strength determination, are sampled at the required location and frequency and are cured in accordance with specified requirements.
- Personnel performing sampling and testing are trained and qualified.
- Sampling is performed at point of placement or, if not, adequate technical justification such as correlation testing is provided for sampling at an alternate location.

g. Curing

Verify that curing is in accordance with specifications and procedures regarding the method, materials, duration, temperature (concrete and ambient), inspections (during curing and after form removal), and records.

h. Acceptance

Verify that the final inspection results after form removal, test results and other information related to the placement (including deficiencies, defects, etc.) have been subjected to an integrated review before acceptance of the placement and that the as-built documentation is complete. Final inspection procedures should include verifying embed locations, finishes, and defining any defects and required repairs.

i. Laboratory Testing

Verify the following:

- Personnel qualifications: The education, experience, and training of testing and inspection personnel have been verified by the employing organization. Verification must be supported by documentation. Certification of inspectors must show which ASTM tests the inspector is qualified to perform.

Particular attention should be directed toward the qualification of personnel and their work performance. Commercial laboratories may hire untrained or inexperienced personnel near the site, then train and certify them for materials testing. A weak training program and low experience level could result in inconsistent or low-quality inspection or test results. In addition to the reviews of training records, consider interviewing personnel who perform material inspection and testing, to independently assess depth of knowledge and experience. Also, be sensitive to a rapid turnover of personnel.

- In some instances, the design organization, the constructor, or licensee may require on-site testing laboratory inspection or review. This may be by reference to ASTM E 329 which could be satisfied by the efforts of Cement and Concrete Reference Laboratory/Materials Reference Laboratories (CCRL/MRL) of the National Bureau of Standards. If such a review has been performed, then these results should be obtained and reviewed prior to any NRC inspection efforts related to the materials and concrete test laboratory.
- Evaluation of test results. The evaluations are being performed, reviewed, and approved at an appropriate level and include trending analysis. The records must be retrievable. There should be a mechanism for feedback to production control. Verify that the adverse trends or problems are identified at an appropriate threshold and entered in the corrective actions program. Where appropriate, results should be evaluated against approved acceptance criteria.
- Testing conforms to the procedures specified in the ASTM standards. The procedures must be available at the work location.
- Testing apparatus is being calibrated at the required frequency.

j. Special Considerations

The following items should be incorporated in the inspection of concrete placements when appropriate (refer to ACI standards for additional guidance):

- Hot and Cold Weather. Provisions for maintaining concrete temperature within specification must be provided. Hot and cold weather conditions must be defined (e.g., per ACI standards such as 301, 318 and the Manual of Concrete Inspection) to avoid confusion.

During periods when concrete is to be placed and cold weather is expected during the curing time, provisions must be made to keep the concrete above 40°F, preferably in the range of 50 to 60°F. If concrete is being mixed or transported in weather below 40°F, the ingredients may be pre-warmed so that the temperature of the concrete after placement is elevated to account for losses. Heating the water is the most effective and most easily controlled technique, but the aggregate must not be frozen. The water should not be so hot as to cause "flash set" of the cement during mixing; that is, the temperature of the mortar should not exceed 100°F. If hotter water is required to warm the aggregate, the water and aggregate may be mixed prior to addition of cement. If the aggregate is heated, close control must be exercised, and the aggregate must be frequently checked for variations in moisture content caused by local variations in heating. Direct fired heaters may produce carbon dioxide in the exhaust fumes forming calcium carbonate on the surface of fresh concrete.

Where the ambient temperature during concrete placement rises much above 70°F, consideration must be given to the effect of high temperatures on the concrete. Although concrete cured at temperatures up to 100°F gives higher early strength, with little degradation of long-term strength, high temperatures during mixing, transportation, and placement can be seriously detrimental. The most obvious effect is that concrete requires more water for workability or the use of additives. A less obvious effect is the need for special attention to curing, because the higher temperature increases water evaporation from the concrete.

Exposure to strong summer sun can raise the temperature of ingredients, equipment, forms, etc. far above the air temperature. If this occurs, provisions should be made for appropriate shades or screens and the equipment, forms, metallic embedments, etc. should be wetted just prior to concrete placement. If the ambient temperature is high enough so that the bulk temperature of freshly mixed concrete exceeds 80°F or 90°F, consideration should be given to some method of cooling the ingredients, such as chilling the water or using ice. If ice is used, it must be crushed or flaked so that all the ice is melted by the time mixing is completed.

- Pumping Concrete. Slump and air content losses must be monitored to ensure placeability and adequate consolidation.
- Large Placements. Planning sessions must ensure consideration of all contingencies. Verify that adequate planning and preparations have been made and that procedures are in place and available to address an unexpected event, e.g., batch plant malfunction, equipment and personnel accident, and weather-related emergencies.

For large placements, e.g., basemats, containment domes, and/or other structures, generally continuous placement is a design requirement. However, due to unexpected events, a continuous placement may not be possible. In such a case, contingency preparations should include approved procedures for stopping a concrete placement; a time limit to restart the placement; profile and preparation of the joint interface; and, if reinforcement dowels are needed, approved size and bend profile, and ready availability of the dowels onsite. In addition, verify that the contingency planning, preparations, and engineering requirements have been reviewed by qualified personnel for technical adequacy.

k. Expansion Anchor Installation.

Verify that concrete expansion anchor installation activities are being adequately controlled by reviewing the applicable procedures, observing work, and checking (e.g., witness of torque wrench operation or QC inspection verification) that the proper tension has been developed in the bolt.

Verify the following:

- Concrete drilling, including depth, perpendicularity, hole size and rebar damage prevention,
- Embedded depth of the anchor bolt,
- Bolt length projection beyond the concrete surface and thread engagement for the nut on the bolt,
- Installation torque to set the anchor bolts,
- The design torque-tension relationship,
- Minimum distance from concrete edges and openings, minimum bolt spacing, and minimum distance from embedded steel,
- Identification of bolt diameter and applicable marking/stamps,
- Design provisions for the subsequent installation of the supported components, including quality checks (e.g., use of torque seal).

It is expected that new plants will significantly reduce or eliminate expansion anchors; therefore, this section may not apply. Before observing any concrete expansion anchor installation activities, the inspector should examine the bolts and related components in storage, evaluating any issues involving special preservation requirements, storage conditions, damage controls, material and component identification, and nonconforming material segregation. In selecting the concrete expansion anchor sample size and population for inspection, emphasis should be given to known ITAAC impact; early installations for process control checks; and the diversity of support installations using concrete expansion anchors, e.g., structural, piping, electrical, HVAC, etc.

QA/QC procedures provide a key element for the effective implementation of inspections and confirmation that concrete expansion anchor installation controls are adequate. QC inspections should require direct verification of important specification requirements and

should not be accomplished merely by surveillance. Laboratory and field-testing activities should provide for direct verification of correct material usage, the selection of proper reference standards, and should preclude the discretionary selection of inspection and testing parameters, without approved procedural direction and guidance. The installation and related QA procedures should reference hold point requirements for in-process inspection activities and address the QA stop work authority and controls if major program weaknesses or process control problems are identified.

If any rebar is damaged or cut during installation, ensure design controls are in place to evaluate the cumulative effect on the affected structures. Ensure the anchor bolt embedment depth accounts for any non-structural finish coats, coverings, or grout, on concrete slabs, especially floors.

Section 5: Structural Steel

Activities for the fabrication and erection of steel structures verify general construction quality and performance. Assess the adequacy and effectiveness of procurement, implementing procedures, qualification of personnel, ongoing construction activities, and records.

a. Procurement documents

Verify the following:

- The shape, size, dimensions, type, and grade of material conform to the approved specifications and design drawings.
- Certified mill tests reports or a certified report of tests made by the fabricator or qualified testing laboratory are available.
- Items on-site are what was ordered by procurement.
- Fabricators and/or erectors providing and/or erecting structural steel for/at nuclear facilities should be certified by the American Institute of Steel Construction (AISC). AISC's certification programs are intended to provide confidence that certified participants, who adhere to program criteria, have the personnel, organization, experience, documented procedures, knowledge, equipment, and commitment to quality to perform fabrication, manufacturing, and/or erection.

b. Process Controls

Verify the following:

- An adequate marking system is used to maintain the identity of material from storage to installation.
- Structural steel is protected from corrosion caused by exposure to weather, and that corrosion limits match design criteria. Refer to design drawing or specifications for governing codes for the site in question.
- Nonconforming material is adequately identified and segregated.

- Structural steel stored on the site should be supported off the ground on blocking. After receipt, markings should be used to indicate that the steel is accepted material and that fabrication has been properly performed.

Review the procedures and standards that apply to ensure familiarity with the requirements and acceptance criteria.

- Receipt inspection reports should be reviewed to verify material conformance. Steel should be inspected for damage and quality of fabrication prior to erection. The nature and extent of any damage that may have occurred because of loading, transit or unloading should be noted along with the identifying piece mark and entered in the corrective action program for proper assessment and disposition.

c. Installation

The installation and inspection of high-strength bolted assemblies used in building construction are typically specified to conform to Research Council on Structural Connections (RCSC), "Specification for Structural Joints using ASTM A325 or A490 Bolts."

As discussed in the American Institute of Steel Construction (AISC) N690, Specification for Safety-Related Steel Structures for Nuclear Facilities, erection methods should not impart damage to any member. Members must have their ends brought together at the correct relative elevation and held in correct alignment so that heavy drifting is not necessary to align the bolt holes. Sufficient drift pins must be installed to obtain accurate alignment of parts, and an adequate number of bolts installed before members are released and allowed to deflect. As a rule of thumb, at least 50 percent of the holes must be filled with pins and snug-tight bolts. Due to the possibility of damaging the threads on bolts, any bolts installed prior to installing the drift pins shall be replaced. Drift pins should be cylindrical and not more than 1/32 inch smaller than the diameter of the hole.

As discussed in the American Institute of Steel Construction (AISC) N690, Specification for Safety-Related Steel Structures for Nuclear Facilities, tightening of bolts by the turn-of-the-nut method requires three separate steps: tightening to a snug-tight condition, match marking the protruding end of the bolt and adjacent surface of the nut and tightening the nut the additional specified rotation. Ensure that the match marks are correctly placed so that the relative rotation of the nut to the bolt is measured and not relative to the steel member or splice plate. The subsequent inspection of bolted joints should involve a torque wrench and a recently calibrated tension testing device. Torque wrenches should be calibrated at the beginning of each day of use and for each diameter or length of bolt being tested.

Verify the following:

- Fit-up tolerances for length, depth, and straightness of structural members and bolt holes are as specified.
- Base plate elevations and degree of levelness as well as limits for contact bearing for column compression joints are as specified.
- Finish for column bases and for thermally cut edges are as specified.

- d. Verify that the following attributes are as specified for anchor bolts, embedded weldments, and anchor plates:
- Minimum concrete edge distance for bolts, studs, or bars with shear loading is as specified.
 - Concrete expansion anchor testing is as required.
 - Maximum and minimum edge distance for slotted, oversize, and standard bolt holes is as specified.
 - Maximum and minimum hole size for standard, oversize, short slotted, and long slotted holes for bolted connections is as specified.
 - Minimum spacing requirements for bolt holes are as specified.
 - Calibration of torque wrenches is as specified.
 - Tightening and tensioning of normal or high-strength bolts is as specified, and the minimum thread engagement is also as specified. Bolt tension may be accomplished by using load indicating washers, torque wrenches or turn-of-the-nut method.
 - For cast-in-place anchors, the critical items shall be as specified. These include anchor size, material, length, embedment detail, length of embedment, projection above concrete, thread lengths, sleeve types, sleeve sizes, sleeve lengths, and grouting requirements.
- e. Structural steel welding

During the welding of structural steel, care must be taken to prevent moisture in the atmosphere from being absorbed by the electrodes which can potentially cause cracking of the weld. Care should be taken to abide by time and temperature restrictions for electrode usage. Refer to specific licensing basis requirements for welding structural steel. However, when ambient weather conditions result in low temperatures (typically lower than 50°F), the base metal is preheated prior to welding (typically for materials up to 3/4 inch thick). Thicker materials typically require even higher ambient temperatures. Further guidance to ensure welding material and processes are adequately controlled can be found in Inspection Procedure 75001.WELD.

- The identification of welds and welders is maintained for each weld.
- Welding procedures and welders are qualified in accordance with the American Welding Society requirements for structural steel welding, and other codes or standards referenced by the product specifications.
- Nondestructive examination methods and acceptance criteria are as specified. Procedures specify the minimum visual examination of weld length requirements and the required inspection sampling for full-penetration and partial-penetration welds.
- Verify that foreign material exclusion (FME) controls are appropriately utilized as specified.

Section 6: Water Barriers for Foundations and Buildings

Exterior walls and the basemat of the nuclear island may require a water barrier up to site grade. The water barrier may consist of either a High-Density Polyethylene (HDPE) double-sided textured waterproofing membrane, a HDPE single-sided self-adhering sheet waterproofing membrane, a sprayed-on waterproofing membrane, or a cementitious crystalline waterproofing additive included in a shotcrete layer. These applications may be present either in or on the walls and mud mat for the nuclear island.

a. HDPE double sided textured waterproof and sprayed-on waterproofing membranes

Verify the following:

- Material Storage

Storage facilities for the waterproofing materials should meet the storage and handling requirements of the quality assurance program and manufacturer requirements.

The materials used for the HDPE or sprayed-on waterproofing membranes may be sensitive to ultraviolet (UV) rays, extreme high or low temperatures, and in some cases, storage durations. It is important when reviewing the storage and material handling procedures to ensure that these requirements are identified and met.

- Surface Preparation

Surface preparation procedures and activities should be consistent with manufacturer's recommendations, or, if applicable, qualification testing. In order for either the HDPE or spray-on membranes to adhere properly to the walls and mud mat, a primer or adhesive must be used. It is important that prior to the application of the primer or adhesive that the concrete surface has cured to the manufacturers recommendations and is properly cleaned to remove any excess moisture and surface laitance (dust). In addition, the surface must be free of holes, surface cracks, and abrupt transitions, excluding designed concrete expansion joints. Care must also be taken to protect the primer or adhesive from exposure to excess dust and moisture once it is applied. Improper surface preparation or protection of the primer or adhesive could have an adverse effect on the membrane's ability to properly bond to the primary surface.

- Membrane Installation

Installation procedures and activities (including, but not limited to, mixing and material preparation) should be consistent with manufacturer's recommendations, or, if applicable, qualification testing. Joint details should also be reviewed. Special attention should be paid to weather conditions. Variances in temperature and humidity could possibly affect the installation of the membrane. For example, sprayed-on membranes may require a minimum curing time prior to being exposed to precipitation while HDPE membranes may experience temperature related thermal expansion or contraction that could ultimately cause a failure in the membrane.

- Final Inspection

It is important when observing the inspection activities or reviewing inspection documentation to ensure that the inspection personnel or laboratory are qualified to perform the necessary activities. Special attention should also be given to any equipment used for performing measurements to ensure recent calibration. Prior to the membrane being permanently covered, a visual inspection should be performed to look for any signs of potential membrane failure. Potential failure may include sagging, pinholes, blistering, lifting, and delamination/peeling. Review of the licensee's report of completion of the installation of the water barrier.

- b. Cementitious crystalline waterproofing shotcrete additive

The placement of shotcrete on the vertical walls of the excavation is a part of the soil retention system and will establish a vertical face with lateral support of the adjoining undisturbed soil or rock. This shotcrete will contain the crystalline waterproofing materials. This installation closely follows the progress of the excavation and is from the top down.

- Shotcrete

Inspection of batch plant procedures and activities to evaluate preparation of the required shotcrete is contained in Section 4 of this attachment, including proper storage and use of concrete materials and additives. It also provides inspection guidance to ensure that the batch plant provides the proper mix strength and uses the proper additives.

The required mix for the vertical walls is typically 4,000 psi to 5,000 psi non-expansive pea gravel shotcrete mix, with a proper mix of Portland cement, very fine silica sand, and proprietary chemicals needed to produce the required waterproofing. Refer to the design requirements and specifications.

Verify the following:

- Proper placement of the welded wire mesh wall reinforcement system.
- Proper placement of the shotcrete includes measurements to ensure that thickness of installed shotcrete meets the design requirements.
- Adequate preparation of construction joints between vertical wall applications to ensure that the construction joints do not provide a leak path.

Installation activities will be dependent on whether the excavation is in soil or rock. In soil, activities will include installation of "soil nails," or some other approved method of soil retention, prior to installation of the welded wire mesh and vertical shotcrete placement. In rock, activities will include provisions for proper support of the welded wire mesh and vertical shotcrete placement. In either case, verify that the welded wire mesh is properly supported and that it is properly embedded and covered by the shotcrete to preclude potential leak paths through the waterproof barrier.

- Mud Mat

Verify that batch plant procedures and activities to evaluate the preparation of concrete for the mud mat ensure proper strength mix and addition of the required cementitious crystalline waterproofing additives.

The mix strength and the required waterproofing additives for the mud mat concrete should be as specified in construction and design specifications.

Verify the following

1. Proper placement of the welded wire mesh reinforcement system
2. Proper preparation and protection of the construction joint between the vertical wall shotcrete and the mud mat to ensure that the construction joint does not provide a leak path
3. Final mud mat thickness is at least nine inches thick, or as specified on the design drawings.

Review of the licensee's report of completion of the installation of the water barrier.

Section 7: Records, Interface Concerns, Lessons Learned

Inspections using this section should not be standalone inspection samples. Instead, guidance in this section should be used while inspecting the other sections.

a. Records

The concrete records establishing that applicable ITAAC has been met should be reviewed and should be assessed for completeness, accuracy, and documented evidence that the quality and code requirements have been satisfied.

Where required in the records documenting material certification, chemical and physical tests for components, parts, and materials should meet the specification requirements for acceptance criteria and test frequencies. Concrete placement testing includes certain in-process tests (e.g., slump tests), as well as completed concrete strength tests (e.g., cylinder compressive testing) and other material testing activities (e.g., mechanical rebar splice tensile testing).

Inspection records should provide evidence that the timing of events (e.g., a concrete pre-placement inspection) and time-dependent work activities (e.g., concrete truck mixing) are consistent with their specification requirements, thereby validating information or conditions applicable to the quality activity being inspected.

Training records should provide evidence of general procedural training for craft and QC personnel and specific qualification requirements (e.g., cadweld crews or concrete test laboratory personnel) where required for special processes.

Verify the following:

- Receipt Inspection and Material Certification: Records should confirm the requisite material characteristics, performance tests, nondestructive tests, and other specification requirements.
- Installation Inspections: Records should confirm that adequate concrete production, placement, inspection, protection and curing activities were performed; that the installation of embedded components was properly controlled; and that objective test results are available to demonstrate compliance with quantitative acceptance criteria.
- Training/Qualification of Craft, QA, and Inspection Personnel: Records should establish that craft personnel have been adequately trained in their assigned tasks (e.g., “cadwelding”) and that QA/QC personnel and other certified inspectors have been qualified to the requisite standards and trained with respect to their responsibilities.

b. Construction Interface Concerns

This section of construction interface concerns is included to provide inspectors with a background on past structural concrete control problems and management issues that should be more closely scrutinized to give the NRC early information for potential problems. The following inspection information provides some insight into the project management and engineering interfaces likely to be encountered during the NRC inspection of structural concrete activities.

- Poor coordination of structural concrete activities with other disciplines. Input from various designers, suppliers, and contractors should be properly integrated into instructions addressing interdisciplinary work (e.g., building steel or piping, electrical, mechanical equipment supports embedded in concrete placements).
- Frequency of civil/structural design engineers visits to the construction site to conduct follow-up checks of concrete placement activities. Interchange of design information between designer, constructors, inspectors, and managers regarding structural work, constructability issues, and field changes.
- Timeliness in design changes and drawing revisions to preclude the need for “last-minute” changes and delays after the concrete placement has been scheduled. This coordination should include consideration for testing requirements of embedded piping.
- Changes in the sources of concrete materials and admixtures from those originally being used.
- Licensee controls used to ensure the construction quality for areas inaccessible after the concrete placement.
- QA/QC inspection controls for signing off on the readiness for a concrete placement.
- Appropriate management oversight including a sufficient number of experienced, trained craft supervisors and QA/QC inspectors present during concrete placement activities.

c. Construction Experience and Lessons Learned

The following concrete quality process related issues (compiled from the NRC inspection records for the prior generation of plants constructed in accordance with 10 CFR 50) represent findings that NRC inspectors might encounter during the inspection of structural concrete activities.

- Inadequate QA/QC records.
- Improper use of vibrators.
- Exceeding allowable time to place concrete.
- Improper sampling of aggregates.
- Improper curing of concrete test cylinders.
- Exceeding allowable concrete temperatures.
- Materials improperly certified.
- Cylinder break test records exceed allowable coefficient of variation.
- Improper splicing practices (reinforcement cleaning, alignment, gage marks, thread damage, inadequate swagging force, etc.).
- Inadequate concrete curing.
- Samples of concrete not taken where and when required.
- Excessive amounts of concrete admixtures.
- Inadequate cleanliness of placement.
- Spacing of reinforcing steel in error.
- QC inspections not performed conscientiously.
- Excessive drop of concrete.
- Batch plants improperly qualified.
- Incorrect location or placement of embedded items such as anchor bolts, plates, and dowels.

While the above concerns primarily reflect process problems in the placement and inspection of structural concrete, these problems, if not corrected and adequately addressed, also adversely affect certain SSCs for which concrete quality is a contributing factor.

IV. References

- American Society for Testing and Materials (ASTM), "Standard Practice for Making and Curing Concrete Test Specimens in the Field (ASTM C31)"
- ASTM C94, "Standard Specification for Ready-Mixed Concrete"
- ASTM C143, "Standard Test Method for Slump of Hydraulic-Cement Concrete"
- ASTM C172, "Standard Practice for Sampling Freshly Mixed Concrete"
- ASTM C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method"
- ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort"
- ASTM E-329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction"
- American Concrete Institute (ACI), Publication MNL-2, "Manual of Concrete Inspection"
- ACI 117, "Tolerances for Concrete Construction and Materials"
- ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"
- ACI 214R, "Guide to Evaluation of Strength Test Results of Concrete"
- ACI 318, "Building Code Requirements for Structural Concrete"
- ACI 301, "Specifications for Structural Concrete"
- ACI 305R, "Guide to Hot Weather Concreting"
- ACI 305.1, "Specification for Hot Weather Concreting"
- ACI 306R, "Guide to Cold Weather Concreting"
- ACI 306.1, "Standard Specification for Cold Weather Concreting"
- ACI 311.4R, "Guide for Concrete Inspection"
- ACI 311.6, "Specification for Testing Ready Mixed Concrete"
- ACI 311.6M, "Specification for Ready Mixed Concrete Testing Services"
- ACI 311.7, "Inspection of Concrete Construction—Specification"
- ACI 336.3R, "Report on Design and Construction of Drilled Piers"
- ACI SPEC-336.1, "Construction of Drilled Piers Specification"
- ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures"

ACI 351.1R, "Report on Grouting between Foundations and Bases for Support of Equipment and Machinery"

ACI 355.2, "Qualification of Post-Installed Mechanical Anchors in Concrete"

ACI 355.4, "Qualification of Post-Installed Adhesive Anchors in Concrete"

ACI 439.3R, "Types of Mechanical Splices for Reinforcing Bars"

ACI 543R, "Guide to Design, Manufacture, and Installation of Concrete Piles"

ACI PRC-546, "Concrete Repair Guide"

American Institute of Steel Construction (AISC), Code of Standard Practice for Steel Buildings and Bridges (AISC 303)

AISC 341, "Seismic Provisions for Structural Steel Buildings"

AISC 358, "Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications"

AISC 360, "Specification for Structural Steel Buildings"

AISC N690, "Specification for Safety-Related Steel Structures for Nuclear Facilities"

American Society of Civil Engineers (ASCE) Standard, "Minimum Design Loads for Buildings and Other Structures (ASCE 7)"

Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice"

Research Council on Structural Connections (RCSC), "Specification for Structural Joints using ASTM A325 or A490 Bolts"

Regulatory Guide (RG) 1.28, "Quality Assurance Program Criteria (Design and Construction)," Revision 6, 06/2010

RG 1.29, "Seismic Design Classification for Nuclear Power Plants," Revision 6, 07/2021

RG 1.69, "Concrete Radiation Shields and Generic Shield Testing for Nuclear Power Plants," Revision 1, 05/2009

RG 1.107, "Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures," Revision 2, 06/2011

RG 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments," Revision 4, 02/2021

RG 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)," Revision 3, 05/2020

END

Attachment 2: Revision History for IP 75001.01

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)
N/A	ML26057A077 04/01/26 CN 26-011	Initial Issuance.	N/A	N/A