

ATTACHMENT 65001.E

INSPECTION OF THE ITAAC-RELATED QUALIFICATION PROGRAM

PROGRAM APPLICABILITY: 2503

This inspection procedure, in conjunction with the ITAAC matrix row inspection procedures, is intended to verify that broad categories of design criteria have been correctly incorporated in System, Structure and Component (SSC) design and construction, and that the corresponding ITAAC have been met for the SSCs. These broad design criteria are referred to as “qualifications” and may be part of an operational program (e.g. environmental qualification), may be a more generic design requirement (e.g. seismic qualification), or may be a qualification unique to a particular type of SSC (e.g. electrical component qualifications).

65001.E-01 INSPECTION OBJECTIVES

01.01 To verify that the licensee is using the appropriate design basis parameters for qualification and that the design basis was appropriately translated into SSCs qualification test or qualification analysis.

01.02 Deleted.

01.03 To verify that required qualification of Structures, Systems, and Components (SSCs) has been completed in accordance with regulatory requirements, design specifications, and approved procedures.

01.04 To verify that licensee records establish an adequate basis for acceptance of ITAAC with qualification criteria attributes.

01.05 To verify that the equipment is installed in a manner consistent with the design assumptions and qualification testing.

01.06 To verify that problems involving qualification activities are identified at an appropriate threshold and are being entered into the corrective action process.

65001.E-02 INSPECTION REQUIREMENTS AND GUIDANCE

02.01 Design Basis Requirements. Verify that the licensee is using the appropriate design basis parameters for qualification. Verify that the design basis was appropriately translated into the SSC qualification test or qualification analysis.

- a. Select several components for review. To the extent possible, the sample should contain components from more than one system and components of various sizes, types, and manufacturers.
- b. Identify the limiting design basis parameters (i.e., minimum or maximum voltage, temperature, or pressure) that were used as input for the qualification of the SSC. Verify, by review of the necessary design basis documents and calculations, as appropriate, that the licensee has correctly incorporated these parameters into the design specification.
- c. Review the design specification developed by the licensee or designated design authority. Verify that all the necessary requirements for the qualification are incorporated, including ITAAC requirements and acceptance criteria.

Seismic Guidance. The design specification documents the seismic analyses and/or tests required to demonstrate that Seismic Category I SSCs will be able to perform their safety functions during and after a seismic event. The design specification should specify design response spectra or design time histories for qualification by analysis, and required response spectra (RRS) for qualification by testing, with appropriate damping values and acceptance criteria. The design specification should also specify the number and magnitude of earthquake cycles for Seismic Category I SSCs sensitive to fatigue. The design specification should finally specify equipment mounting details and interface connections. Reference can be made to the plant **Final Safety Analysis Report (FSAR)** for seismic design basis requirements for SSCs. Seismic Category I SSCs must also be protected from unacceptable structural interaction with Seismic Category II and non-seismic structures during and after a **safe shutdown earthquake (SSE)**. Refer to Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," and its referenced standard IEEE, Std 344, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Section 11, **Documentation** for a complete list of information that should be included in the design specification.

Physically verify that Seismic Category I components are installed in a Seismic Category I structure. If the structure is not Seismic Category I, then the inspector should verify that adequate action has been taken to assure structural integrity of the equipment.

Review the applicant records for equipment qualification and verify that they followed the methodology called out in the license. Review the seismic qualification reports for the selected equipment. This could include review of walk down records and drawings, checking on assumptions made in the seismic qualification reports against the as-installed equipment configurations, and anchorages. For tests, verify that the appropriate response spectra were used for the location of the equipment and that the results are acceptable. For analyses, review the licensee's analyses to determine that it is valid and follows the methodology called out in the license. The targeted ITAAC should provide a sufficient sample to complete this portion of the inspection for the site and to conclude that there is reasonable assurance that qualification requirements have been met. Expand the sample if concerns are identified to determine the extent of condition.

On-site inspection is needed to verify that the as-built equipment, including the anchorage, is installed as designed and bounded by the testing and/or analyzed condition. Verify that the design was reconciled with the as-built configuration if this was required.

Environmental Qualification (EQ) Guidance. See NRC regulatory requirements in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants." For example, the EQ qualification must account for the following design basis parameters: temperature, pressure, humidity, chemical effects, radiation, aging, submergence, and synergistic effects, and must apply appropriate margins to account for unquantified uncertainty. The design specification should include equipment mounting details and interface connections, age conditioning procedure, service conditions and margins, and acceptance criteria. See NUREG 0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," and its referenced standard IEEE Std 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Section 6 for a complete list of information that should be included in the design specification. For mechanical equipment, review the materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, hydraulic fluids, and diaphragms). Mechanical equipment will experience the same environmental conditions as those defined in 10CFR 50.49 (e) for electrical equipment. These conditions will be used in reviewing the environmental qualification of mechanical equipment. See NRC Standard Review Plan Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment," for additional guidance. Refer to IP 51080, "Part 52 Environmental Qualification (EQ) under 10CFR 50.49" for additional inspection guidance."

Electrical Isolation and Electromagnetic Interference (EMI) Guidance. Proper electrical isolation prevents faults in a non-safety system from propagating into a safety system. Electrical isolation can be achieved by the use of qualified isolation devices, shielding and wiring techniques, or separation distance. See Regulatory Guide 1.75, "Criteria for Independence of Electrical Safety Systems," and its referenced standard IEEE Std 384, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," for more information. Design of the nuclear power generating station's safety equipment must consider the electromagnetic environment to include electrostatic discharge (ESD) as well as the four coupling mechanisms: conductive, radiative, inductive, and capacitive. The design techniques to provide protection against ESD, EMI, radio frequency interference (RFI), and surge withstand capability (SWC) are shielding, grounding wire selection, wire routing, suppression, filtering, data quality checking, and software handling (software band pass filtering). See Regulatory Guide 1.75, "Criteria for Independence of Electrical Safety Systems," and its referenced standard IEEE Std 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Annex B for more information. The design specification should include equipment mounting details, interface requirements including connections, power, and control signal inputs and outputs, age conditioning procedure, service conditions and margins, and acceptance criteria. See NUREG 0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," and its referenced standard IEEE Std 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Section 6 for a complete list of information that should be included in the design specification.

Digital I&C Guidance. The design shall include barriers that provide adequate confidence that the non-safety functions cannot interfere with the performance of safety functions of the software or firmware. The design must also include the security of computer system software to prevent unauthorized and unsafe intrusions into the safety system. The software should have no undocumented codes. See Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," and its referenced standard IEEE Std 7-4.3.2, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," for additional information.

The design shall ensure that automatic safety function and Class 1E manual controls have priority over non-Class 1E controls within the software or firmware. Refer to IP 65001.22, "Inspection of Digital Instrumentation and Control (DI&C) System/Software Design Acceptance Criteria (DAC) - Related to ITAAC" for additional inspection guidance.

Main Control Room (MCR) and Remote Shutdown Workstation (RSW) Human Factors Engineering (HFE) Guidance. Use ANSI/ANS-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination," for the verification and validation testing requirements in the software development process in a controlled configuration environment and scenario-based testing requirements. Use IP 41502, Section 02.02, the results of previously conducted IP 41502 inspections, and/or IP 65001.23 "Inspection Of Human Factors Engineering Integrated System Validation ITAAC" to conduct this part of the inspection. Risk-important human actions should be identified from the probabilistic risk assessment/human reliability analysis (PRA/HRA) and used as input to the HFE design effort in order to minimize the likelihood of personnel error when operating the MCR or RSW. See Standard Review Plan 18.0, "Human Factors Engineering," and NUREG-0711, "Human Factors Engineering Program Review Model," for additional information.

02.02 Deleted.

02.03 Qualification Inspection. Verify that the qualification of SSCs is in accordance with appropriate design specifications and meets the acceptance criteria.

- a. Observe the qualification testing of selected components when the qualification test will take place on-site. Observe on-site acceptance testing of selected SSCs when the acceptance test is intended to verify the adequacy of the SSCs qualification. Consider observation or review of the results from field surveys or tests of RFI or EMI electromagnetic field strengths, and compare to the maximum allowed values. Verify that the test was conducted in accordance with approved procedures.
- b. Review the qualification report. Depending on the type of qualification, the qualification may consist of a test, an analysis, or a combination of test and analysis. In addition, NRC-approved industry experience may be used for seismic qualification. Verify that the qualification was conducted in accordance with the specification, the results meet the acceptance criteria stated in the design specification and the ITAAC, and the results state the qualified life of the SSC.

- c. Verify that the qualification report, for the equipment required to be qualified, concludes that the SSC can withstand the conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.

Seismic Guidance. Refer to Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," and its referenced standard, IEEE Std 344, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Section 11 for a complete list of information that should be included in the qualification report.

EQ Guidance. See NUREG 0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," and its referenced standard, IEEE Std 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Section 7 for a complete list of information that should be included in the qualification report.

Electrical Isolation and Electromagnetic Interference Guidance (EMI). See NUREG 0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," and its referenced standard, IEEE Std 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Section 7 for a complete list of information that should be included in the qualification report.

Digital I&C Guidance. Qualification of digital systems should include system hardware configuration, including all external connectivity, software integration testing, software qualification testing, system integration testing, system qualification testing, and system factory acceptance testing. See Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," Regulatory Guide 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," and its referenced standard, IEEE Std 1012, "IEEE Standard for Software Verification and Validation," for more information.

MOV Guidance. The qualification of an MOV to be installed by the licensee consists of three parts:

- Qualification of a valve assembly (e.g., valve and motor operator). The vendor or contractor will qualify an MOV by performing an internal inspection of the valve, actuator, and stem nut for condition and critical internal dimensions, and dynamic diagnostic testing under applicable temperature, pressure, and flow conditions. This will most likely be at or near design basis conditions.
- Qualification of a similar MOV. A similar MOV, for example, one that differs only in size or material, will be qualified by a comparison of the MOV's physical attributes to the qualified MOV and diagnostic test data or comparison of physical attributes and a test-based analytical method. Specifically, an internal inspection of the MOV will be conducted to establish applicability to the qualified MOV. A static diagnostic test will be performed to verify proper MOV assembly. A dynamic diagnostic test will be performed under applicable temperature, pressure, and flow conditions and compared to the

qualified MOV. The testing will be at less than design basis conditions. A test-based analytical method that has been demonstrated to reliably predict MOV performance may be used to minimize the amount of dynamic testing required to verify the capability of the valve to stroke under design basis conditions.

- Demonstration of the functional capability of the MOV to be installed by the licensee. This will be accomplished by verification of the physical attributes, application, and diagnostic data of the MOV to be installed to the MOV qualified in **bullet 2** above. The MOV to be installed will have an internal inspection to verify applicability to the qualified similar MOV. A static diagnostic test will be performed to verify proper MOV assembly. The valve will then be cycled under fluid conditions to verify functional capability. The fluid conditions may be less than those in 2 above. A test-based analytical method may be used to minimize the testing under flow conditions.

The construction inspector should verify all three parts of the MOV qualification. However, if the licensee elects to perform the MOV functional capability testing (**bullet 3 above**) following final MOV installation, the inspection of that portion of the qualification needs to be conducted by the startup testing inspector. See ASME QME-1, Section QV, for additional information.

In addition, the MOV qualification must also account for other design basis conditions not typically tested, such as degraded voltage and elevated ambient temperature conditions, uncertainty (test equipment inaccuracy, torque switch repeatability), and age-related degradation (stem lubrication degradation, spring pack relaxation, rate of loading degradation, and valve seat degradation). The licensee must have an adequate engineering basis for the values selected. For gate valves, the licensee must assess the potential for pressure locking and thermal binding and address any potential issues. Switches must be set to ensure the valve will operate under design basis conditions without valve or actuator damage. Valve stroke time must be within the time assumed in the design bases, accident analyses, the technical specifications, or the ASME IST program. See IP 62708, "Motor-Operated Valve Capability," IP 62710, "Power-Operated Gate Valve Pressure Locking and Thermal Binding," and IP 73756, "Functional Design, Qualification, and Inservice Testing Program for Pumps, Valves, and Dynamic Restraints," for additional guidance. See also Standard Review Plan Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints."

Main Control Room (MCR) and Remote Shutdown Workstation (RSW) Human Factors Engineering (HFE) Guidance. Use IP 71111.11, Sections 02.11, 03.11 and Appendix C; **IP 41502, Sections 02.02, 02.03, 03.01, 03.02, Attachment 1, and Attachment 2; the results of previously conducted IP 41502 inspections, or IP 65001, Attachment 65001.23** to conduct this part of the inspection for the normal, transient, and accident conditions specified in the selected ITAACs. For risk-significant, time-dependent operator actions, verify that the actions can reasonably be completed in the time assumed in the design analysis or probabilistic risk assessment (PRA). Verify that the man-machine interface of the main control room and remote shutdown workstations supports efficient plant operation and minimizes the likelihood of personnel error. See Standard Review Plan 18.0, "Human Factors Engineering," for additional information.

02.04 Documentation. Review the licensee's records for documenting the acceptance of ITAAC qualification. Verify that the records are maintained in an auditable manner, are complete, and clearly document completion of the ITAAC.

- a. Verify that the licensee or contractor has complete records for every SSC in the ITAAC. A complete record for each SSC should contain, as a minimum, a design specification and a qualification report as described in section 02.02 and 02.03 above.
- b. Verify that the documentation includes a licensee or contractor review of the ITAAC records and documentation that the ITAAC requirements have been met.

EQ Guidance. The licensee also must maintain a master list of all EQ equipment. See NRC regulatory requirements for electrical equipment in 10 CFR 50.49(d).

Main Control Room (MCR) and Remote Shutdown Workstation (RSW) Human Factors Engineering (HFE) Guidance. For simulator qualification, Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations," and its referenced standard, ANSI/ANS-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination," require that a record of the performance test results be maintained, including data comparisons. **Use IP 41502, Section 03.03 and Attachment 1 or the results of a previously conducted IP 41502 inspection to conduct this part of the inspection.**

02.05 Equipment Installation. Perform a walk down of the selected SSCs, where accessible, to verify that the equipment is installed in a manner consistent with the assumptions in the qualification **analysis**. EQ equipment must be installed in a configuration similar to the tested configuration.

Seismic Guidance. Seismic Category I equipment must be oriented and anchored the same way as assumed in the qualification. Any deviations from the qualified configuration must be adequately justified. Additionally, any potential Seismic Category II interactions from overhead or nearby equipment must be addressed.

MOV Guidance. MOVs must be installed consistent with their qualification and switch setup assumptions. If the standard or preferred orientation is not used, the reason should be documented and an evaluation performed that addresses any negative impact. Standard orientation for gate and globe valves is with a vertical upward stem. A gate valve oriented with the stem horizontal may have greater than expected friction between the valve disk and the guide if the disk guide is not designed to support the disk in the horizontal position. Preferred orientation for butterfly valves is stem axis in the same plane as the plane of an elbow bend when an upstream elbow is present, manufacturer specified flow direction for non-symmetric disc designs, and manufacturer-specified direction of disk rotation. Installation in a non-preferred orientation can cause a significant increase in dynamic torque requirements due to flow acting on different portions of the disk than assumed in the analysis. The increased torque requirements resulting from valve orientation must be incorporated into the MOV calculations and switch settings. Additionally, the reduction in expected life of the valve must be considered.

Main Control Room (MCR) and Remote Shutdown Workstation (RSW) Human Factors Engineering (HFE). Use Inspection Procedure 65001.23 to conduct this part of the inspection.

Verify that equipment operators, and control room operators when using the RSW, can perform the necessary field equipment manipulations in the time assumed in the design basis analysis. Consider travel time, number of personnel required, access restrictions due to fire, flooding, radiation or other plant conditions, personal protective equipment (PPE), and the need for ladders or special tools to reach and operate the equipment.

Security Guidance. Verify that bullet-resistant doors and windows were installed in accordance with manufacturer's recommendations.

02.06 Problem Identification and Resolution. The inspector should confirm that problems identified during the qualification process were entered into the licensee/constructor corrective action program in accordance with program requirements and appropriately prioritized and adequately resolved. In addition, the inspector should confirm that identified problems which could affect the quality of an SSC's qualification attributes were also entered into a corrective action program and resolved. The inspector may review licensee actions to address similar or related problems that were previously identified, in order to check the extent of condition and confirm the effectiveness of the licensee's corrective measures.

Guidance. This inspection task is intended to verify that problems are entered into the applicable process to assure corrective actions appropriate to the circumstances are developed and prioritized. See IP 71152, "Problem Identification and Resolution," for additional details.

See also IP 35007 Appendix XVI "Corrective Action." Inspections of Quality Assurance Program implementation, effectiveness of Problem Identification and Resolution, and Self-Assessment will be performed under the IMC 2504 process.

65001.E-03 RESOURCE ESTIMATE

Inspection resources necessary to complete this inspection procedure are estimated to be 360 hours of direct inspection effort over the course of plant construction.

65001.E-04 REFERENCES

Facility Final Safety Analysis Report (FSAR) and Design Control Document (DCD)

10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"

10 CFR 55, "Operators' Licenses"

10 CFR 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants"

ANSI/ANS-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination"

ASME QME-1, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants"

IEEE Std 7-4.3.2, "IEEE Standard for Digital Computers in Safety Systems of Nuclear Power Generating Stations"

IEEE Std 323, "IEEE Standard for Qualifying Class 1E Electrical Equipment for Nuclear Power Generating Stations"

IEEE Std 344, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

IEEE Std 384, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits"

IEEE Std 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations"

IEEE Std 1012, "IEEE Standard for Software Verification and Validation"

IP 35007 "Quality Assurance Program Implementation During Construction and Pre-Construction Activities"

IP 41502, "Nuclear Power Plant Simulation Facilities"

IP 51080, "Part 52 Environmental Qualification (EQ) Under 10CFR 50.49" for additional inspection guidance"

IP 62708, "Motor-Operated Valve Capability"

IP 62710, "Power-Operated Gate Valve Pressure Locking and Thermal Binding"

IP 65001.22, "Inspection of Digital Instrumentation and Control (D&IC) System/Software Design Acceptance Criteria (DAC) – Related to ITAAC"

IP 65001.23, "Inspection Of Human Factors Engineering Integrated System Validation ITAAC"

IP 71111.11, "Licensed Operator Requalification Program and Licensed Operator Performance"

IP 71152, "Problem Identification and Resolution"

IP 73756, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints"

NRC Letter dated 9/25/2006, Subject: Final Safety Evaluation on Joint Owners Group Program on Motor-Operated Valve Periodic Verification (ML061280315)

NUREG-0588, "Interim Position on Environmental Qualification of Safety-Related Electrical Equipment"

NUREG 0711, "Human Factors Engineering Program Review Model"

Regulatory Guide 1.12, "Nuclear Power Instrumentation for Earthquakes"

Regulatory Guide 1.29, "Seismic Design Classification"

Regulatory Guide 1.75, "Criteria for Independence of Electrical Safety Systems"

Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants"

Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations"

Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants"

Regulatory Guide 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"

Regulatory Guide 5.12, "General Use of Locks in the Protection and Control of Facilities and Special Nuclear Materials" (ML003740035)

Standard Review Plan Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints" (NUREG-0800)

Standard Review Plan Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment" (NUREG-0800)

Standard Review Plan Section 18.0, "Human Factors Engineering" (NUREG 0800)

TR-106563-V1, EPRI, Application Guide for Motor-Operated Valves in Nuclear Power Plants, Volume 1: Gate and Globe Valves, Rev. 1

TR-106563-V2, EPRI Application Guide for Motor-Operated Valves in Nuclear Power Plants, Volume 2: Butterfly Valves, Rev. 0

UL 752-2005, "Standard for Bullet Resistant Equipment"

Standard Review Plan Section 17.4, "Reliability Assurance Program"

END

Attachment:

Revision History for IP 65001.E

Attachment 1 - Revision History for IP 65001.E

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution Accession Number
N/A	08/19/08 CN 08-024	Initial issuance to support ITAAC related inspections under 10CFR52. Researched commitments for 4 years and found none.	N/A	N/A
N/A	ML14115A171 06/20/14 CN – 14-013	Periodic update. Deleted 01.02 and 02.02 at the request of NRO/COLB. There are no ITAAC for simulators. Researched commitments for 4 years and found none.	N/A	ML14115A172