INSPECTION PROCEDURE 69020 APPENDIX A

INSPECTION OF FOUNDATIONS AND BUILDINGS AT NON-POWER PRODUCTION AND UTILIZATION FACILITIES

Effective Date: March 25, 2025

PROGRAM APPLICABILITY: IMC 2550

69020.A-01 INSPECTION OBJECTIVES

01.01 To determine if safety-related foundation and buildings work is being performed in accordance with regulatory requirements, the licensing basis, specifications, drawings, and work procedures.

01.02 To determine if the applicant/licensee's system for preparing, reviewing, and maintaining records relative to safety-related foundation and building activities reflect work accomplishment consistent with specifications and procedures.

01.03 To determine if the as-built condition of safety-related foundations and buildings meets the specified design requirements, specifications, and drawings.

01.04 To determine that the implementation of the quality assurance program (QAP) related to work activities for safety-related foundations and buildings is effective and to verify that deviations from requirements are appropriately resolved.

69020.A-02 INSPECTION REQUIREMENTS

02.01 For the safety-related structure(s) selected for inspection, determine if appropriate and adequate procedures in the following areas are compatible with the QAP and prescribe adequate methods to meet specifications:

a. excavation and subgrade preparation
b. foundation verification
c. placement of engineered fill and backfilling
d. dewatering
e. construction quality control inspection and testing
f. instrumentation and settlement monitoring
g. surveying
h. engineering direction
i. soil compaction and testing

02.02 Determine if the applicant/licensee has an established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements in the area of geotechnical/foundation activities. Confirm the audit program ensures that examination, inspection and test personnel associated with

performing tests and inspections of geotechnical/ foundation activities are qualified and/or certified to perform their assigned work.

02.03 Determine if the following geotechnical/foundation activities are being controlled and accomplished in accordance with the requirements of the documents reviewed in 02.01, above:

a. excavation and subgrade preparation
b. foundation verification
c. backfilling (fill materials and compaction control)
d. dewatering systems (If applicable)
e. construction quality inspection and onsite testing laboratory
f. instrumentation and settlement monitoring program
g. surveying
h. engineering direction
i. soil compaction and testing
j. configuration management

02.04 Review the documentation generated for the safety-related geotechnical/foundation activities. Determine if the applicant/licensee/contractor system for documenting safety-related work is functioning properly. Records should be complete, reviewed by quality control, engineering personnel, or designee and readily retrievable. Review safety-related records in the following areas:

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

69020.A-03 INSPECTION GUIDANCE

General Guidance

Inspectors should review the facility description in the safety analysis report (SAR) or equivalent and be familiar with the safety-related structures being constructed at the site. The purpose of these inspections is to verify that the assumptions and critical attributes reviewed during the licensing review process remain valid; the design was appropriately translated to construction specifications; the licensee/applicant constructed the facility in accordance with these specifications; and any changes made to the design described in the SAR comply with the licensee's configuration management program.

Inspectors should also be familiar with the licensee's QAP and use IP 69021, "Inspections of Quality Assurance Program Implementation During Construction of Non-Power Production and Utilization Facilities" to perform "vertical slice" inspections as described in the body of this IP. Inspectors should complete this appendix by inspecting the attributes listed in this appendix for foundation and building work on-site at the time of the inspection with a focus on safety-related structures. Inspectors should also coordinate this appendix with inspection of structural concrete (Appendix B of this IP), and structural steel and steel supports (Appendix C of this IP) for efficiency, if possible.

Inspectors should contact the applicant/licensee prior to the on-site inspection to help determine which building(s) are to be inspected. Observation during in-progress construction of the buildings is desirable but not required. If necessary, inspectors may select completed foundations and buildings for inspection. Inspectors should not attempt to inspect all the buildings on the site but may expand if significant concerns with the applicant/licensee's control of foundation and building construction arise.

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

Inspectors should choose one or more safety-related structures and review the areas listed in 02.01 through 02.04 to the extent practical and may use their judgment in determining which areas to concentrate on if time is limited. However, inspectors should gain an understanding of the applicant/licensee's program to the extent necessary to determine if the licensee conforms to regulatory requirements. Not all items in the inspection requirements section will be applicable or required in all situations for all safety-related structures, systems, and components.

03.01 Inspection Requirement 02.01

a. For the building(s) selected for inspection, review procedures, specifications, drawings, and other relevant design documents to verify they conform to the commitments contained in the licensing basis, including construction specifications:

    1. excavation and subgrade preparation
    2. foundation verification
    3. placement of engineered fill and backfilling
    4. dewatering
    5. construction quality inspection and testing
    6. instrumentation and settlement monitoring
    7. surveying
    8. engineering direction
    9. soil compaction and testing

b. If applicable to the project, perform a review of the results of the test-fill program before reviewing the implementing procedures, to verify that the fill procedures have been qualified. The implementing procedures should reflect the methods, equipment, materials, and conditions of the test-fill program.

03.02 Inspection Requirement 02.02

a. Review applicant/licensee's established audit program (including plans, procedures, and audit schedule) for assessing the adequacy of work control functions and requirements in their licensing basis for geotechnical/foundation activities.

b. Review audit program to verify if examination, inspection, and test personnel associated with performing tests and inspections of geotechnical/foundation activities are qualified and/or certified to perform their assigned work.

c. Verify records establish that the required audits were performed and that deficiencies identified during audits were appropriately resolved.

03.03 Inspection Requirement 02.03

Determine if the following activities are being controlled and accomplished in accordance with the requirements of the documents reviewed in 02.01, above:

1. Excavation and Subgrade Preparation

a) The excavation methods and sequence of operations should not be detrimental to the final foundation subgrade materials. Unusual or changed conditions encountered during excavation of cavities, faults, pockets of unsuitable material, springs, seeps, boils, and protrusions, are noted, investigated, evaluated, and taken into consideration.

b) The foundation subgrade should be free of organic or soft unsuitable material. Depressions or holes left by grubbing and stripping or excavation should be backfilled with suitable materials compacted and tested to the specified density and moisture content. Soil classification at the depth excavated for foundations should be verified and compared with the soil profile determined during subgrade explorations (bore holes, exploratory excavations, etc.). The occurrence of extraneous detrimental or unexpected soil may necessitate further investigation or evaluation/redesign. The finished grade should be as specified, meet compaction and density requirements, be protected from the elements, and be tested and inspected.

c) Determine if the stockpiling and segregation of excavated materials which are to be used as seismic fill material are in accordance with specifications.

d) The foundation subgrade treatment such as compaction, installation of foundation drains, or other methods should be properly controlled.

e) Determine if construction quality inspections are adequate regarding scope, frequency, and inspector qualifications.

f) The record-keeping activities should reflect the actual conditions encountered in the field and provide adequate documentation of work and inspections. Determine if records are being maintained, reviewed, and approved as specified.

g) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee's commitments. Refer to the licensing basis documents for actual commitments and requirements.

Unexpected conditions are frequently encountered, ranging from unfavorable deposits of materials not found in the exploratory program, to problems not identified in previous site studies.

Where unfavorable conditions are encountered, further exploration by test pits, borings, or other means are necessary to define the extent and nature of conditions. The effect of the unexpected conditions should be evaluated in

relation to the original design. Examples of common unfavorable conditions frequently encountered are:

1) highly compressible and low-strength soils;
2) collapsible soils - low-density soils that collapse when saturated;
3) old river channels;
4) cavities and solution features;
5) overhangs and surface depressions;
6) springs or artesian conditions; and
7) unstable excavation slopes because of unanticipated conditions.

Excavation materials are frequently used as engineered fill or backfill around structures. The inspector should determine if these materials have been qualified through explorations and testing by a soils testing laboratory and if they are stockpiled in designated areas. Excavated materials to be used as structural fill, should be excavated in layers, so that widely varying soil classes are not mixed. Some of the more common tests used for qualifying soils materials, and their associated standards, are:

1) moisture/density relationships;
2) soil-classification tests;
3) particle-size analysis;
4) test for plastic limit and plasticity index; and
5) other codes and standards. A geotechnical engineer should control acceptance and qualification of excavated materials.

2. Foundation Verification.

a) Verify that geotechnical engineering direction is available. Foundation subgrades should be approved by an experienced geotechnical engineer before placement of engineered fill, mud mats, or structural concrete. Determine if records are maintained to document approval of the final foundation subgrade. Records should include elevation, actual conditions, methods to achieve acceptable conditions, and inspection and test acceptance criteria and final acceptance results.

b) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee's commitments. Refer to the licensing basis documents for actual commitments and requirements.

A geotechnical engineer should approve soil subgrades before placement of engineered fill, mud mats, or structural concrete. Compaction is the usual method to treat or stabilize loose, disturbed, or unsuitable areas in soil subgrades. The inspector should determine if appropriate sampling and testing procedures are included to verify the material in place is as specified.

3. Backfilling (Fill Materials and Compaction Control)

a) Specified lift thicknesses are adhered to, and specified equipment is being used with the correct number of roller passes.

b) Source material being used is identified and is traceable to an approved borrow source. The approved source material should meet design and earthwork specification requirements and have been properly qualified by an approved soils laboratory.

c) Ensure that engineered fill or backfill is placed at the proper location and on approved foundation materials.

d) Verify that in-place density tests are being performed at the required frequency with properly calibrated instruments (including moisture content tests). If a nuclear density test is performed using a nuclear density gauge or Troxler, verify that the instrument has been calibrated, and radioactive source leak checks have been performed.

e) Samples for laboratory tests are being taken at the required frequency, chain-of-custody established, and the samples are adequately identified. Review the results of the required tests and compare results to design specification requirements and applicable standards.

f) Construction quality inspection activities are being performed as required by qualified and/or certified personnel. Review inspection documentation and verify that the records quantitatively define actual construction conditions and qualitative test results.

g) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee's commitments. Refer to the licensing basis documents for actual commitments and requirements.

In some instances, preparation for foundations may consist merely of excavation and grading to appropriate dimensions. However, in many locations, the top layer of native site material may be too soft, or otherwise unsuitable, to properly support the structures. In this case, some special comp active effort may be required. Occasionally, adequate compaction may be achieved on the native material in place in conjunction with careful control of groundwater level. More typically, it will be necessary to remove the native material and fill the resultant excavation under carefully controlled procedures, in relatively thin layers, sequentially compacted.

Before placing engineered fills, materials and compaction requirements should be qualified by laboratory tests and test fills. Required moisture/density relationships for each material should be determined in accordance with applicable construction codes and may reference ASTM D-698 or ASTM D-1557. The inspector should be assured that the specified method is being used. Where impervious materials are used, qualification tests should include determination of the Atterberg Limits ("Liquid Limit, Plastic Limit and Plasticity Index", ASTM D-4318). Particle-size analysis should also be made and may reference test methods in ASTM D-422 and ASTM D-1140.

Test fills for each material type should be made to determine lift thickness, type of compaction equipment, and number of passes to be used in compacting fills to specified densities.

In-process testing used to control fill placement, for the most part, will be density tests and moisture tests. Acceptance will be in terms of some percentage of the maximum dry density (usually 95 percent) and a moisture content within some percentage of optimum (usually 2 percent), which may include reference to ASTM D-698 or ASTM D-1557. Density tests may be made by test methods that may reference ASTM D-1556 (most common method used); ASTM D-2167; ASTM D-2922, or ASTM D-2937. Test-method ASTM D-2922, if used, should be calibrated against a reliable direct method.

Control of moisture content at time of compaction is extremely important, especially with materials having more than 12 percent passing a No. 200 sieve. Testing and research has demonstrated that variation of the moisture content of a material, at time of compaction, even though it has been compacted to the same dry density, has a wide-ranging effect on the shear strength, permeability, and consolidation characteristics of the material. Ultimate control of moisture should be by test-method and may reference ASTM D-2216, “Laboratory Determination of Moisture Content of Soil.” Rapid methods, such as the "Speedy" and field stoves, are sometimes used to expedite operations, because of the time required for test-method ASTM D-2216. Where rapid methods are used, they should be calibrated against ASTM D-2216, and their variation taken into consideration in controlling moisture content of the fill. For example, if the specified moisture control is 2 percent of optimum and calibration checks show that the rapid method varies by 1 percent from ASTM D-2216, then field control using the rapid method should be held to 1 percent of optimum. Field-stove methods should be limited to granular materials, with little or no fines, since experience shows results with impervious materials are erratic (probably because of driving off the water of hydration).

4. Dewatering Systems. Note that 1 and 2 below represent good practice but are not requirements unless specified in the site specifications.

   a) Emergency power supply to ensure continuous dewatering system operation is being maintained and tested.

   b) Open excavations are protected from flooding by an adequate sump pump system.

   c) Piezometric surfaces are being defined by monitoring performed at the required frequency.

   d) Inspection and testing of system discharge should assure that sediment material is not being removed from the foundation.

   e) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee’s commitments. Refer to the licensing basis documents for actual commitments and requirements.

      Some degree of groundwater control will be required, at least during site preparation and foundation placement. Groundwater removal may be required to properly compact the soil-bearing area. The design may require that groundwater be permanently maintained below some specified elevation.

Excavations and placement of fill and foundations should be in the dry state. Discharge outlets of dewatering systems should be monitored for sediment content, to assure that subgrades are not being undermined. Dewatering systems, if not properly designed, installed, and operated, can have an adverse effect on foundations. Improper design and operation can, and have, resulted in undermining of foundations through removal of sediment with the discharge water. The inspector should assure himself that careful consideration has been given to the impact that the installation, operation, shutting down, and decommissioning of the system will have on foundation design. Through observations, the inspector should satisfy themself that the system has been installed and is being monitored as specified. Piezometers or observation wells should be used in conjunction with the dewatering system, to monitor the groundwater surface and pore pressure beneath the subgrade and adjacent ground.

Acceptable methods for installation and maintenance of piezometers and observation wells can be found in the U.S. Army Corps of Engineers Manual, EM 1110-2-1908, 1972. Refer to licensing basis and applicable building codes for requirements.

5. Construction quality inspection and Onsite Testing Laboratory.

   a) The onsite laboratory has performed verification of laboratory personnel qualifications (education and experience) of testing and inspection personnel. Personnel qualification verifications should be supported by objective evidence documenting education and experience.

   b) Test results are being evaluated at an appropriate level and evaluation includes trend analysis.

   c) Observed testing standards conform to the procedures specified in the American Society for Testing and Materials.

   d) Testing apparatuses are calibrated at the required frequency and calibration traceable to a nationally recognized standard and calibration is in accordance with approved procedures.

   e) Records reflect the results of inspections, the actual field conditions, testing frequency requirements, acceptance criteria, and data calculations are checked.

   f) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee's commitments. Refer to the licensing basis documents for actual commitments and requirements.

      Acceptance of all earthwork on site, including verification of soil foundations, engineered fill and backfill will usually be based on testing done by the site-soil laboratory. The inspector should routinely check the soils laboratory during inspections. The inspector should ensure that work is being done in accordance with specified methods and with specified equipment that is periodically calibrated for accuracy. Testing personnel should check data calculations for accuracy and the inspector should spot check them.

Qualifications of testing personnel should be checked by personal interviews, examination of certification records, and licensee's procedures and records, to verify contractor's qualification records.

6. Instrumentation and Settlement Monitoring Program.

   a) Number, location, and type of instruments are appropriate.

   b) Instrumentation and settlement-monitoring systems installed before start of activity being monitored.

   c) Instrumentation and settlement-monitoring systems are installed as specified, functioning properly, and protected against construction hazards.

   d) Operation and monitoring: operations are monitored at specified frequency to assure that construction activities have not made installed instrumentation inoperable.

   e) Calibration of measuring and testing equipment is maintained, logged, and functionally checked.

   f) Recordkeeping activities: records reflect specified frequency of monitoring, data checks (e.g., supervisory review, engineering review), data evaluated and accepted. This is important in activities such as settlement monitoring. A comparison of the actual settlement data with those predicted can reveal problems at an early stage, enable the cause to be determined relatively early in the construction phase, or can cause design changes to be incorporated before the completion of extensive construction work.

   g) Reference Guidance. For reference and consideration when selecting samples and assessing inspection results. Any references cited in this section are for background and not reflective of actual applicant/licensee’s commitments. Refer to the licensing basis documents for actual commitments and requirements.

      Instrumentation will usually consist of settlement monuments for monitoring settlement and piezometers, or well points for monitoring the groundwater surface and pore pressure. Specific guidance regarding their use, installation, and maintenance can be found in the U.S. Army Corps of Engineers Manual EM 1110-2-1908. Refer to licensing basis and applicable building codes for requirements. The inspector should ensure that the instrumentation is installed as specified, is adequate for the intended use, and that accuracy of the data recorded is sufficient to provide needed information. The instruments should be monitored periodically, throughout construction, and, if needed, post-construction.

7. Surveying. The instruments are properly calibrated, and calculations are checked to assure accurate results.

8. Engineering Direction. Engineering direction is available onsite to monitor geotechnical/foundation construction activities. The onsite engineering staff should be supplemented by an experienced geotechnical engineer to approve final foundation subgrade materials, monitor, and review quality control inspections and

test results, and identify changed field conditions. The onsite engineering staff should be involved in disposition of nonconformance reports and prepare engineering field change requests for approval by the engineering design agent or organization.

9. Configuration management. For the activities observed during Inspection Requirement 02.03., verify if changes occurred during these construction activities, the applicant/licensee properly controlled and documented these changes for engineering review, approval, and subsequent incorporation into the final as-built drawings. Verify these actions were completed in accordance with their procedures and QAP.

03.04 Inspection Requirement 02.04

Determine if, for the geotechnical/foundation activities, the applicant/licensee/contractor system for documenting safety-related work is functioning properly.

1. Receipt Inspection and Material Certification. Applicable for materials purchased from offsite suppliers such as drainage materials, geosynthetic fabrics, select fill materials, sand and gravel, instrumentation, and dewatering system components. Records confirm that required material characteristics, performance tests, civil soil tests, nondestructive tests, and other earthwork specification requirements were met.

2. Installation Inspection. Records confirm that specified materials and components were installed as specified and that the required construction inspections were performed, and acceptance criteria are defined.

3. Nonconformance/Deviation Record. Records include current status of these items. Nonconformance reports include the status of corrective action or resolution, (e.g., determine if adequate corrective action is being taken when moisture density test results are not within tolerance or acceptance criteria.)

4. Training/Qualification Records of Craft, and Quality Inspection Personnel. Records establish that quality inspection personnel are adequately qualified for their assigned duties and responsibilities and that craft personnel have been trained in their assigned tasks.

5. Configuration Management Records. Review and evaluate a selected sample of configuration management records, and determine if:

   a) Records associated with design and field changes, as well as related work and IP changes, reflect that timely review and evaluation of design and field change documents have been performed by personnel who are qualified.

   b) Records of periodic inspections ensure that only the most recent approved documents, including design changes, were used in the field.

   c) Design changes are subject to adequate design control, including consideration of the impact of the change on the overall design and on as built records.

   d) Records of nonconformance’s to design requirements include preparation of a nonconformance report even if the nonconformance is resolved through the design-change process.

03.05 Additional Guidance

Note: Determine if enough adequately qualified quality control inspection personnel are at the construction site, commensurate with the work in progress, and adequately performing their assigned duties through the established organizational structure.

Prevalent Errors and Concerns. Prevalent errors and recent concerns are areas in which the inspector should be alert to potential generic issues. These areas include:

1. Insufficient compaction of foundation and backfill materials was identified at several sites, as described in IE Circular 81-08.

2. Placement of fill for control of compaction requires control of ground-water levels.

3. Construction quality control test results need to be reviewed and trended to assure that tests are performed in accordance with specification requirements, that the results are reasonable, that the results meet requirements, and that locations where samples/tests were obtained (location and elevation) can be accurately identified. Test deficiencies need to be entered into the corrective action program and evaluated by engineering personnel.

4. Audits should identify procedural inadequacies or the cause of repetitive nonconforming conditions.

69020.A-04 RESOURCE ESTIMATE

Completion of this appendix requires 40–80 hours of direct inspection. Inspection preparation, including review of applicable licensing basis, safety analysis report (SAR), and codes and standards is not included in this estimate.

69020.A-05 PROCEDURE COMPLETION

This inspection procedure appendix is complete when one inspection sample is complete. An inspection sample, in the context of this IP appendix, is one inspection of a safety-related building at the facility. More than one safety-related building may be included in the sample if time permits. Inspectors are not expected to complete every activity in this IP appendix. Instead, inspectors should prioritize inspection activities based on 1) importance of the activity to safety, 2) availability of the onsite activity at the time of the inspection, and 3) available inspection resources. This appendix does not need to be completed if there are no safety-related items (or services) covered by this appendix at an NPUF.

69020.A-06 REFERENCES

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

American Society of Testing and Materials (ASTM), ASTM D-1140, “Test for Amount of Material in Soils Finer than No. 200 Sieve”

ASTM D-1556, “Test for Density of Soil in Place by the Sand-Cone Method”

ASTM D-1557, “Moisture-Density Relations of Soils”

ASTM D-2167, “Test for Density of Soil In place by the Rubber-Balloon Method”

ASTM D-2216, “Laboratory Moisture Content of Soil”

ASTM D-2922, “Tests for Density of Soil and Soil-Aggregate In place by Nuclear Methods (Shallow Depth)”

ASTM D-2937, “Test for Density of Soil In place by the Drive-Cylinder Method”

ASTM D-422, “Particle Size Analysis of Soils”

ASTM D-4318, “Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils”

ASTM D-698, “Moisture-Density Relations of Soils”

Office of Inspection and Enforcement, IE Circular No. 81-08, “Foundation Materials”, May 29, 1981

U.S. Army Corps of Engineers, “Instrumentation of Earth and Rock-Fill Dams (Groundwater and Pore Pressure Observations)”, Engineer Manual EM 1110-2-1908

U.S. Army Corps of Engineers, “Soil Sampling”, Engineer Manual EM 1110-2-1907

END

List of Attachments:
Revision History for IP 69020 Appendix A

Attachment 1 – Revision History for IP 69020 Appendix A

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	ML24264A193 03/25/25 CN 25-005	Procedure was rewritten for conformance with changes to IMC 2550 and is now a standalone appendix to IP 69020.	N/A	N/A