C.II.1 Inspections, Tests, Analyses, and Acceptance Criteria

The requirements in 10 CFR 52.80(a) specify that a COL application must include the proposed inspections, tests, and analyses (including those that apply to emergency planning) that the licensee shall perform and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC regulations.

In Section 14.3 of the FSAR, the COL applicant should provide its proposed methodology for developing ITAAC for the facility, as well as its proposed criteria for establishing the necessary and sufficient acceptance criteria in accordance with 10 CFR 52.80(a). The COL applicant should provide its proposed ITAAC, containing the information described below, in an appropriate section of the COL application, as defined in Section C.IV.2 of this regulatory guide. Because successful completion of all ITAAC is a prerequisite for fuel load and a condition of the license, ITAAC will no longer exist after the Commission makes its finding in accordance with 10 CFR 52.103(g) and authorizes fuel load. Therefore, the COL application section containing the ITAAC will not become part of the facility's FSAR. In recognition of this finite nature, the COL application content requirements in 10 CFR 52.80 identify ITAAC as additional technical information required in the application. However, ITAAC that are associated with a certified design will always remain part of the certified design unless modified in accordance with the change process specified in Section VIII of the applicable appendix to 10 CFR Part 52.

Previous design certification applicants have used the ITAAC format discussed below, which is acceptable to the NRC staff. The NRC developed the ITAAC format for design certification with a structure and system-based focus on SSCs. The agency does not require COL applicants to follow the format provided in this guidance, and applicants may propose alternative formats for ITAAC with suitable justification and a discussion concerning the development and use of the proposed ITAAC format and content for NRC review. For example, the COL applicant may propose alternatives that include ITAAC formats that have a construction-based focus, where ITAAC are organized by plant elevation, modules, and so forth. Alternatively, COL applicants may propose an ITAAC format that is a hybrid combination of a SSC and construction-based formats that seeks to maximize NRC review efficiency and performance of ITAAC during plant construction.

Since COL applications may incorporate, by reference, ESPs, design certification rules (DCR), neither, or both, the scope of ITAAC development for a COL applicant will differ depending on which of these documents it references in the application. However, the COL applicant must propose a complete set of ITAAC that addresses the entire facility, including ITAAC on emergency planning and physical security hardware. The NRC will incorporate a complete set of facility ITAAC (COL-ITAAC) into the COL as a license condition to be satisfied prior to fuel load. Section C.II.7 of this regulatory guide provides guidance on ITAAC for COL applicants that reference an ESP, a DCD, or both.

C.II.1.1 Design Descriptions and ITAAC Format and Content

Design Description and ITAAC Design Description

The applicant should base the content of proposed ITAAC on an extraction from the information provided in the detailed design descriptions for SSCs in the FSAR portion of the COL application. This FSAR information is similar to the Tier 2 document provided for a certified design. As such, it includes specific information on design requirements and safety functions, and it provides relevant tables and figures. In a certified design, a Tier 1 document that contains design descriptions, ITAAC, and site interface requirements is also provided and is strictly controlled by regulation. The design descriptions contained in a Tier 1 document are derived from the Tier 2 document. In addition, the design description contains tables and figures that are referenced in the Design Commitments column of the ITAAC. Those tables and figures identify the components, equipment, system piping, building walls, and so forth that must be verified by ITAAC and provide a convenient method for managing the size of the ITAAC tables. For example, ITAAC that require verification of functional arrangement for a system typically refer to "the functional arrangement of the XXX system as shown in Figure X.X." Also, ITAAC that require verification of the design functions of MOVs may refer to a specific table listing those MOVs.

Although not a requirement, COL applicants who do not reference a certified design may also develop design descriptions that include design bases, tables, and figures specifically for use and reference by the ITAAC. In this case, and to distinguish these design descriptions from those included in the Tier 1 document for a certified design, the COL applicant should call its descriptions "ITAAC design descriptions." These ITAAC design descriptions should be separate but derived from the detailed design information contained in the FSAR portion of the COL application. The proposed ITAAC may also reference specific sections, tables, and figures in the ITAAC design descriptions for design requirements and commitments to be verified.

As stated above, the ITAAC for a COL application should not be included in the FSAR. In addition, it is noteworthy that a COL application that does not reference a certified design may provide information that is similar to that provided in a certified design with regard to level of detail. However, the Tier 1 and Tier 2 designations do not apply to a COL application that does not reference a certified design because certified design information is subject to a different change process than a COL (i.e., Section VIII of the applicable appendix to 10 CFR Part 52). Section C.IV.3 of this regulatory guide provides additional guidance regarding the change process.

<u>ITAAC Tabular Format and Content</u>

The applicant may format an ITAAC as a three-column table, as shown in Table C.II.1-1, which appears at the end of this section. Input provided in this sample table is intended only to establish an acceptable format (e.g., the NRC has replaced ITAAC terminology, such as basic configuration, used in previously certified designs). Section C.III.7 of this regulatory guide includes additional discussion of terminology.

The first column of the ITAAC table should identify the proposed design requirement and/or commitment to be verified. This column should contain the specific text of the design commitment, which is extracted from the detailed design descriptions contained in the COL application. Applicants should minimize any differences in text unless intended, for example, to better conform the commitments in the design description with the ITAAC format. Any differences in text, however, should retain the principal performance characteristics and safety functions of the design feature that must be verified.

The second column of the ITAAC table should identify the proposed method (inspection, testing, analysis, or some combination of the three) by which the licensee will verify the design requirement/commitment described in column 1. The detailed design information provided in the COL application should include detailed supporting information for various inspections, tests, and analyses that can, and should, be used to satisfy the acceptance criteria. This information describes an acceptable means (albeit not the only means) of satisfying an ITAAC.

Section C.II.1.1.1 of this guide defines inspections, which include visual and physical observations, walkdowns, or record reviews.

Section C.II.1.1.1 defines tests, which mean the actuation, operation, or establishment of specified conditions to evaluate the performance or integrity of the as-built SSCs. This includes functional and hydrostatic tests for the systems. The preferred means to satisfy the ITAAC is in situ testing, where possible, of the as-built facility. The term "as-built" is intended to mean testing in the final as-installed condition at the facility. The term "type tests" is used in this column to mean manufacturer's tests or other tests that are not necessarily intended to be in the final as-installed condition. The results of preoperational tests can be used to satisfy an ITAAC, and licensees must document the preoperational tests, or portions thereof, that are credited in successful completion of ITAAC. However, the preoperational tests described in Section 14.2 of the FSAR portion of a COL application or in RG 1.68 are not a substitute for ITAAC. Where testing is specified, appropriate conditions for the test should be established in accordance with the ITP described in FSAR Section 14.2 of a COL application and in RG 1.68. Conversion or extrapolation of test results from the test conditions to the design conditions may be necessary to satisfy the ITAAC. The COL applicant should provide suitable justification for, and applicability of, any necessary conversions or extrapolations of test results necessary to satisfy the ITAAC.

Section C.II.1.1.1 also defines analyses. Either the ITAAC or the applicable sections of the COL application must specify the details of the analysis method. The ITAAC should not reference the applicable sections of the COL application, but COL application sections may reference the appropriate ITAAC. For example, Chapter 3 of the COL application contains detailed analysis methods of seismic and environmental qualification supporting detailed design descriptions for SSCs, as well as detailed piping design information supporting additional design material applicable to multiple sections of the design.

The third column of the ITAAC table should identify the proposed specific acceptance criteria for the inspections, tests, or analyses described in column 2 that, if met, demonstrate that the licensee has met the design requirements/commitments in column 1. In general, the acceptance criteria should be objective and unambiguous in order to prevent misinterpretation. Numeric performance values for SSCs may be specified as ITAAC acceptance criteria when values consistent with the design commitments are possible or when failure to meet the stated acceptance criterion would clearly indicate a failure to properly implement the design (i.e., values selected for verification should be those assumed in the safety analyses, rather than the design values).

The COL ITAAC must verify the complete facility, in accordance with 10 CFR 52.97(b), and this requirement can be met by providing ITAAC for all structures and systems within the facility. The type of information and the level of detail included in the ITAAC for each structure and system are based on a graded approach that is commensurate with the safety-significance of the facility's SSCs. Top-level design information selected for verification in the ITAAC should contain the principal performance characteristics and safety functions of the SSCs, their important features in various safety analyses, and their functions for defense-in-depth considerations. The COL applicant's development of proposed ITAAC should consider the following factors:

- Carefully consider design-specific and unique features of the facility for inclusion in ITAAC.
- Ensure that the ITAAC reflect the important insights and assumptions from the PRA with respect to the safety-significance of SSCs.

- Ensure that the ITAAC reflect the resolutions of technically relevant USIs and GSIs), NRC generic correspondence (such as bulletins and generic letters), and relevant industry operating experience.
- Ensure that the ITAAC are consistent with the TS, including their bases and LCOs.
- Ensure that the ITAAC are consistent with the preoperational test program described in Section C.I.14.2 of this guide since many of the preoperational tests for SSCs may be used to satisfy ITAAC.
- Ensure that the ITAAC emphasize testing of the as-built facility and use the definitions for testing provided in Section C.II.1.1.1 of this guide.
- Ensure that the ITAAC include SSCs for which the features or functions are necessary to satisfy the NRC's regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," 10 CFR Part 50, 10 CFR Part 73, "Physical Protection of Plants and Materials," or 10 CFR Part 100.
- Ensure that ITAAC include severe accident design features and plant features designed for protection against hazards.
- Ensure that SSCs for which there is no discernible safety-significance have "no entry" for their ITAAC.

The NRC staff is particularly interested in ensuring that the ITAAC adequately consider the assumptions and insights from key safety and integrated plant safety analyses in the FSAR, where plant performance is dependent on contributions from multiple systems of the facility design. Addressing these assumptions and insights in ITAAC ensures that the as-built facility preserves the integrity of the fundamental analyses for the facility design. These analyses include flooding, overpressure protection, containment, core cooling, fire protection, transients, ATWS, steam generator tube rupture (PWRs only), radiological concerns, USIs/GSIs, TMI Action Plan items, or other key analyses specified by the staff. Thus, in a table provided in FSAR Section 14.3, COL applicants should cross-reference the important design information and parameters from these analyses to their treatment (i.e., inclusion or exclusion) in the ITAAC. These cross-references should be sufficiently detailed to enable the COL applicant or licensee to consider whether a proposed design change impacts the treatment of these parameters in the ITAAC.

In addition, the applicant should provide cross-references showing how the design information in the COL application addresses key insights and assumptions from facility-specific PRAs and severe accident analyses. For these analyses only, the cross-references should show where the ITAAC capture each key assumption and insight. The applicant should develop these cross-references along with the detailed facility-specific PRA and severe accident analyses and should provide them in FSAR Section 14.3. In addition, the cross-references should be sufficiently detailed to enable the COL applicant or licensee to consider whether a proposed design change impacts the treatment (i.e., inclusion or exclusion) of these parameters in the ITAAC.

Section C.II.1.2 of this regulatory guide provides specific guidance on ITAAC development, while Appendix A to this section provides general guidance to assist COL applicants in developing their COL-ITAAC. The staff has primarily developed this specific guidance to be consistent with NRC staff review responsibilities, as defined in NUREG-0800. By contrast, the agency has developed the general guidance to be consistent with functional engineering disciplines. It, may include specific guidance for topics that are unique to design certifications and advanced and/or evolutionary reactors.

C.II.1.1.1 *Definitions*

Although not all-inclusive, COL applicants should develop their proposed ITAAC using the definitions below for terms that may be used in the design descriptions for SSCs in the COL application.

Acceptance criteria refers to the performance, physical condition, or analysis result for an SSC, which demonstrates that the design requirement/commitment is met.

Analysis means a calculation, mathematical computation, or engineering/technical evaluation.

As-built means the physical properties of the SSC following the completion of its installation or construction activities at its final location at the plant site.

Column line is the designation applied to a plant reference grid used to define the locations of building walls and columns. Column lines may not represent the center line of walls and columns. (The COL applicant should define the alternative plant reference grids and discuss their use in the COL application.)

Design requirement/commitment means that portion of the detailed design information provided in the COL application that is verified by ITAAC.

Design plant grade means the elevation of the soil around the facility assumed in the design (i.e., typically, the elevation is correlated to an elevation specified in the nuclear island).

Division (for electrical systems or equipment) is the designation applied to a given safety-related system (or set of components) that is (are) physically, electrically, and functionally independent from other redundant sets of components.

Division (for mechanical systems or equipment) is the designation applied to a specific set of safety-related components within a system.

Functional arrangement (for a system) means the physical arrangement of systems and components to provide the service for which the system is intended and that is described in the ITAAC design description and as shown in the figures.

Inspect or inspection means visual observations, physical examinations, or reviews of records that compare the SSC condition to one or more design commitments. Examples include walkdowns, configuration checks, measurements of dimensions, or NDEs.

ITAAC design description is an information feature for a COL application that does not reference a certified design to provide flexibility for developing ITAAC, which may involve verification of numerous SSCs. As such, the ITAAC design description is intended to provide the same level of design information as the Tier 1 design description for a certified design, but without the strict regulatory controls.

Operate means the actuation and running of the equipment.

Physical arrangement (for a structure) means the arrangement of the building features (e.g., floors, ceilings, walls, doorways, and basemat) and of the SSCs within, which are described in the ITAAC design description and as shown in the figures.

Test means actuation or operation, or establishment, of specified conditions to evaluate the performance or integrity of as-built SSCs, unless explicitly stated otherwise.

Transfer open (or transfer closed) means to move from a closed position to an open position (or vice versa).

Type test means a test on one or more sample components to qualify other components of the same type and manufacturer. A type test is not necessarily a test of the as-built SSC.

C.II.1.2 Specific ITAAC Development Guidance and Organizational Conformance with the Standard Review Plan (NUREG-0800)

Section C.I of this regulatory guide provides guidance for a COL applicant who does not reference a certified design and/or an ESP. The regulations contained in 10 CFR Part 52 include requirements for providing proposed ITAAC with an application for design certification in accordance with Subpart B to 10 CFR Part 52, as well as a COL application in accordance with Subpart C. In developing the guidance in this regulatory guide, the NRC staff also considered the corresponding interface with the SRP. That is, the staff will review the guidance provided herein, regarding information that a COL applicant must submit to the NRC, in accordance with the SRP to assess compliance with the applicable regulations. To better facilitate the interface between this regulatory guide and the SRP, the staff has organized the specific guidance for developing ITAAC in the same manner as the SRP. That is, SRP Section 14.3 provides introductory and general guidance for the following associated SRP sections, which have been organized in accordance with the primary review responsibilities of the NRC's technical staff branches:

- SRP Section 14.3.1 Site Parameters
- SRP Section 14.3.2 Structural and Systems Engineering
- SRP Section 14.3.3 Piping Systems and Components
- SRP Section 14.3.4 Reactor Systems
- SRP Section 14.3.5 Instrumentation and Controls
- SRP Section 14.3.6 Electrical Systems
- SRP Section 14.3.7 Plant Systems
- SRP Section 14.3.8 Radiation Protection
- SRP Section 14.3.9 Human Factors Engineering
- SRP Section 14.3.10 Emergency Planning
- SRP Section 14.3.11 Containment Systems
- SRP Section 14.3.12 Physical Security Hardware

The NRC staff developed SRP Section 14.3 and its associated SRP sections with a greater focus on reviewing design certification applications in accordance with Subpart B of 10 CFR Part 52. As a result, the review guidance for those SRPs may not address the entire review scope for a COL application. By contrast, the guidance in Section C.I of this regulatory guide addresses the entire scope for a COL application that does not reference a certified design. As such, exact correlations between the guidance in this regulatory guide and the SRP review guidance may not exist for some areas.

For example, the guidance and review scope for site parameters is different because a COL application that does not reference a certified design must include design information for an entire facility at a specifically chosen site. As such, the site parameters are defined by the chosen site, and the COL applicant, in this example, is not required to demonstrate that site parameters assumed in a certified design are applicable to, and in conformance with, the parameters of the chosen site.

Appendix A to this section provides additional general guidance to assist COL applicants in developing COL-ITAAC. The staff has developed this general guidance to be consistent with functional engineering disciplines, and it may include specific guidance for topics that are unique to design certifications and advanced and/or evolutionary reactors.

The following sections provide discussion and guidance on ITAAC development for a COL applicant who does not reference a certified design and/or an ESP. To ensure consistency and completeness in ITAAC development, COL applicants should consider the specific guidance provided in the following sections; refer to Table C.II.1-1, which appears at the end of this section; and apply the general guidance, as applicable, provided in Appendix A to this section.

C.II.1.2.1 *ITAAC for Site Parameters (SRP Section 14.3.1)*

COL applicants who do not reference a certified design and/or an ESP must provide design information for their entire proposed facility at a specifically chosen site. As such, the design basis for the proposed facility will use site parameters specific to the chosen site. This is unlike certified designs, which are developed to encompass a broad range of potential sites and for which a COL applicant referencing that certified design must demonstrate compliance, as required by 10 CFR 52.47, "Contents of Applications," with the set of site parameters defined in the Tier 1 portion of the certified design. Although the site parameters for certified designs were included in the Tier 1 document, no ITAAC were developed for those site parameters. Likewise, the NRC staff does not anticipate the need for any site parameter ITAAC to be developed for a COL applicant who does not reference a certified design and/or an ESP. Therefore, this section does not provide guidance for developing site parameter ITAAC. Nonetheless, the staff recognizes that the parameters for the site identified in a COL application that does not reference a certified design will form the bases for many ITAAC developed for the facility described in the COL application.

C.II.1.2.2 *ITAAC for Structures and Systems (SRP Section 14.3.2)*

This section primarily involves building structures and structural aspects of major components, such as the reactor pressure vessel (RPV), pressurizer, and steam generator.

Ideally, applicants should develop ITAAC for structures and systems and group them by systems and building structures. However, COL applicants may propose their own bases for grouping and organizing ITAAC for structures and systems. For as-built building structures, the structural capability is typically verified by performing an analysis to reconcile the as-built data with the structural design bases for each safety-related building or a verification of building dimensions. System-specific performance tests are typically conducted to demonstrate that the as-built system can perform its intended function. For major as-built components, the verification of design, fabrication, testing, and performance requirements should be partially addressed in conjunction with the specific system ITAAC.

The scope of structural design covers the major structural systems in the COL applicant's proposed facility, including the RPV; Class 1, 2, and 3 piping systems defined by the ASME Code; and major building structures (e.g., primary containment, reactor building, control building, turbine building, service building, radwaste building). In addition, scope should include other structures and systems that are considered to be risk significant based on insights from the COL applicant's PRA. Using the GDC specified in Appendix A to 10 CFR Part 50, the ITAAC proposed by the COL applicant should verify the following design attributes for the major structures and systems in the proposed facility:

(1) pressure boundary integrity (GDC 14, GDC 16, and GDC 50)
(2) normal loads (GDC 2)
(3) seismic loads (GDC 2)
(4) suppression pool hydrodynamic loads (GDC 4)
(5) flood, wind, and tornado (GDC 2)
(6) rain and snow (GDC 2)
(7) pipe rupture (GDC 4)
(8) codes and standards (GDC 1)
(9) site proximity missiles and externally generated missiles
(10) aircraft hazards

In addition, to ensure that the final as-built plant conforms with the licensed facility, COL applicants should provide ITAAC to reconcile the as-built plant with the structural design basis. The following provides summary-level guidance for developing ITAAC to confirm the design attributes identified above.

- pressure boundary integrity
  - The applicant should establish ITAAC to verify the pressure boundary integrity of the RPV, pressurizer, steam generator, piping, and primary containment, as these are needed to ensure the defense-in-depth principle.
  - For the RPV, pressurizer, steam generator, and piping, ITAAC should require hydrostatic tests and preoperational NDE performed in conjunction with Sections III and V of the ASME Code.
  - For the primary containment, ITAAC should require the performance of a structural integrity test on the pressure boundary components of the primary containment, in accordance with Section III of the ASME Code.
- normal loads
  - The applicant should establish ITAAC to verify that the normal and accident loads have been appropriately combined with the effects of natural phenomena for the as-built SSCs.
  - For piping systems, ITAAC should require an analysis to reconcile the as-built piping design with the design-basis loads, which incorporate the appropriate combination of normal and accident loads.
  - ITAAC should verify the existence of the reports required by the ASME Code to document that the RPV has been designed, fabricated, inspected, and tested to ASME Code requirements to ensure an adequate safety margin.
  - For safety-related buildings, ITAAC should require a structural analysis report that reconciles the as-built plant with the structural design-basis loads, including the combination of normal and accident loads with the effects of natural phenomena.
  - ITAAC should apply only to safety-related and risk-significant structures.
  - ITAAC for other design aspects of structures may be included, as deemed appropriate by the COL applicant.

- seismic loads
  - The applicant should develop ITAAC to verify that safety-related systems and structures have been designed to seismic loadings.
  - Applicants should address component qualification for seismic loads using ITAAC established for the specific systems containing the components.
  - ITAAC should require an analysis to reconcile the as-built piping design with the design-basis loads, including seismic loads.
  - ITAAC should verify the existence of the reports required by the ASME Code to document that the RPV design and fabrication have properly considered seismic loads.
  - For safety-related buildings, ITAAC should require a structural analysis report that reconciles the as-built plant with the structural design-basis loads, including seismic loads.
  - The applicant should develop ITAAC to verify that, under seismic loads, the intended function of buildings containing components designed to prevent fission product leakage will not impair the safety-related functions of any structures or equipment located adjacent to or within those buildings.
  - The applicant should develop ITAAC, as needed, to verify that failure of nonseismic category SSC will not impair the safety-related functions of any SSC located adjacent to or within the non-seismic building.
  - The applicant should develop ITAAC to verify that, under seismic loads, the fire protection standpipe systems will remain functional in areas containing safety-related SSCs.
- suppression pool hydrodynamic loads (boiling-water reactors only)
  - The applicant should develop ITAAC to verify that the safety-related systems and structures have been designed to suppression pool hydrodynamic loadings, which include safety/relief valve (SRV) discharge and LOCA loadings.
  - Component qualification for suppression pool loading may be contained in, or addressed by, ITAAC developed for the specific systems containing the components.
  - ITAAC should require an analysis to reconcile the as-built piping design with the design-basis loads, which include suppression pool hydrodynamic loads.
  - For the RPV, ITAAC should verify the existence of the reports required by the ASME Code to ensure that the RPV has been designed (to accommodate hydrodynamic loads), fabricated, inspected, and tested to meet ASME Code requirements.
  - ITAAC should require an analysis to reconcile the as-built building configuration with the structural design-basis loads, which include suppression pool hydrodynamic loads.
  - ITAAC should require verification of the horizontal vent system, water volume, and safety-relief valve discharge line quencher arrangement to ensure the adequacy of the suppression pool hydrodynamic loads used for design.
- flood, wind, tornado, rain, and snow
  - The applicant should develop ITAAC to verify that the safety-related systems and structures have been designed to withstand the effects of natural phenomena other than a seismic event (i.e., flood, wind, tornado, rain, and snow, as applicable).

- For safety-related buildings and risk-significant structures, ITAAC should require an analysis to reconcile the as-built plant with the structural design-basis loads, which include the flood, wind, tornado, rain, and snow loads, as applicable.
- ITAAC should require inspections to verify that divisional flood barriers and watertight doors exist and that penetrations in the divisional walls are sealed up to the internal and external flood levels.
- For safety-related buildings and risk-significant structures, ITAAC should require inspections to verify that flood barriers are installed up to the finished plant grade level to protect against water seepage and that flood doors and flood barrier penetrations are provided with flood protection features.
- ITAAC should require inspections to verify that watertight doors exist; that penetrations in the divisional walls are at an acceptable level above the floor; and that safety-related and risk-significant electrical, instrumentation, and control equipment is located at an acceptable level above the floor surface.
- For safety-related buildings and risk-significant structures, ITAAC should verify that external walls that are below flood level are of adequate thickness to protect against water seepage and that penetrations in external walls below flood level are provided with flood protection features.

• pipe break

- The applicant should develop ITAAC to verify that safety-related and risk-significant SSCs have been designed to withstand the dynamic effects of pipe breaks.
- Applicants should address component qualification for the dynamic effects of pipe breaks using ITAAC developed for the specific systems containing these components.
- ITAAC for the RCS system should require an inspection of critical locations that establish the bounding loads in the LOCA analyses for the RPV to ensure that the as-built areas do not exceed the postulated break areas assumed in the LOCA analyses.
- The applicant should develop ITAAC to verify—by inspection of as-built, high-energy pipe break mitigation features and the pipe break analysis report—that safety-related and risk-significant SSCs are protected against the dynamic and environmental effects of the postulated high-energy pipe breaks.

• codes and standards

- The applicant should develop ITAAC to verify by inspection that documents required by the ASME Code demonstrate that the RPV, piping systems, and containment pressure boundaries have been designed and constructed to the appropriate ASME Code requirements.

• as-built reconciliation

- The applicant should develop ITAAC to verify by inspection that structural analysis reports document the structural analyses that reconcile the as-built configuration of plant structures with the structural design bases of the licensed facility.
- The applicant should develop ITAAC to verify by inspection that an as-built piping analysis report documents analyses of piping systems that verify the existence of acceptable final as-built piping stress reports, which conclude that the as-built piping systems are adequately designed.

- For the as-built RPV, the applicant should develop ITAAC to verify by inspection that the key dimensions (and acceptable variations thereof) of the as-built RPV system conform with the licensed design and are documented in an as-built report.
- For component qualification, the applicant should develop system-specific ITAAC to demonstrate that the as-built seismic Category I mechanical and electrical equipment (including connected I&C) and associated anchorages in the given system are qualified to withstand design-basis dynamic loads without loss of safety function.

The applicant is responsible for defining and organizing the overall ITAAC program to support the licensing process as well as to facilitate the later completion and reporting of the defined inspections, tests, and analyses. This may result in the combination of several items identified in this guide into a single ITAAC item or the division of an item in this guide into multiple ITAAC items. If the organization of the applicant's ITAAC does not closely correlate to the suggested ITAAC items discussed in this guide, the applicant could support staff review efforts and minimize requests for additional information by including discussions in the ITAAC design commitment or providing a table with cross-references between this guide and the proposed ITAAC items.

C.II.1.2.3 *ITAAC for Piping Systems and Components (SRP Section 14.3.3)*

This subsection primarily involves piping system design and components and includes treatment of MOVs, POVs, and check valves as well as dynamic qualification, welding, fasteners, and safety classification of SSCs.

The scope of piping systems and components covers piping design criteria, structural integrity, and functional capability of safety-related and risk-significant piping systems included in the COL applicant's facility design. The scope is not limited to ASME Code Class 1, 2, and 3 piping and supports. Rather, the scope includes buried piping, instrumentation lines, interaction of nonseismic Category I piping with seismic Category I piping, and any safety-related and risk-significant piping designed to industry standards other than the ASME Code. In addition, the scope includes analysis methods, modeling techniques, pipe stress analysis criteria, pipe support design criteria, high-energy line break criteria, and the LBB approach, as applicable to the COL applicant's facility design.

ITAAC for piping systems should address the following considerations:

- The applicant should develop ITAAC to require the existence of an ASME Code-certified stress report to ensure that the ASME Code Class 1, 2, and 3 piping systems and components are designed to retain their pressure boundary integrity and functional capability under internal design and operating pressures and design-basis loads.
- The applicant should develop ITAAC to require the existence of a pipe break analysis report, which documents that as-built SSCs that are required to be functional during and following a safe-shutdown earthquake have adequate high-energy pipe break mitigation features. That is, the report should confirm that as-built piping stresses in the containment penetration area are within their allowable stress limits, as-built pipe whip restraints and jet shield designs are capable of mitigating pipe break loads, loads on safety-related SSCs are within their design load limits, and as-built SSCs are protected or qualified to withstand the environmental effects of postulated pipe failures.
- If the design uses LBB methods, the applicant should develop ITAAC to require the existence of an LBB evaluation report, which documents that the as-built piping and piping materials comply with the LBB acceptance criteria for the systems to which LBB is applied. The LBB evaluation

report should address actual material properties of the LBB piping and final piping configurations and should reconcile the as-built piping configurations with the LBB design assumptions. Chapter 3 of the FSAR should contain detailed information that supports this ITAAC.

- The applicant should develop ITAAC to require the existence of a report that documents the results of an as-built reconciliation confirming that the piping systems have been built in accordance with the ASME Code certified stress report. That is, the document should confirm that as-built documentation used for construction has been reconciled with the documentation used for design analysis as well as the certified stress report.
- The applicant should develop ITAAC to require the existence of reports that document fastener compliance with ASME Section III requirements.

The applicant should develop ITAAC for components and systems to verify the following piping and component classification, fabrication, dynamic and seismic qualification, and selected testing and performance requirements:

- Either a generic piping ITAAC, as described above, or a system-specific ITAAC can verify ASME Code class requirements.
- The applicant should develop system-specific ITAAC to verify the welding quality of as-built pressure boundary welds for ASME Code Class 1, 2, and 3 SSCs.
- The applicant should develop system-specific ITAAC to verify pressure integrity for ASME Code Class 1, 2, and 3 SSCs by specifying hydrostatic testing.
- The applicant should develop system-specific ITAAC to verify by inspection the dynamic qualification records (e.g., seismic, LOCA, and SRV discharge loads) of seismic Category I mechanical and electrical equipment (including connected I&C) and associated equipment anchorages.
- The applicant should develop system-specific ITAAC to verify by inspection the vendor test records that demonstrate the ability of pumps, valves, and dynamic restraints to function under design conditions.
- The applicant should develop system-specific ITAAC to verify through in situ testing and functional design and qualification records that installed pumps, valves, and dynamic restraints have the capability to perform their intended functions under expected ranges of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including design-basis conditions.

C.II.1.2.4 *ITAAC for Reactor Systems (SRP Section 14.3.4)*

This subsection primarily involves reactor systems, fuel, control rods, loose parts monitoring system, and core cooling systems as follows:

- The applicant should develop ITAAC to verify important input parameters used in the transient and accident analyses for the facility design.
- The applicant should develop ITAAC to verify NPSH for key pumps.
- The applicant should develop ITAAC to verify elevation differences between the reactor core and storage pools and/or tanks credited in the safety analyses for passive plants.

- The applicant should develop ITAAC to verify the design pressures of the piping systems that interface with the reactor coolant boundary to validate intersystem LOCA analyses.
- The applicant should develop ITAAC to verify the top-level design aspects of the reactor systems listed below:
  - functional arrangement
  - seismic and ASME Code classification
  - weld quality and pressure boundary integrity
  - valve qualification and operation
  - controls, alarms, and displays
  - logic and interlocks
  - equipment qualification for harsh environments
  - interface requirements with other systems
  - numeric performance values
  - Class 1E electrical power sources and divisions, if applicable
  - system operation in various modes

C.II.1.2.5 *ITAAC for Instrumentation and Controls (SRP Section 14.3.5)*

This subsection primarily addresses I&C involving reactor protection and control, engineered safety features actuation, reactivity control systems, other miscellaneous I&C systems, digital computers in I&C systems, and selected interface requirements related to I&C issues. As such, the NRC staff recognizes that the facility design may not be completed in some I&C areas at the time the COL application is submitted. Therefore, some of the ITAAC-related guidance more accurately describes verification of design process application, completion, and implementation, rather than simply verifying as-built design implementation. The I&C systems portion of Appendix A to this section includes additional guidance in these areas.

Applicants should develop ITAAC for I&C to address the following:

- compliance with 10 CFR 50.55a(h) and each of the following sections of IEEE Standard 603-1991[1] (and the correction sheet dated January 30, 1995), as they pertain to safety systems:
  - Section 4.1, identification of design-basis events
  - Section 4.4, identification of variables monitored and analytical limits
  - Section 4.5, minimum criteria for manual initiation and control of protective actions
  - Section 4.6, identification of the minimum number and locations of sensors
  - Section 4.7, range of transient and steady-state conditions
  - Section 4.8, identification of conditions that have the potential to cause functional degradation of safety system performance
  - Section 4.9, identification of the methods used to assess the reliability of the safety system design
  - Section 5.1, single-failure criterion
  - Section 5.2, completion of protective action for protective actions

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1 Refer to Appendix 7B to Section C.I.7 of this regulatory guide for additional discussion on conformance with IEEE Standard 603.

- Section 5.3, quality
- Section 5.4, equipment qualification
- Section 5.5, system integrity
- Section 5.6, independence
  (1) physical independence
  (2) electrical independence
  (3) communications independence
- Section 5.7, capability for test and calibration
- Section 5.8, information displays
- Section 5.9, control of access
- Section 5.10, repair
- Section 5.11, identification
- Section 5.12, auxiliary features
- Section 5.13, multiunit stations
- Section 5.14, human factors considerations
- Section 5.15, reliability
- Sections 6.1 and 7.1. automatic control
- Sections 6.2 and 7.2, manual control
- Section 6.3, interaction between the sense and command features and other systems
- Section 6.4, derivation of system inputs
- Section 6.5, capability for testing and calibration
- Sections 6.6 and 7.4, operating bypasses
- Sections 6.7 and 7.5, maintenance bypass
- Section 6.8, setpoints
- Section 7.3, completion of protective action for executive features
- Section 8, power source requirements

• compliance with each of the following GDC set forth in Appendix A to 10 CFR Part 50:
  - GDC 1, as it pertains to quality standards for design, fabrication, erection, and testing
  - GDC 2, as it pertains to protection against natural phenomenon
  - GDC 4, as it pertains to environmental and dynamic effects
  - GDC 13, "Instrumentation and Control," as it pertains to I&C requirements
  - GDC 19, as it pertains to control room requirements
  - GDC 20, "Protection System Functions," as it pertains to protection system design requirements

- GDC 21, "Protection System Reliability and Testability," as it pertains to protection system reliability and testability requirements
- GDC 22, "Protection System Independence," as it pertains to protection system independence requirements
- GDC 23, as it pertains to protection system failure modes requirements
- GDC 24, as it pertains to separation of protection systems from control systems
- GDC 25, "Protection System Requirements for Reactivity Control Malfunctions," as it pertains to protection system requirements for reactivity control malfunctions
- GDC 29, as it pertains to protection against AOO

• documentation of a high-quality software design process:

- The ITAAC should address the following planning documentation, with a requirement to demonstrate each of the management, implementation, and resource characteristics shown in BTP 7-14 in SRP Chapter 7:

  (1) software management plan
  (2) software development plan
  (3) software test plan
  (4) software QA plan
  (5) integration plan
  (6) installation plan
  (7) maintenance plan
  (8) training plan
  (9) operations plan
  (10) software safety plan
  (11) software verification and validation plan
  (12) software configuration management plan

- The ITAAC should address the following implementation documents, with a requirement to demonstrate each of the management, implementation, and resource characteristics shown in BTP 7-14:

  (1) safety analyses
  (2) V&V analysis and test reports
  (3) configuration management reports
  (4) requirement traceability matrix

- The implementation documents should document each of the following life-cycle phases:

  (1) requirements
  (2) design
  (3) implementation
  (4) integration
  (5) validation
  (6) installation
  (7) operations
  (8) maintenance

– The ITAAC should address the following software life-cycle process design output documents, with a requirement to demonstrate each of the characteristics shown in BTP 7-14:

(1) software requirements specifications

(2) hardware and software architecture descriptions

(3) software design specifications

(4) code listings

(5) build documents

(6) installation configuration tables

(7) operations manuals

(8) maintenance manuals

(9) training manuals

(10) system test procedures and test results (validation tests, site acceptance tests, preoperational and startup tests), which should provide assurance that the system functions as intended

(11) confirmation by the application that defense in depth and diversity design conform to the guidance in SRP BTP 7-19

(12) application commitment to, or confirmation that, digital safety system security guidance is in conformance with RG 1.152, Revision 2

C.II.1.2.6 *ITAAC for Electrical Systems (SRP Section 14.3.6)*

This subsection primarily involves the entire station electrical system, including Class 1E portions of the system, equipment qualification, major portions of the non-Class 1E system, and portions of the plant lightning, grounding, and lighting systems. The development of ITAAC for evolutionary plants, which typically involve significant reliance on alternating current (ac) electrical systems to accomplish safety functions, may be much different than the development of ITAAC for passive plant designs that involve much less reliance on ac electrical systems to accomplish safety functions.

Applicants should develop ITAAC for electrical systems and equipment to verify the following:

- equipment qualification for seismic and harsh environments
  - The applicant should develop ITAAC to verify that Class 1E equipment is seismic Category I and that equipment located in a harsh environment is qualified.
- redundancy and independence
  - The applicant should develop ITAAC to verify the Class 1E divisional assignments and independence of electric power by both inspections and tests.
- capacity and capability
  - The applicant should develop ITAAC to verify adequate sizing of the electrical system equipment and its ability to respond to postulated events (e.g., automatically in the times needed to support the accident analyses).

- The applicant should develop ITAAC to verify by analysis the ability of the as-built electrical system and installed equipment (e.g., diesel generators, transformers, switchgear, direct current systems, and batteries) to power the loads, including tests to demonstrate the operation of equipment.
- The applicant should develop ITAAC to verify the initiation of the Class 1E equipment necessary to mitigate postulated events for which the equipment is credited (e.g., LOCA, LOOP, and degraded voltage conditions).
- The applicant should develop ITAAC to verify by analysis how the as-built electrical power system responds to a LOCA, LOOP, combinations of LOCA and LOOP (including LOCA with delayed LOOP as well as LOOP with delayed LOCA), and degraded voltage, including tests to demonstrate the actuation of the electrical equipment in response to postulated events.

• electrical protection features

  - The applicant should develop ITAAC to analyze the ability of the as-built electrical system equipment to withstand and clear electrical faults.
  - The applicant should develop ITAAC to analyze the protection feature coordination and verify its ability to limit the loss of equipment attributable to postulated faults.

• displays, controls, and alarms

  - The applicant should develop ITAAC to verify by inspection the ability to retrieve the information (displays and alarms) and to control the electrical power system in the main control room and/or at locations provided for remote shutdown.

• offsite power

  - The applicant should develop ITAAC to verify by inspection the direct connection of offsite power sources to the Class 1E divisions as well as the adequacy of voltage, capacity, and independence/separation of the offsite sources.
  - The applicant should develop ITAAC to verify by inspection appropriate lightning protection and grounding features.

• containment electrical penetrations

  - The applicant should develop ITAAC to verify that all electrical containment penetrations are protected against postulated currents greater than their continuous current rating.

• alternate ac (Aac) power source (if applicable)

  - The applicant should develop ITAAC to verify through inspection and testing the Aac power source (combustion gas turbines, diesel generators, or hydro units) and its auxiliaries to ensure the availability of the Aac power source for SBO events as well as its independence from other ac sources.

• lighting

  - The applicant should develop ITAAC to verify the continuity of power sources for plant lighting systems to ensure that portions of the plant lighting remain available during accident scenarios and power failures.

- electrical power for nonsafety plant systems
  - The applicant should develop ITAAC to verify the functional arrangement of electrical power systems provided to support nonsafety systems to the extent that those systems perform a significant safety function.
- physical separation and independence
  - The applicant should develop ITAAC to verify separation and independence of redundant electrical equipment, circuits, and cabling for postfire safe shutdown.

C.II.1.2.7 *ITAAC for Plant Systems (SRP Section 14.3.7)*

This subsection primarily involves most of the fluid systems that are not part of the reactor systems and also includes new and spent fuel handling systems; power generation systems; air systems; cooling water systems; radioactive waste systems; HVAC systems; and fire protection systems, as follows:

- The applicant should develop ITAAC to require as-built plant reports for reconciliation with flood analyses to ensure consistency with design requirements of SSCs for flood protection and mitigation.
- The applicant should develop ITAAC to require as-built plant reports for reconciliation with postfire safe shutdown analyses to ensure consistency with design requirements of SSCs for fire protection and mitigation (e.g., fire detection and alarm systems, fire suppression systems, fire barriers).
- The applicant should develop ITAAC to verify heat removal capabilities for DBAs as well as tornado and missile protection.
- The applicant should develop ITAAC to verify NPSH for key pumps.
- The applicant should develop ITAAC to verify physical separation for appropriate systems.
- The applicant should develop ITAAC to verify that the minimum inventory of alarms, controls, and indications—as derived from emergency procedure guidelines; RG 1.97; and PRA insights—is provided for the main control room and remote shutdown stations.
- Commensurate with the importance of the design attribute to safety, the applicant should develop ITAAC to verify the following design attributes for plant systems:
  - functional arrangement
  - key design features of systems
  - seismic and ASME Code classifications
  - weld quality and pressure boundary integrity, as necessary
  - valve qualification and operation
  - controls, alarms, and displays
  - logic and interlocks
  - equipment qualification for harsh environments
  - required interfaces with other systems
  - numeric performance values
- The applicant should develop ITAAC to verify the performance of the liquid waste management system (as permanently installed systems or in combination with mobile processing equipment), expressed as removal efficiencies or decontamination factors, such that liquid effluent concentrations and associated doses to members of the public are in compliance with NRC

regulations and the EPA environmental standards of 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

- The applicant should develop ITAAC to verify the performance of the gaseous waste management system (as permanently installed systems or in combination with mobile processing equipment), expressed as removal efficiencies, decontamination factors, and holdup or decay times, such that gaseous effluent concentrations and associated doses to members of the public are in compliance with NRC regulations and the EPA environmental standards of 40 CFR Part 190.
- The applicant should develop ITAAC to verify the performance of the solid waste management system (as permanently installed systems or in combination with mobile processing equipment), such that liquid, wet, and dry solid wastes will be processed and disposed of in accordance with NRC regulations.
- The applicant should develop ITAAC to verify the performance of the process and effluent radiological monitoring instrumentation and sampling systems (as permanently installed systems or in combination with portable skid-mounted equipment) in controlling and monitoring process and effluent streams in accordance with NRC regulations.

C.II.1.2.8 ***ITAAC for Radiation Protection (SRP Section 14.3.8)***

This subsection primarily involves those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or monitoring of radiation (or radioactivity concentration) for normal operations and during accidents, as follows:

- The applicant should develop ITAAC to verify the adequacy of as-built walls, structures, and buildings as radiation shields, as applicable.
- The applicant should develop ITAAC to verify the plant airborne concentrations of radioactive materials through adequate design of ventilation and airborne monitoring systems.
- The applicant should develop ITAAC to verify the functional arrangement of ventilation systems.
- The applicant should develop ITAAC to verify the operability of radiation detection and monitoring equipment consistent with the requirements of 10 CFR 50.49(b)(3) and guidance in RG 1.97, Revision 2.
- The applicant should develop ITAAC to verify radiation and airborne radioactivity levels within plant rooms and areas to ensure the adequacy of plant shielding and ventilation system designs.
- The applicant should develop ITAAC to verify that radiation levels are commensurate with area access requirements and with ALARA principles during normal plant operations and maintenance.
- The applicant should develop ITAAC to verify that adequate shielding is provided to ensure that radiation levels in plant areas are within the limits necessary for operator actions to aid in mitigating or recovering from an accident.

C.II.1.2.9 ***ITAAC for Human Factors Engineering (SRP Section 14.3.9)***

This section primarily involves HFE as it pertains to main control panels, remote shutdown panels, local control panels, the technical support center, and the emergency offsite facility. In addition, it addresses the minimum inventory of alarms, controls, and indications appropriate for the main control room and the remote shutdown station.

Because the implementation of HFE is part of the design process, the related ITAAC should primarily address verification of products resulting from HFE implementation (e.g., verifying the design functionality of panels and associated instrumentation).

The applicant should develop HFE-related ITAAC to verify design implementation of the following essential aspects of the plant:

- HFE aspects of the main control room (i.e., ensure that the as-built design conforms with the verified and validated design that resulted from the HFE design process), including ITAAC that should address the special considerations listed in Section C.I.18.7.3 of this regulatory guide, such as safety function monitoring and minimum inventory of controls, displays, and alarms
- HFE aspects of the remote shutdown station (e.g., functionality and minimum inventory of remote shutdown station controls, displays, and alarms)
- HFE aspects of safety-related LCS and those LCS associated with risk-important and credited human actions (e.g., functionality and minimum inventory of LCS controls, displays, and alarms)
- HFE aspects of the technical support center
- HFE aspects of the emergency offsite facility

In addition, while the NRC staff expects that all other HFE-related design activities (as specified in SRP Section 18.II.A) will be completed by the time the Commission issues the COL, the applicant should provide ITAAC for any HFE-related activity that could not be completed by that time, such as integrated system validation. When proposing such HFE ITAAC, the applicant should justify why these activities are not completed.

C.II.1.2.10 *ITAAC for Emergency Planning (SRP Section 14.3.10)*

The COL applicant shall provide proposed ITAAC for the facility's emergency planning (EP-ITAAC) in accordance with the requirements of 10 CFR 52.80(a). In so doing, the applicant may provide proposed EP-ITAAC that are consistent with those provided in Table C.II.1-B1 of Appendix C.II.1-B and are modified, as necessary, to accommodate site-specific impacts or features. The applicant should include the EP-ITAAC in an appropriate section of the COL application, together with all other facility ITAAC, as defined in Section C.IV.2 of this regulatory guide.

C.II.1.2.11 *ITAAC for Containment Systems (SRP Section 14.3.11)*

This subsection primarily involves containment design and associated issues, such as containment isolation provisions, containment leakage testing, hydrogen generation and control, containment heat removal, suppression pool hydrodynamic loads, and subcompartment analysis, as follows:

- The applicant should develop ITAAC to verify key parameters and insights from containment safety analyses, such as LOCA, main steamline break, main feedline break, subcompartment analyses, and suppression pool bypass analyses.
- The applicant should develop ITAAC to verify the existence of severe accident prevention and mitigation design features.

- The applicant should develop ITAAC to verify the functional arrangements of containment isolation provisions.
- The applicant should develop ITAAC to verify the design qualification of containment isolation valves.
- The applicant should develop ITAAC to verify by in situ testing the containment isolation functions of MOVs and check valves.
- The applicant should develop ITAAC to verify containment isolation signal generation.
- The applicant should develop ITAAC to verify containment isolation valve closure times.
- The applicant should develop ITAAC to verify containment isolation valve leakage.

C.II.1.2.12 ***ITAAC for Physical Security Hardware (SRP Section 14.3.12)***

The COL applicant should provide proposed ITAAC for the facility's physical security hardware (PS-ITAAC). In so doing, the applicant may provide proposed PS-ITAAC that are consistent with those provided in Appendix C.II.1-C and are modified, as necessary, to accommodate site-specific impacts or features. The applicant should include the PS-ITAAC in an appropriate section of the COL application, together with all other facility ITAAC, as defined in Section C.IV.2 of this regulatory guide.

Table C.II.1-1 Sample ITAAC Format

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The basic configuration of the ______ system is as shown in Figure ___. (If a figure is not used, reference the section number.)	1. Inspections of the as-built system will be conducted.	1. The as-built ______ system conforms with the basic configuration shown in Figure ___.
2. The ASME Code components of the ____ system retain their pressure boundary integrity under internal pressures that will be experienced during service.	2. A hydrostatic test will be conducted on those components of the ____ system required to be hydrostatically tested by the ASME Code. (Note 1) Preoperational NDE will be conducted on those components of the ____ system for which inspections are required by the ASME Code. (Note 1: Modify to call out pressure test for pneumatic/gas and oil systems, if that is proposed. Alternatively, pressure test can be used for all entries since the code will determine the testing fluid.)	2. The results of the hydrostatic test of the ASME Code components of the ____ system conform with the requirements in Section III of the ASME Code. (Note 1)

Table C.II.1-1 Sample ITAAC Format

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3a. The ______________ pumps have sufficient NPSH. 3b. The ________ storage tank/pool has sufficient capacity. Note: These items in the list at right require system-unique modification.	3. Inspections, tests, and analyses will be performed based upon the as-built system. The analysis will consider the effects of the following: • pressure losses for pump inlet piping and components • suction from the suppression pool with water level at the minimum value • 50% blockage of pump suction strainers • design-basis fluid temperature at 212 °F (100 °C) • containment at atmospheric pressure • vendor test results of required NPSH	3a. The available NPSH exceeds the required NPSH. 3b. The ________ storage tank/pool capacities exceed the minimum required volumes of ___ gallons (____ liters).
4. Each of the ___ system divisions (or Class 1E loads) is powered from its respective Class 1E division, as shown in Figures ___.	4. Tests will be performed on the ____ system by providing a test signal in only one Class 1E division at a time.	4. The test signal exists only in the Class 1E division (or at the equipment powered from that division) under test in the ____ system.
5. Each mechanical division of the ____ system (Divisions A, B, C)* is physically separated from the other divisions. * As appropriate for each system.	5. Inspections of the as-built ____ system will be performed.	5. Each mechanical division of the _____ system is physically separated from other mechanical divisions of the _____ system by structural and/or fire barriers (with the exception of _____).
6. Control room alarms, displays, and/or controls* provided for the _____ system are defined in Section ____. * Delete any category for which the design description includes no entries.	6. Inspections will be performed on the control room alarms, displays, and/or controls* for the _____ system. * Delete any category for which the design description includes no entries.	6. Alarms, displays, and/or controls* exist or can be retrieved in the control room as defined in Section ____. * Delete any category for which the design description includes no entries.

Table C.II.1-1 Sample ITAAC Format

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. RSS displays and/or controls provided for the ___ system are defined in Section ____.	7. Inspections will be performed on the RSS displays and/or controls for the ____ system.	7. Displays and/or controls exist on the RSS as defined in Section ____.
8. MOVs are designated in Section ___ as having an active safety-related function (open, close, or both open and close) under design-basis differential pressure, fluid flow, and temperature conditions.	8. Tests and/or analyses of installed valves will be performed for opening, closing, or both opening and closing under differential pressure, fluid flow, and temperature conditions.	8. Upon receipt of the actuating signal, each MOV opens, closes, or both opens and closes, depending upon its safety function.
9. The pneumatically operated _____ valves shown in Figure ______ close (or open) if either electric power to the valve actuating solenoid or pneumatic pressure to the valves is lost.	9. Tests will be conducted on the as-built _______ valves.	9. The pneumatically operated ______ valves shown in Figure ______ close (open) when either electric power to the valve actuating solenoid or pneumatic pressure to the valves is lost.
10. CVs are designated in Section ____ as having an active safety-related function (open, close, or both open and close) under system pressure, fluid flow, and temperature conditions.	10. Tests of installed CVs for opening, closing, or both opening and closing will be conducted under differential pressure, fluid flow, and temperature conditions.	10. Based on the direction of the differential pressure across the valve, each CV opens under minimum differential pressure and remains open under minimum flow conditions, closes, or both opens and closes, depending upon its safety functions.

Table C.II.1-1 Sample ITAAC Format

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. In the ____ system, independence is provided between Class 1E divisions and between Class 1E divisions and non-Class 1E equipment.	11.1. Tests will be performed on the ____ system by providing a test signal in only one Class 1E division at a time. 11.2. Inspection of the as-installed Class 1E divisions in the ____ system will be performed.	11.1. The test signal exists only in the Class 1E division under test in the ____ system. 11.2. In the ____ system, physical separation or electrical isolation exists between these Class 1E divisions. Physical separation or electrical isolation also exists between Class 1E divisions and non-Class 1E equipment.

APPENDIX C.II.1-A

GENERAL ITAAC DEVELOPMENT GUIDANCE

FLUID SYSTEMS

This section provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for fluid systems that have been selected for inclusion based on the ITAAC selection methodology described in Section 14.3 of the FSAR, including any design descriptions developed separately for the ITAAC and any supporting tables and figures. Examples of this information appear in the DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52.

I. Design Descriptions and Figures

A. Design Descriptions

For the ITAAC design descriptions that may be developed separately from the detailed design information contained in the COL application, the various design descriptions should include the information below in a consistent order.

(1) System Purpose and Functions (minimum is safety functions, possibly including some nonsafety functions)

The design description identifies the system's purpose and function and captures the system components that are involved in accomplishing the system's direct safety function. Each design description should include wording (preferably in the first paragraph) that identifies whether the system is safety related or nonsafety related. The design description should note exceptions if parts of the system are not safety related or if certain aspects of a nonsafety system have a safety significance.

(2) Location of the System

The design description should identify the building in which the system is located (e.g., containment, reactor).

(3) Key Design Features of the System

The design description should describe the components that make up the system, including key features such as the use of SRVs to perform as the automatic depressurization system. However, the design description need not include component design details (such as internal workings of the MSIVs and SRVs) because this could limit the COL applicant or licensee to a particular make and model of a component. If the PRA results indicate that a particular system component or function is risk significant, the design description should describe that component or function. The design description should describe any features (such as flow limiters, backflow protection, surge tanks, severe accident features) as follows:

- Flow-Limiting Features for High-Energy Line Breaks Outside of Containment. ITAAC should verify the minimum pipe diameter because these features are needed to directly limit or mitigate DBE such as pipe breaks. Lines with diameters less than 1 inch (2.54 centimeters), such as instrument lines, need not be included because their small size limits the effects of high-energy line breaks outside containment.

- Keep Fill Systems. The design description should include these systems when needed for the direct safety function to be achieved without the damaging effects of water hammer.
- Online Test Features. Some systems/components have special provisions for online test capability (such as an ECCS test loop), which is critical to demonstrate the capability of the system/component to perform its direct safety function. The design description should describe these online test features.
- Filters. The design description should describe filters that are required for a safety function (such as control room HVAC radiation filtering). The functional arrangement ITAAC should include verification that the filter exists, but need not test its performance.
- Surge Tank/Storage Pool. The capacity of the surge tank/storage pool should be verified if the tank/pool is needed to perform the direct safety function. For example, in the case of the reactor cooling water surge tank, a certain volume is required to meet the specific system leakage assumptions.
- Severe Accident Features. The design description should describe these features, and the functional arrangement ITAAC should verify that they exist. In general, the ITAAC need not include the capabilities of these features. The applicable sections of the COL application should include detailed analyses.
- Hazard Protection Features. The appropriate system design description should include special features (switches, valves, dampers) that are used to provide protection from hazards (e.g., flood, fire). Other features (such as walls, doors, curbs) should also be covered; however, in most cases, an ITAAC for buildings or structures should address these.
- Special Cases for Seismic Qualification. Some nonsafety equipment may require special treatment because of its importance to safety. One example is the seismic analysis of the BWR main steam piping, which provides a fission product leakage path to the main condenser and allows elimination of the traditional MSIVLCS.

(4) Seismic and ASME Code Classifications

The design description of each system should describe the safety classification of fluid systems and components. The functional drawings should identify the boundaries of the ASME Code classification that are applicable to the safety class. The ITAAC for system piping should include verification of the design report to ensure that the appropriate code design requirements for the system’s safety class have been implemented. Therefore, the design description need not specify design pressures and temperatures for fluid systems, except in special cases (such as intersystem LOCAs) where the system has to meet additional requirements.

(5) System Operation

The design description should describe the system’s important performance modes of operation. This description should include realignment of the system following an actuation signal (e.g., a safety injection signal for a PWR or a LOCA signal for a BWR).

(6) Alarms, Displays, and Controls

The design description for the systems should describe the important system alarms, displays (without using the term “indications”), and controls available in the control room. Important instrumentation that is required for direct operation or accident mitigation should be shown in the system figure or described in the design description if there is no figure. Those that are provided for routine system performance monitoring or operator convenience need not be shown or discussed.

The functioning of the alarms, displays, and controls in the main control room (MCR) and remote shutdown panel (RSP) must be verified in either the system ITAAC or the MCR/RSP ITAAC. The intent is to test the integrated as-built system; however, separate testing of the actual operation of the system and alarm, display, and control circuits using simulated signals may be acceptable where this is not practical.

(7) Logic

If a system/component has a direct safety function, it typically receives automatic signals to perform some action (e.g., start, isolation). The design description captures these aspects related to the system's direct safety function.

(8) Interlocks

The system design description should include interlocks needed for direct safety functions. Examples include the interlocks to prevent intersystem LOCA and those that switch the system or component from one mode to a safety function mode. The design description should not include other interlocks that are more equipment-protective in nature, and related discussions should remain only in applicable sections of the COL application.

(9) Class 1E Electrical Power Sources/Divisions

The design description or figure should identify the electrical power source/division for equipment included in the system. Independent Class 1E power sources are required for components that perform direct safety functions and are needed to meet the single-failure criterion, GDC 17, "Electric Power Systems," and the like. The ITAAC developed for the electrical and I&C systems also should address electrical separation.

(10) Equipment To Be Qualified for Harsh Environments

Applicants must demonstrate that electrical equipment performs a necessary safety function is capable of maintaining functional operability under all service conditions, including LOCA, that are postulated to occur during its installed life for the time it is required to operate. Applicants should complete documentation related to equipment qualification for all equipment important to safety in accordance with the requirements of 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants." ITAAC associated with equipment qualification should verify this aspect of the design. The scope of environmental qualification to be verified by the ITAAC includes the Class 1E electrical equipment identified in the design description (or the accompanying figures), connected I&C, connected electrical components (such as cabling, wiring, and terminations), digital I&C equipment, and lubricants necessary to support performance of the safety functions of components located in harsh environments. The I&C ITAAC should address the qualification of digital I&C equipment for other-than-harsh environments.

(11) Accessibility for Inservice Inspection and Testing

The applicable sections of the COL application should discuss accessibility requirements. ITAAC associated with systems for which the design includes accessibility requirements should provide verification of accessibility.

(12) Numeric Performance Values

Applicants should specify numeric performance values for SSCs as ITAAC to demonstrate satisfaction of a design commitment. The numeric performance values need not be specified as design commitments and documented in the design description unless there is a specific reason to include them. However, the design description should include key numbers and physical parameters used in the Chapter 6, 14.3, and 15 safety analyses and significant parameters of the PRA.

B. Figures

(1) In general, figures and/or diagrams are required for all systems. However, a separate figure may not be necessary for simple fluid systems and components (e.g., the condenser). The format for the figures and/or diagrams should be simplified P&IDs for mechanical systems. Symbols used on the figures should be consistent with the legend provided by the applicant.

(2) The figures should show all components discussed in the design description.

(3) The figures should clearly delineate system boundaries with other systems. With few exceptions, system boundaries should occur at a component.

(4) ASME Code class boundaries for mechanical equipment and piping are shown on the figures and form the basis for system-based ITAAC verifications. These verifications may include functional arrangement checks, system boundary checks, piping support checks, and inspections of the welding quality for all ASME Code Class 1, 2, and 3 piping systems described in the design description. A hydrotest and preoperational NDE are also required in each system ITAAC for ASME Code Class 1, 2, and 3 piping systems to verify the pressure integrity of the overall piping system, including the process of fabricating the system as well as welding and bolting requirements.

(5) As a minimum, the figures should show or the design description should describe the instruments (e.g., pressure, temperature) required to ensure plant safety and perform in accordance with technical guidelines for human factors as discussed in Chapter 18 of a COL application.

(6) The minimum inventory of alarms, displays, and controls, if established in ITAAC associated with the MCR or RSP, need not be discussed in individual design descriptions or shown on figures. The figures should show other essential alarms (e.g., those associated with shutdown cooling system high-pressure (intersystem LOCA), shutdown cooling system performance monitoring indications) that are not part of the minimum inventory.

(7) The system diagram or (alternatively) ITAAC associated with the RSP should include identification of all alarms, displays, and controls on the RSP.

(8) Class 1E power sources (i.e., division identification) for electrical equipment can be shown on the figure in lieu of including them in the design description.

(9) Figures for safety-related systems should include most of the valves on the P&IDs included in applicable sections of the COL application, except for items such as fill, drain, test tees, and maintenance isolation valves. The scope of valves to be included on the figures encompasses those MOVs, POVs, and check valves that have a safety-related active function. (The IST plan contains a complete list of such valves.) The figures must show valves that are remotely operable from the MCR if their mispositioning could affect the system safety function. Other valves are evaluated for exclusion on a case-by-case basis. Figures for nonsafety-related systems may have less detail.

(10) Fail-safe positions of the pneumatic valves need not be shown on figures or discussed in the design description unless the fail-safe position is relied on to accomplish a direct safety function of the system.

(11) Containment isolation valves (CIVs) should be shown on the figures of the applicable system ITAAC or discussed in the design description if there is no figure. Either the system ITAAC or a separate containment isolation system ITAAC that encompasses all CIVs may include the demonstration of CIV performance to a containment isolation signal, electrical power assignment to the CIVs, and failure response to the CIVs, as applicable. The design description should address, and the containment ITAAC may address, leak rate testing of the CIVs.

(12) Heat loads requiring cooling (e.g., pump motors, heat exchangers) need not show the source of cooling unless that source has a specific or unique characteristic that is credited in the safety analyses (e.g., reactor coolant pump seal water cooling).

C. Style Guidelines for Design Descriptions and Figures

(1) Applicants should use standard terminology in favor of new terminology, which should be avoided (i.e., use terms that are common in the CFR or NRC regulatory guides, rather than redefining them).

(2) Pressures should include units to indicate whether the parameter is absolute, gage, or differential.

(3) Applicants should use the term "LOCA signal" (rather than specific input signals such as "high drywell" or "low water level") because control systems generally process the specific input signals and generate a LOCA signal that actuates the component.

(4) In general, applicants should avoid using the term "associated" because it has particular meaning regarding electrical circuits and its use may lead to confusion.

(5) Numbers should be expressed in English or metric units with converted units in parentheses, as appropriate.

(6) The design description should be consistent in the use of present or future tense.

(7) Applicants should use the term "division" instead of train, loop, or subsystem (unless it is a subsystem).

(8) Systems should be described as "safety related" and "nonsafety related," rather than "essential" and "nonessential."

(9) Applicants should use the correct system name consistently.

II. Inspections, Tests, Analyses, and Acceptance Criteria

A. Operational and Functional Aspects of the System

The design description or the COL application design information captures the system components that are involved in accomplishing the direct safety function. Typically, the system ITAAC specify functional tests, or tests and analyses, to verify the direct safety functions for the various system operating modes.

B. Critical Assumptions from Transient and Accident Analyses

ITAAC should verify the critical assumptions from transient and accident analyses. Section 14.3 of the COL application should provide cross-references, showing how ITAAC capture and verify the key physical parameters from these safety analyses. These cross-references, which are also called roadmaps, should identify all critical parameters given in the relevant sections of the COL application (mainly in Chapters 6 and 15). COL applicants should ensure that the applicable system ITAAC include critical input parameters, as appropriate.

C. PRA and Severe Accident Insights

If the PRA results indicate that a particular system component or function is risk significant, ITAAC should verify that component or function. Chapter 19 of the COL application should identify PRA insights. Section 14.3 of the COL application should include roadmaps for PRA, including shutdown safety analyses and severe accidents, with specific references to the system ITAAC where the key parameters from those analyses are verified.

D. Online Test Features

Some systems have special provisions for online test capability (such as an ECCS test loop), which is critical to demonstrate the system's capability to perform the direct safety function. ITAAC should verify these online test features.

E. Surge Tanks

The operating inventory and/or surge capacity of a surge tank should be verified if the tank is needed to perform the direct safety function. For example, BWRs require a certain reactor cleanup water (RCW) surge tank inventory to meet the specific system leakage assumptions.

F. Special Cases for Seismic Qualification

Some nonsafety equipment may require special treatment because of its importance to safety. One example is the seismic analysis of the BWR main steam piping, which provides a fission product leakage path to the main condenser and allows elimination of the traditional MSIV leakage control system. Another example is the seismic analysis of the fire protection standpipe system, which provides manual firefighting capability in areas that contain safety-related SSCs.

G. Initiation Logic

If a system/component has a direct safety function, it typically receives automatic signals to perform some action (e.g., start, isolation). The system ITAAC should capture these aspects related to the system's direct safety function. The system ITAAC will not test the entire logic and combinations because the overall logic is checked in the I&C ITAAC for the safety system logic.

H. Interlocks

The system design description or COL application design information and the ITAAC should include interlocks needed for direct safety functions. Examples include the interlocks to prevent intersystem LOCAs and those that switch the system or component from one mode to a safety function mode. ITAAC should not include other interlocks that are more equipment-protective in nature. In addition, some interlocks are not tested in the system ITAAC because the overall logic is checked in the I&C ITAAC for the safety system logic.

I. Automatic Override Signals

The ITAAC need not include automatic signals that override equipment protective features during a DBE (e.g., thermal overloads for MOVs) if there are other acceptable methods to ensure system function during a DBE.

J. Single Failure

The design description should not state that the system meets the single-failure criterion, and there should not be an ITAAC to verify that the system meets the single-failure criterion.

Rather, the ITAAC should address the system attributes (such as independence and physical separation) that relate to the single-failure criterion.

K. Flow Control Valves

In general, the ITAAC need not test the check valve flow control capability, unless the safety analyses credit flow control. However, the figure should show flow control valves if they are required to fail-safe or receive a safety actuation signal. The figure should note the fail-safe position, or the design description or the COL application design information should discuss it if there is no figure.

L. Pressure Testing of Ventilation Systems

Where ductwork constitutes an extension of the control room boundary for habitability, the ductwork should be pressure-tested.

M. Fire Dampers in HVAC Systems

Applicants should verify full automatic closure of fire dampers in ductwork that penetrates fire barriers that are required to protect SSCs that are important to safety.

III. Style Guidelines for ITAAC

A. The wording in the first column of the ITAAC (Design Commitment column) should be as close as possible to the design description or the design information in the COL application.

B. The second column of the ITAAC should always contain at least one of the three methods ("Inspection" or "Test" or "Analysis") and may sometimes contain a combination of the three.

C. Standard preoperational tests, defined in relevant sections of the COL application and RG 1.68 are not a substitute for ITAAC; however, the results of such tests can be used to satisfy an ITAAC.

D. If an ITAAC test is not normally performed as part of a preoperational test, the relevant section of the COL application should describe the test methodology. Appropriate sections of the application may also include any supporting design or analysis issues as well as references to the ITAAC.

E. Use of the terms "Test" and "Type Test" in the second column should be consistent with the definitions provided in Section C.II.1.1.1 of this regulatory guide. Alternatively, testing may be classified as "Vendor," "Manufacturer," or "Shop" to clarify the intended test type.

F. If the ITAAC requires an analysis, the ITAAC should identify the specific type of analysis and/or its results/outcome. The relevant sections of the COL application, which may reference the ITAAC as required, may also discuss the specific analysis of results/outcome necessary to support the ITAAC.

G. The second column of the ITAAC should identify the component, division, or system to be verified by the inspection, test, and/or analysis.

H. ITAAC should refer only to inspections, not visual inspections.

I. The third column of the ITAAC (Acceptance Criteria column) should specify numerical values.

J. The ITAAC should be consistent in the use of present or future tense.

K. Applicants should use the term "division" instead of train, loop, or subsystem (unless it is a subsystem).

L. Applicants should write ITAAC clearly to avoid the use of clarifying phrases.

M. Applicants should use the correct system name consistently.

INSTRUMENTATION AND CONTROL SYSTEMS

This section provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for I&C systems, including any design descriptions developed separately for the ITAAC and any supporting tables and figures. The DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52 provide examples of this information.

I. Design Descriptions and Figures

The design description should address I&C equipment that is involved in performing safety functions. Essentially, this would include the complete Class 1E I&C systems and should include the information below.

A. Provide hardware architecture descriptions, including the following

- descriptions of all hardware modules
- cabinet layout and wiring
- seismic and environmental control requirements
- power sources

B. Provide software architecture descriptions, including the following:

- software design specifications
- code listings
- build documents
- installation configuration tables

C. Indicate regulatory guides that have specific recommendations. This may be an area where the applicant identifies as a design commitment a specific design aspect addressed by a regulatory guide, but the acceptance criteria allow alternative approaches, which the applicant then discusses in the FSAR portion of the COL application.

D. Note safety-significant operating experience problems that have been identified (particularly through generic letters or bulletins and in some cases information notices).

E. Identify policy issues raised for the standard designs.

F. State new design features (such as communications between various portions of the digital system or other systems).

G. Provide insights or key assumptions identified through the PRA.

H. Note GSI resolutions that have resulted in design/operational features.

I. Include post-TMI requirements (e.g., postaccident monitoring).

II. ITAAC Entries (for the above equipment)

The applicant should develop I&C ITAAC to address the considerations below.

A. Compliance with 10 CFR 50.55a(h) and IEEE Standard 603-1991 (and the Correction Sheet Dated January 30, 1995[1])

- Section 4.1 Identification of the DBEs. The ITAAC should verify the inclusion of the initial conditions and allowable limits of plant conditions for each DBE.

- Section 4.4 Identification of monitored variables. The ITAAC should verify the analytical limit associated with each variable, the ranges (normal, abnormal, and accident conditions), and the rates of change for these variables to be accommodated until proper completion of the protective action is ensured.
- Section 4.5 Minimum criteria for manual initiation and control of protective actions subsequent to initiation. The ITAAC should verify the points in time and the plant conditions during which manual control is allowed; the justification for permitting initiation or subsequent control solely by manual means; the range of environmental conditions imposed upon the operator during normal, abnormal, and accident circumstances throughout which the manual operation is performed; and the variables that will be displayed for the operator to use in taking manual action.
- Section 4.6 Identification of the minimum number and locations of sensors. The ITAAC should include analysis of the minimum number and locations of sensors that the safety systems require for protective purposes.
- Section 4.7 Range of transient and steady-state conditions. The ITAAC should verify the range of transient and steady-state conditions, including both motive and control power and the environment (e.g., voltage, frequency, radiation, temperature, humidity, pressure, and vibration) during normal, abnormal, and accident circumstances throughout which the safety system is required.
- Section 4.8 Identification of conditions having the potential to cause functional degradation of safety system performance. The ITAAC should include analysis of the conditions that have the potential to cause functional degradation of the safety systems (e.g., missiles, pipe breaks, fires, loss of ventilation, spurious operation of fire suppression systems, operator error, failure in nonsafety-related systems).
- Section 4.9 Identification of the methods used to assess the reliability of the safety system design. The ITAAC should verify that this analysis was performed correctly and accepted by the NRC.
- Section 5.1 Single-failure criterion. The ITAAC should include analysis or demonstration to show that the safety systems can perform all safety functions required for a DBE in the presence of (1) any single detectable failure within the safety systems, concurrent with all identifiable but nondetectable failures, (2) all failures caused by the single failure, and (3) all failures and spurious system actions that cause or are caused by the DBE requiring the safety functions.

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1 Refer to Appendix 7B to Section C.I.7 of this regulatory guide for additional discussion on conformance with IEEE Standard 603.

- Section 5.2 Completion of protective action. The ITAAC should include analysis or demonstration to show that the safety systems are designed so that, once initiated (automatically or manually), the intended sequence of protective actions of the execute features shall continue until completion, and deliberate operator action is required to return the safety systems to normal.
- Section 5.3 Quality. The ITAAC should verify that all components, modules, and software are of a quality that is consistent with minimum maintenance requirements and low failure rates and that the safety system equipment has been designed, manufactured, inspected, installed, tested, operated, and maintained in accordance with a prescribed QA program.
- Section 5.4 Equipment qualification. The ITAAC should include analysis or demonstration to show that the safety system equipment has been qualified by type test, previous operating experience, or analysis or by any combination of these three methods to substantiate that it will be capable of meeting, on a continuing basis, the design-basis performance requirements.
- Section 5.5 System integrity. The ITAAC should include analysis or demonstration to show that the safety systems have been designed to accomplish their safety functions under the full range of applicable conditions enumerated in the design basis.
- Section 5.6 Independence. The ITAAC should include analysis or demonstration to show that there is physical, electrical, and communications independence between redundant portions of a safety system, between safety systems and effects of a DBE, and between safety systems and other systems.
- Section 5.7 Capability for test and calibration. The ITAAC should include analysis or demonstration to show that the safety systems have the capability to test and calibrate safety system equipment while retaining the systems' capability to accomplish their safety functions.
- Section 5.8 Information displays. The ITAAC should verify that (1) the display instrumentation provided for manually controlled actions for which no automatic control is provided are part of the safety systems, (2) the display instrumentation provides accurate, complete, and timely information pertinent to safety system status, and (3) there is an indication of bypasses.
- Section 5.9 Control of access. The ITAAC should verify that the safety system design permits administrative control of access to safety system equipment.
- Section 5.10 Repair. The ITAAC should verify that the safety systems have been designed to facilitate timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.
- Section 5.11 Identification. The ITAAC should verify that (1) the safety system equipment is distinctly identified for each redundant portion of a safety system, (2) identification of safety system equipment is distinguishable from any identifying markings placed on equipment for other purposes,

and (3) identification of safety system equipment and its divisional assignments does not require frequent use of reference material.

- Section 5.12 Auxiliary features. The ITAAC should include analysis or demonstration to show that auxiliary supporting features meet all requirements of this standard and do not degrade the safety systems below an acceptable level.
- Section 5.13 Multiunit stations. The ITAAC should include analysis or demonstration to show that safety systems that are shared between units at multiunit generating stations can simultaneously perform required safety functions in all units.
- Section 5.14 Human factors considerations. The ITAAC should verify that functions that are allocated (in whole or in part) to the human operators and maintainers can be successfully accomplished to meet the safety system design goals.
- Section 5.15 Reliability. The ITAAC should verify that an appropriate analysis of the design has been performed to confirm that established quantitative or qualitative reliability goals have been achieved for systems for which such goals have been defined.
- Section 6.1 Automatic control. The ITAAC should verify that all protective actions can be automatically initiated and controlled.
- Section 6.2 Manual control. The ITAAC should verify that the control room provides the means to manually initiate and control automatically initiated protective actions at the division level.
- Section 6.3 Interaction between the sense and command features and other systems. The ITAAC should include analysis or demonstration to show that no single credible event (including the event's direct and consequential results) can cause a nonsafety system action that results in a condition, which requires protective action and can concurrently prevent that protective action in sense and command feature channels that are designated to provide principal protection against the condition.
- Section 6.4 Derivation of system inputs. The ITAAC should verify that sense and command feature inputs are derived from signals that are direct measures of the desired variables, as specified in the design basis.
- Section 6.5 Capability for testing and calibration. The ITAAC should include analysis or demonstration to show that there are means for checking, with a high degree of confidence, the operational availability of each sense and command feature input sensor that may be required for a safety function during reactor operation.
- Section 6.6 Operating bypasses. The ITAAC should include analysis or demonstration to show that whenever the applicable permissive conditions are not met, a safety system will automatically prevent the activation of an operating bypass or will initiate the appropriate safety functions.
- Section 6.7 Maintenance bypass. The ITAAC should include analysis or demonstration to show that the safety system can accomplish its

safety function while sense and command features equipment is in a maintenance bypass state.

- Section 6.8 Setpoints. The ITAAC should verify that the allowance for uncertainties between the process analytical limit and the device setpoint has been determined using a documented and approved methodology.
- Section 7.3 Completion of protective action for executive features. The ITAAC should include analysis or demonstration to show that the safety systems are designed so that once initiated, the protective actions of execute features will proceed to completion.
- Section 8 Power source requirements. The ITAAC should verify that the power to the safety system is Class 1E.

B. Compliance with GDC in Appendix A to 10 CFR Part 50

The ITAAC should address each of the following GDC:

- GDC 1, as it pertains to quality standards for design, fabrication, erection, and testing. The ITAAC should verify that (1) the safety-related I&C systems were designed, fabricated, erected, and tested to the required quality standards, (2) those standards were evaluated to determine their applicability, adequacy, and sufficiency, (3) a QA program was established and implemented, and (4) appropriate records of the design, fabrication, erection, and testing of SSCs are being maintained by (or under the control of) the nuclear power unit licensee throughout the life of the unit.
- GDC 2, as it pertains to protection against natural phenomenon. The ITAAC should verify that (1) the safety-related I&C systems were designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions, (2) the most severe natural phenomena were appropriately considered with sufficient margin, and (3) the effects of normal and accident conditions were appropriately combined with the effects of the natural phenomena.
- GDC 4, as it pertains to environmental and dynamic effects. The ITAAC should verify that the safety-related I&C systems were designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs.
- GDC 13, "Instrumentation and Control," as it pertains to I&C requirements. The ITAAC should verify that the safety-related I&C systems were designed to provide instrumentation to monitor variables and systems over their anticipated ranges for normal operation, AOO, and accident conditions, as appropriate to ensure adequate safety. This monitoring should include those variables and systems that can affect the fission process, the integrity of the reactor core, the RCPB, and the containment and its associated systems. In addition, appropriate controls should be provided to maintain these variables and systems within prescribed operating ranges.
- GDC 19, as it pertains to control room requirements. The ITAAC should verify that (1) actions can be taken in the control room to safely operate the nuclear power unit under normal conditions and maintain it in a safe condition under accident conditions, including LOCAs, and (2) adequate radiation protection has been provided to permit access to, and occupancy of, the control room under accident conditions for the duration

of the accident without personnel receiving radiation exposures in excess of the total effective dose equivalent of 0.05 sievert (5 rem) specified in 10 CFR 50.2.

- GDC 20, "Protection System Functions," as it pertains to protection system design requirements. The ITAAC should verify that the protection system was designed to automatically initiate the operation of appropriate systems, including the reactivity control systems, to (1) ensure that specified acceptable fuel design limits are not exceeded as a result of AOO, (2) sense accident conditions, and (3) initiate the operation of systems and components important to safety.

- GDC 21, "Protection System Reliability and Testability," as it pertains to protection system reliability and testability. The ITAAC should verify that the safety-related I&C systems were designed for high functional reliability and inservice testability. The ITAAC should also verify that the redundancy and independence designed into the systems will be sufficient to ensure that (1) no single failure results in loss of the protection function and (2) the removal of any component or channel from service will not result in loss of the required minimum redundancy unless the acceptable reliability of protection system operation can otherwise be demonstrated. In addition, the ITAAC should verify that the protection system was designed to permit periodic testing of its functioning with the reactor in operation and that this capability includes testing channels independently to identify any failures or losses of redundancy that may have occurred.

- GDC 22, "Protection System Independence," as it pertains to protection system independence. The ITAAC should verify that the safety-related I&C systems were designed so that neither natural phenomena nor normal operating, maintenance, testing, and postulated accident conditions will affect redundant channels in a manner that results in loss of the protection function. Alternatively, the ITAAC should demonstrate on some other defined basis that (1) the safety-related I&C systems offer acceptable independence of the protection system and (2) design techniques, such as functional diversity or diversity in component design and principles of operation, were used to prevent loss of the protection function.

- GDC 23, as it pertains to protection system failure modes. The ITAAC should verify that the safety-related I&C systems were designed to fail into a safe state or into a state that is demonstrated to be acceptable if they experience conditions such as disconnection of the system, loss of energy, or postulated adverse environments.
- GDC 24, as it pertains to separating protection systems from control systems. The ITAAC should verify that the safety-related I&C systems were separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel that is common to the control and protection systems, leaves intact a system that satisfies all reliability, redundancy, and independence requirements of the protection system. In addition, the ITAAC should verify that interconnection of the protection and control systems was sufficiently limited to ensure that safety is not significantly impaired.
- GDC 25, "Protection System Requirements for Reactivity Control Malfunctions," as it pertains to protection system requirements for reactivity control malfunctions. The ITAAC should verify that the protection system was designed to ensure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal of control rods.

- GDC 29, as it pertains to protection against AOO. The ITAAC should verify that the protection and reactivity control systems were designed to ensure an extremely high probability of accomplishing their safety functions in the event of AOO.

C. Documentation of a High-Quality Software Design Process

- The ITAAC should address the following planning documentation, with a requirement to demonstrate each of the management, implementation, and resource characteristics shown in BTP 7-14[2]:
  - Software management plan. The ITAAC should (1) verify that the software management plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14 and (2) specifically evaluate how the quality of the vendor effort will be assessed and found to be acceptable.
  - Software development plan. The ITAAC should verify that the software development plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify that the plan clearly states (1) which tasks are part of each life cycle, (2) what the inputs and outputs of that life cycle will be, and (3) how the review, verification, and validation of those outputs are defined.
  - Software test plan. The ITAAC should verify that the software test plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify (1) which tasks are part of each life cycle, (2) what the inputs and outputs of that life cycle will be, and (3) how the review, verification, and validation of those outputs were determined.
  - Software quality assurance plan. The ITAAC should verify that (1) the software QA plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14 and (2) following this plan will result in high-quality software that will perform its intended safety function.
  - Integration plan. The ITAAC should verify that the integration plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, if some of the software is dedicated as commercial grade or reuses previously developed software, the ITAAC should specifically verify how that software will be integrated with newly developed software.
  - Installation plan. The ITAAC should verify that the installation plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14.
  - Maintenance plan. The ITAAC should verify that the maintenance plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify how software maintenance will be performed after the system has been delivered, installed, and accepted.

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2 Refer to Appendix 7C to Section C.I.7 of this regulatory guide for additional discussion on conformance with IEEE Standard 7-4.3.2.

- Training plan. The ITAAC should verify that the training plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14.
- Operations plan. The ITAAC should verify that the operations plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically evaluate the system's operational security, verifying the existence of means to ensure no unauthorized changes to hardware, software, and system parameters as well as monitoring to detect penetration (or attempted penetration) of the system.
- Software safety plan. The ITAAC should verify that the software safety plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14.
- Software V&V plan. The ITAAC should verify that the software V&V plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify the independence of the V&V organization in management, scheduling, and finance.
- Software configuration management (CM) plan. The ITAAC should verify that the software CM plan addresses each of the management, implementation, and resource characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify that the following items will be under the control of a software librarian or group that is responsible for archiving the various versions of the software, including any software or software information that affects the safety software, such as software requirements, designs, and code; support software used in development; libraries of software components essential to safety; software plans that could affect quality; test software requirements, designs, or code used in testing; test results and analyses used to qualify software; software documentation; databases and software configuration data; predeveloped software items that are safety system software; software change documentation; and tools used in the software project for management, development, or assurance tasks.

• The ITAAC should address the following implementation documents, with a requirement to demonstrate each of the management, implementation, and resource characteristics shown in BTP 7-14:

  - safety analyses
  - V&V analysis and test reports
  - CM reports
  - requirement traceability matrix

  The ITAAC should verify that each of the implementation documents will document each of the following life-cycle phases:

  - requirements
  - design
  - implementation
  - integration
  - validation
  - installation
  - operations
  - maintenance

- The ITAAC should address the following software life-cycle process design output documents, with a requirement to demonstrate each of the characteristics shown in BTP 7-14:
  - The ITAAC should verify the system test procedures and results (validation tests, site acceptance tests, preoperational and startup tests) that provide assurance that the system functions as intended.
  - The ITAAC should verify that the design output documents address each of the functional characteristics shown in BTP 7-14. In addition, the ITAAC should specifically verify that the defense-in-depth and diversity design conforms to the guidance of BTP 7-19.
  - The ITAAC should verify that the application conforms with the digital safety system security guidance provided in Revision 2 of RG 1.152.
  - The ITAAC should verify that the software requirements specifications address each of the functional characteristics shown in BTP 7-14, each individual requirement is traceable to a digital system requirement, and there are no added functions or requirements that are not traceable to the system requirements.
  - The ITAAC should verify that the hardware and software architecture descriptions address each of the functional characteristics shown in BTP 7-14 and that the hardware and software architecture is clear, understandable, and sufficiently detailed to allow understanding of the operation of the hardware and software.
  - The ITAAC should verify that the software design specifications address each of the functional characteristics shown in BTP 7-14.
  - The ITAAC should verify that the code listings address each of the functional characteristics shown in BTP 7-14 and have sufficient comments and annotations to clearly show the developer's intent.
  - The ITAAC should verify that the build documents address each of the functional characteristics shown in BTP 7-14.
  - The ITAAC should verify that the installation configuration tables address each of the functional characteristics shown in BTP 7-14.
  - The ITAAC should verify that the operations manuals address each of the functional characteristics shown in BTP 7-14.
  - The ITAAC should verify that the maintenance manuals address each of the functional characteristics shown in BTP 7-14.
  - The ITAAC should verify that the training manuals address each of the functional characteristics shown in BTP 7-14.

III. Style Guidelines for ITAAC

A. The wording in the first column of the ITAAC (Design Commitment column) should be as close as possible to the design description or the design information in the COL application.

B. The second column of the ITAAC should always contain at least one of the three methods ("Inspection" or "Test" or "Analysis") and may sometimes contain a combination of the three.

C. Standard preoperational tests, defined in relevant sections of the COL application and RG 1.68, are not a substitute for ITAAC; however, the results of such tests can be used to satisfy an ITAAC.

D. If an ITAAC test is not normally performed as part of a preoperational test, the relevant section of the COL application should describe the test methodology. Appropriate sections of the application may also include any supporting design or analysis issues as well as references to the ITAAC.

E. Use of the terms “Test” and “Type Test” in the second column should be consistent with the definitions provided in Section C.II.1.1.1 of this regulatory guide. Alternatively, testing may be classified as “Vendor,” “Manufacturer,” or “Shop,” to clarify the intended test type.

F. If the ITAAC requires an analysis, the ITAAC should identify the specific type of analysis and/or its results/outcome. The specific analysis or results/outcome necessary to support the ITAAC may also be discussed in the relevant sections of the COL application, which may reference the ITAAC as required.

G. The second column of the ITAAC should identify the component, division, or system to be verified by the inspection, test, and/or analysis.

H. Applicants should refer only to inspections, not visual inspections.

I. The third column of the ITAAC (Acceptance Criteria column) should specify numerical values.

J. The ITAAC should be consistent in the use of present or future tense.

K. Applicants should use the term “division” instead of train, loop, or subsystem (unless it is a subsystem).

L. Applicants should write ITAAC clearly to avoid the use of clarifying phrases.

M. Applicants should consistently use the correct system name.

ELECTRICAL SYSTEMS

This section provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for electrical systems (including lighting), including any design descriptions developed separately for the ITAAC and any supporting tables and figures. The DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52 include examples of this information.

I. Design Descriptions and Figures

The design description should address electrical equipment that is involved in performing the direct safety function. At a minimum, this should include the complete Class 1E electrical system, including power sources (which include offsite sources even though they are not Class 1E) and dc and ac distribution equipment. The design description should also address additional factors with regard to the electrical equipment that is part of the Class 1E system, but is included to improve the reliability of the individual Class 1E divisions (e.g., equipment protective trips). For example, if a failure or false actuation of a feature (such as a protective device) could prevent the safety function, and operating experience has shown problems related to this feature, the design description should probably include these. In addition, some fire protection analyses are based on the ability of breakers to clear electrical faults caused by fire. With respect to the non-Class 1E portions of the electrical system (powering the balance of plant loads), the applicant may include a brief design description. The design description for this portion should focus on the aspects, if any, needed to support the Class 1E portion. Therefore, based on the above, the design description should include the equipment below.

A. Overall Class 1E electric distribution system. This would include any high-level treatment for ac and dc cables, breakers, disconnect switches, switchgear, metal enclosed bus, load centers, motor control centers, motor starters, relays, protective devices, distribution transformers, and connections/terminations.

B. Power sources, including the following:

- offsite, including feeds from the main generator (a generator breaker to allow backfeed should be addressed), main power transformers, unit auxiliary transformers, reserve auxiliary transformers, and others
- dc system (batteries/battery chargers)
- emergency diesel generator (EDG), including load sequencing and EDG support systems that may be included for passive designs, also due to risk-significance
- Class 1E vital ac inverters, regulating transformers, transfer devices
- Aac power sources for SBO, including Aac power sources that may be included for passive plants, also due to risk significance

C. Other electrical features, including the following:

- containment electrical penetrations.
- cable ampacity and derating criteria
- cable tray loading criteria

D. Lightning protection (general configuration type check).

E. Grounding (configuration type check). For both lightning protection and grounding, it is expected that this will be part of an inspection to check that the features exist. ITAAC should not include any analyses to demonstrate adequacy.

F. Lighting (emergency control room, RSP), with the basis for inclusion related more to defense in depth, support function, operating experience, or PRA, rather than accomplishing a direct safety function.

G. Requirements specified by GDC 17 and GDC 18. For example, GDC 17 requires that physically independent circuits must be provided from the offsite to the Class 1E distribution system. Also GDC 17 requires provisions be included to minimize the probability of losing electric power from any of the remaining supplies as a result of or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies. This is a case where some design description and ITAAC or interface requirements are needed for a non-Class 1E area, because of its importance to safety. GDC 18 requires electric power systems important to safety to be designed to permit appropriate periodic inspection and testing.

H. Other specific rules and regulations that are applicable to electric systems. For example, the SBO rule (10 CFR 50.63) is met by an Aac source or a coping analysis, and the design description should include appropriate features. These are non-Class 1E aspects, but they are important to safety.

I. Regulatory guides that have specific recommendations. This may be an area where the applicant identifies as a design commitment a specific design aspect addressed by a regulatory guide. However, all regulatory guide recommendations may not need Tier 1 treatment.

J. Safety-significant operating experience problems that have been identified, particularly through electrical distribution system functional inspections, generic letters, circulars, RISs, NRC bulletins, and in some cases information notices. For example, degraded voltages, breaker coordination, and short circuit protection have been highlighted.

K. Policy issues raised for the standard designs. For the electrical area, this includes the Aac source for SBO, second offsite source to non-Class 1E buses, and direct offsite feed to Class 1E buses.

L. New features in the design (all of the new features may not need Tier 1 treatment). For example, on the advanced BWR, new design features include the main generator breaker for backfeed purposes, the potential for harmonics introduced by new reactor internal pumps, and main feedwater pump speed controllers and their potential effects on the Class 1E equipment.

M. Insights or key assumptions from the PRA. In the electrical area, this typically involves SBO, which should already receive treatment in ITAAC because of the SBO rule (see above). As another example, in the case of the System 80+ reactor, the split bus arrangement is a significant or key assumption in the PRA, and, in some cases, it is therefore important that a particular pump motor is on a particular bus within a given division. The ITAAC included this arrangement based on the PRA insights. In some cases, it may be possible to use PRA results to decide that some aspects of the design do not need to be verified by ITAAC (i.e., the PRA shows that the given aspects have little safety significance).

N. Severe accident features added to the design. Where the design includes such features, the ITAAC may need to address certain electrical support aspects.

O. Design/operational features resulting from solutions identified to resolve GSIs. For example, the resolution of GI-48/49 (as part of GI-128) identified treatment of tie breakers. The figure showing the Class 1E distribution system should show this feature if it exists, and the ITAAC should verify any special requirements to accommodate this feature.

P. Post-TMI requirements such as power to the power-operated relief valve, block valve, and pressurizer heaters.

II. ITAAC Entries (for the above equipment)

The following provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for electrical systems (including lighting) that the applicant has selected for inclusion based on the ITAAC selection methodology described in Section 14.3 of the FSAR.

A. Arrangement/Configuration

General functional arrangement. The ITAAC should verify the functional arrangement of the system to a level of detail determined by the design description or the COL application design information and any supporting information included in figures.

Qualification of systems and components. The ITAAC should verify the qualification of systems and components for seismic and harsh environments. Only the applicable sections of the COL application should discuss electrical equipment located in a mild environment. However, an exception is made for state-of-the-art digital I&C equipment located in an other-than-harsh environment because operational experience has shown that this state-of-the-art equipment is sensitive to temperature. Applicants should include ITAAC to verify the qualification of equipment for which performance may be impacted by sensitivity to environmental conditions that the regulations do not consider to be harsh.

B. Independence

The ITAAC should verify adequate separation, required interties (if any), required identification (e.g., color coding), proper routing and termination (i.e., location), and separation of non-Class 1E loads from Class 1E buses. In addition, the fire protection ITAAC should address postfire safe-shutdown separation of electrical circuits.

C. Capacity and Capability (Sizing of Sources and Distribution Equipment)

Loading. The ITAAC should include analyses to demonstrate that the equipment has adequate capacity to support the accomplishment of a safety function, and the relevant sections of the COL application should discuss those analyses. In addition, the ITAAC should include testing to verify EDG capacity and capability based on the TS. (In some cases, regulatory guidance specifies the need for margin in capacity to allow for future load growth. If it is only for future load growth, the ITAAC need not check for the additional margin.)

Voltage. The ITAAC should include analyses to demonstrate the acceptability of voltage drop and verify its adequacy to support the accomplishment of a direct safety function. The relevant sections of the COL application should discuss how the voltage analyses will be performed, with reference to industry standards. In addition, the ITAAC should include testing to verify that the EDG voltage and frequency response are acceptable and consistent with those specified in the technical specifications.

D. Equipment Protective Features

The inclusion of equipment protective features in ITAAC should be based on operating experience and the potential to prevent safety functions, as follows:

- The ITAAC should include analyses to verify equipment short-circuit capability and breaker coordination, and the relevant sections of the COL application should describe those analyses.
- Similarly, the ITAAC should consider diesel generator protective trips (and bypasses, if applicable).
- If the postfire safe shutdown circuit analyses rely on fire-induced faults to be cleared, this may need to be treated in the design description or COL application design information and in the ITAAC, although it may be covered by breaker coordination (see above).

E. Sensing Instrumentation and Logic

The ITAAC should include sensing instrumentation and logic (e.g., detection of undervoltage and subsequent starting and sequential loading of the EDG). This is a direct safety function in response to a design-basis loss of power. This requirement should consider problems with relay settings.

F. Controls, Displays, and Alarms

Applicants should include ITAAC to verify the minimum inventory for EOP, as discussed in the applicable section of the COL application (e.g., Chapter 18).

G. Test Features

Test features are limited to cases where special online test features have been specifically included (such as for a special new design feature).

H. Connection of Non-Class 1E Loads on Class 1E Buses

Because of the potential degradation of Class 1E sources and fire-induced cable damage, the applicant should include ITAAC to verify this aspect as part of the independence review.

I. Location of Equipment

Because of the importance of location for some equipment in relation to its environment and separation from redundant division equipment, the applicant should include ITAAC to verify proper location of the equipment.

BUILDING STRUCTURES

This section provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for building structures, including any design descriptions developed separately for the ITAAC as well as any supporting tables and figures. Examples of this information appear in the DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52. The building structure design descriptions should include the information below.

I. Building Structures

A. An ITAAC item for each building should verify the building's structural capability to withstand design-basis loads. A structural analysis should be performed to reconcile the as-built data with the structural design basis. The acceptance criterion should be the existence of a structural analysis report, which concludes that the as-built building is able to withstand the structural design-basis loads. The applicant should not use the ASME Code N-stamp as an acceptance criterion. Rather, ITAAC should verify the existence of ASME Code-required design documents (e.g., design specifications or design reports).

The applicable sections of the COL application should provide detailed descriptions of the scope and content of the structural analysis report as well as the need to reconcile construction deviations and design changes with the building's dynamic response and structural adequacy.

B. The building design description should specify—and the ITAAC should verify—the embedment depth (from the top of the foundation to the finished grade).

C. Building structure design descriptions should provide sufficient dimensions for the COL applicant or licensee to verify by ITAAC and develop dynamic models for the seismic analyses. Examples of these dimensions include overall building dimensions as well as the thicknesses of walls, floor slabs, and foundation mat.

D. The ITAAC should define and verify the ASME Code boundary for primary containment.

II. Protection Against Hazards

A. Internal flooding. The design descriptions should include—and the ITAAC should verify—features such as divisional walls, fire doors, watertight doors, and penetrations.

B. External flooding. The design descriptions should include—and the ITAAC should verify—features such as wall thicknesses and protection features for penetrations below the flood level.

C. Fire barriers. The design descriptions should include—and the ITAAC should verify—the fire ratings of divisional walls, floors, doors, and penetrations. In addition, the fire protection ITAAC should address fire detection and suppression.

D. External events (tornadoes, wind, rain, and snow). The structural analysis described in item I.A should also address these loads.

E. Internal events (fires, floods, pipe breaks, and missiles). The structural analysis described in item I.A should also address these loads.

APPENDIX C.II.1-B

DEVELOPMENT GUIDANCE FOR EMERGENCY PLANNING ITAAC

The NRC and NEI coordinated to develop a generic set of acceptable EP-ITAAC (known as EP-ITAAC). This coordinated effort resulted in the development of generic EP-ITAAC that are provided in Table C.II.1-B1.[1] The COL applicant should consider this set of EP-ITAAC in the development of its application-specific EP-ITAAC that are tailored to the specific reactor design and EP program requirements for the proposed plant site. A smaller set of EP-ITAAC is acceptable if the application contains information that fully addresses EP requirements associated with any of the generic ITAAC contained in Table C.II.1-B1. This table is not all-inclusive or exclusive of other ITAAC that an applicant may propose. Applicants may propose additional plant-specific EP-ITAAC (i.e., beyond those listed in Table C.II.1-B1), and the staff will examine them to determine their acceptability on an applicant-specific basis.

[1] See SECY-05-0197and SRM-SECY-05-0197, dated February 22, 2006. The generic emergency planning ITAAC in SECY-05-0197 formed the basis for Table C.II.1-B1.

Table C.II.1-B1 Emergency Planning—Generic Inspection, Test, Analysis, and Acceptance Criteria (EP-ITAAC)[1,2]

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
1.0 Assignment of Responsibility – Organization Control			
10 CFR 50.47(b)(1) – Primary responsibilities for emergency response by the nuclear facility licensee, and by State and local organizations within the EPZs have been assigned, the emergency responsibilities of the various supporting organizations have been specifically established, and each principle response organization has staff to respond and to augment its initial response on a continuous basis.	**1.1** The staff exists to provide 24-hour per day emergency response and manning of communications links, including continuous operations for a protracted period. [A.1.e, A.4]	**1.1** An inspection of the implementing procedures or staffing rosters will be performed.	**1.1** The staff exists to provide 24-hour per day emergency response and manning of communications links, including continuous operations for a protracted period. [The COL applicant will identify specific capabilities.]
2.0 Onsite Emergency Organization			
10 CFR 50.47(b)(2) – On-shift facility licensee responsibilities for emergency response are unambiguously defined, adequate staffing to provide initial facility accident response in key functional areas is maintained at all times, timely augmentation of response capabilities is available, and the interfaces among various onsite response activities and offsite support and response activities are specified.	**2.1** The staff exists to provide minimum and augmented on-shift staffing levels, consistent with Table B-1 of NUREG-0654/FEMA-REP-1, Rev. 1. [B.5, B.7]	**2.1** An inspection of the implementing procedures or staffing rosters will be performed.	**2.1** The staff exists to provide minimum and augmented on-shift staffing levels, consistent with Table B-1 of NUREG-0654/FEMA-REP-1, Rev. 1. [The COL applicant will identify responsibilities and specific capabilities.]

1. Standard design certification criteria or COL ITAAC may replace specific (generic) ITAAC in this table.

2. See also SRM SECY-05-0197, and associated February 22, 2006, SRM (ML060530316). These COL EP ITAAC are identified as asterisked "*" & **bolded** text.

3. The alphanumeric designations correspond to NUREG-0654/FEMA-REP-1, Rev. 1, evaluation criteria.

4. A license condition may be used, if required, to address those aspects of emergency planning and preparedness that reflect offsite (i.e., non-licensee) responsibilities.

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
3.0 Emergency Response Support and Resources			
10 CFR 50.47(3) - Arrangements for requesting and effectively using assistance resources have been made, arrangements to accommodate State and local staff at the licensee's near-site Emergency Operations Facility have been made, and other organizations capable of augmenting the planned response have been identified.			
4.0 Emergency Classification System			
10 CFR 50.47(b)(4) – A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee, and State and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures.	***4.1 A standard emergency classification and emergency action level (EAL) scheme exists, and identifies facility system and effluent parameters constituting the bases for the classification scheme. [D.1]**	***4.1 An inspection of the control room, TSC, and EOF will be performed to verify that they have displays for retrieving facility system and effluent parameters specified in the emergency classification and EAL scheme.**	***4.1 The specified parameters are retrievable in the control room, TSC and EOF, and the ranges of the displays encompass the values specified in the emergency classification and EAL scheme. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]**
5.0 Notification Methods and Procedures			
10 CFR 50.47(b)(5) – Procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations and the public has been established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone have been established.	***5.1 The means exists to notify responsible State and local organizations within 15 minutes after the licensee declares an emergency. [E.1]** ***5.2 The means exists to notify emergency response personnel. [E.2]**	***5.1 - 5.3 A test will be performed of the capabilities.**	***5.1 The responsible State and local agencies receive notification within 15 minutes after the licensee declares an emergency.** ***5.2 Emergency response personnel receive the notification and mobilization communication. [The COL applicant will provide specific acceptance criteria.]**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
	***5.3 The means exists to notify and provide instructions to the populace within the plume exposure EPZ. [E.6]**		***5.3 The means for notifying and providing instructions to the public are demonstrated to meet the design objectives, as stated in the emergency plan. [The COL applicant will identify specific capabilities.]**
6.0 Emergency Communications			
10 CFR 50.47(b)(6) – Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public.	***6.1 The means exists for communications among the control room, TSC, EOF, principal State and local emergency operations centers (EOCs), and radiological field assessment teams. [F.1.d]** ***6.2 The means exists for communications from the control room, TSC, and EOF to the NRC headquarters and regional office EOCs (including establishment of the Emergency Response Data System (ERDS) [or its successor system] between the onsite computer system and the NRC Operations Center.) [F.1.f]**	***6.1 & 6.2 A test will be performed of the capabilities.**	***6.1 Communications are established among the control room, TSC, EOF, principal State and local EOCs, and radiological field assessment teams.** ***6.2 Communications are established from the control room, TSC and EOF to the NRC headquarters and regional office EOCs, and an access port for ERDS [or its successor system] is provided.**
7.0 Public Education and Information			
10 CFR 50.47(b)(7) – Information is made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) are established in advance, and procedures for coordinated dissemination of information to the public are established.	***7.1 The licensee has provided space which may be used for a limited number of the news media. [G.3.b]**	***7.1 An inspection of the as-built facility/area provided for the news media will be performed.**	***7.1 The licensee has provided space, which may be used for a limited number of the news media. [The COL applicant will specify the number of news media to be accommodated.]**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
8.0 Emergency Facilities and Equipment			
10 CFR 50.47(b)(8) – Adequate emergency facilities and equipment to support the emergency response are provided and maintained.	***8.1 The licensee has established a TSC and onsite OSC. [The TSC and OSC may be combined at a single location.] [H.1, H.9]**	***8.1 An inspection of the as-built TSC and OSC will be performed, including a test of the capabilities.**	***8.1.1 The TSC size is consistent with NUREG-0696.** ***8.1.2 The TSC is close to the control room, and the walking distance from the TSC to the control room does not exceed two minutes. [Advanced communication capabilities may be used to satisfy the two minute travel time.] [The COL applicant will adopt design certification criteria, if applicable, or otherwise specify TSC location.]** ***8.1.3 The TSC has comparable habitability with the control room under accident conditions. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]** ***8.1.4 TSC communications equipment is installed, and voice transmission and reception are accomplished. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]** ***8.1.5 The TSC has the means to receive, store, process, and display plant and environmental information, and to initiate emergency measures and conduct e emergency assessment. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
			***8.1.6 The OSC is located onsite, separate from the control room and TSC. [The TSC and OSC may be combined at a single location.] [The COL applicant will adopt design certification criteria, if applicable, or otherwise specify OSC location and identify specific capabilities.]** ***8.1.7 OSC communications equipment is installed, and voice transmission and reception are accomplished. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]**
	***8.2 The licensee has established an EOF. [H.2]**	***8.2 An inspection of the as-built EOF will be performed, including a test of the capabilities.**	***8.2.1 The EOF working space size is consistent with NUREG-0696, and is large enough for required systems, equipment, records and storage. [The COL applicant will identify EOF size characteristics.]** ***8.2.2 The EOF habitability is consistent with Table 2 of NUREG-0696. [The COL applicant will specify the acceptance criteria for EOF habitability.]** ***8.2.3 EOF communications equipment is installed, and voice transmission and reception are accomplished with the control room, TSC, NRC, and State and local agencies. [The COL applicant will identify specific capabilities.]**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
			***8.2.4 The EOF has the means to acquire, display and evaluate radiological, meteorological, and plant system data pertinent to determining offsite protective measures. [The COL applicant will identify specific capabilities.]**
	8.3 The means exists to initiate emergency measures, consistent with Appendix 1 of NUREG-0654/FEMA-REP-1, Rev. 1. [H.5]	**8.3 - 8.6** A test will be performed of the capabilities	**8.3** The means exists to initiate emergency measures, consistent with Appendix 1 of NUREG-0654/FEMA-REP-1, Rev. 1. [The COL applicant will identify specific capabilities.]
	8.4 The means exists to acquire data from, or for emergency access to, offsite monitoring and analysis equipment. [H.6]		**8.4** The means exists to acquire data from, or for emergency access to, offsite monitoring and analysis equipment. [The COL applicant will identify specific capabilities.]
	8.5 The means exists to provide offsite radiological monitoring equipment in the vicinity of the nuclear facility. [H.7]		**8.5** The means exists to provide offsite radiological monitoring equipment in the vicinity of the nuclear facility. [The COL applicant will identify specific capabilities.]
	8.6 The means exists to provide meteorological information, consistent with Appendix 2 of NUREG-0654/FEMA-REP-1, Rev. 1. [H.8]		**8.6** The means exists to provide meteorological information, consistent with Appendix 2 of NUREG-0654/FEMA-REP-1, Rev. 1. [The COL applicant will identify specific capabilities.]

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
9.0 Accident Assessment			
10 CFR 50.47(b)(9) – Adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition are in use.	***9.1 The means exists to provide initial and continuing radiological assessment throughout the course of an accident. [I.2]** ***9.2 The means exists to determine the source term of releases of radioactive material within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors. [I.3]** ***9.3 The means exists to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions. [I.4]** ***9.4 The means exists to acquire and evaluate meteorological information. [I.5]**	***9.1 - 9.9 A test will be performed of the capabilities.**	***9.1 The means exists to provide initial and continuing radiological assessment throughout the course of an accident. [The COL applicant will identify specific capabilities.]** ***9.2 The means exists to determine the source term of releases of radioactive material within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors. [The COL applicant will identify specific capabilities.]** ***9.3 The means exists to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions. [The COL applicant will identify specific capabilities.]** ***9.4 Meteorological data is available at the EOF, TSC, control room, offsite NRC center, and to the State. [The COL applicant will identify specific capabilities].**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
	9.5 The means exists to determine the release rate and projected doses if the instrumentation used for assessment is off-scale or inoperable. [I.6]		**9.5** The means exists to determine the release rate and projected doses if the instrumentation used for assessment is off-scale or inoperable. [The COL applicant will identify spe cific capabilities.]
	9.6 The means exist for field monitoring within the plume exposure EPZ. [I.7]		**9.6** The means exists for field monitoring within the plume exposure EPZ. [The COL applicant will identify specific capabilities.]
	***9.7 The means exists to make rapid assessments of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways, including activation, notification means, field team composition, transportation, communication, monitoring equipment, and estimated deployment times. [I.8]**		***9.7 The means exists to make rapid assessment of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways. [The COL applicant will identify specific capabilities.]**
	***9.8 The capability exists to detect and measure radioiodine concentrations in air in the plume exposure EPZ, as low as 10^{-7} µCi/cc (microcuries per cubic centimeter) under field conditions. [I.9]**		***9.8 Radioiodine can be detected in the plume exposure EPZ, as low as 10^{-7} µCi/cc. [The COL applicant will identify specific capabilities.]**
	***9.9 The means exists to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the EPA protective action guides (PAGs). [I.10]**		***9.9 The means exists to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the EPA protective action guides (PAGs). [The COL applicant will identify specific capabilities.]**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
10.0 Protective Response			
10 CFR 50.47(b)(10) – A range of protective actions has been developed for the plume exposure EPZ for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place, and protective actions for the ingestion exposure EPZ appropriate to the locale have been developed.	***10.1 The means exists to warn and advise onsite individuals of an emergency, including those in areas controlled by the operator, including: [J.1]** **1. employees not having emergency assignments;** **2. visitors;** **3. contractor and construction personnel; and** **4. other persons who may be in the public access areas, on or passing through the site, or within the owner controlled area.**	***10.1 - 10.4 A test will be performed of the capabilities.**	***10.1 The means exists to warn and advise onsite individuals. [The COL applicant will identify specific capabilities.]**
	10.2 The means exist to radiological monitor people evacuated from the site. [J.3] **10.3** The means exists to notify and protect all segments of the transient and resident populations. [J.10] **10.4** The means exists to register and monitor evacuees at relocation centers. [J.12]		**10.2** The means exist to radiological monitor people evacuated from the site. [The COL applicant will identify specific capabilities.] **10.3** The means exists to notify and protect all segments of the transient and resident populations. [The COL applicant will identify specific capabilities.] **10.4** The means exists to register and monitor evacuees at relocation centers. [The COL applicant will identify specific capabilities.]

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
11.0 Radiological Exposure Control			
10 CFR 50.47(b)(11) – Means for controlling radiological exposures, in an emergency, are established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA Emergency Worker and Lifesaving Activity PAGs.	**11.1** The means exists to provide onsite radiation protection. [K.2] **11.2** The means exists to provide 24-hour-per-day capability to determine the doses received by emergency personnel and maintain does records. [K.3] **11.3** The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. [K.5.b, K.7] **11.4** The means exists to provide onsite contamination control measures. [K.6]	**11.1 - 11.4** A test will be performed of the capabilities.	**11.1** The means exists to provide onsite radiation protection. [The COL applicant will identify specific provisions.] **11.2** The means exists to provide 24-hour-per-day capability to determine the doses received by emergency personnel and maintain dose records. [The COL applicant will identify specific provisions.] **11.3** The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. [The COL applicant will identify specific provisions.] **11.4** The means exists to provide onsite contamination control measures. [The COL applicant will identify specific provisions.]
12.0 Medical and Public Health Support			
10 CFR 50.47(b)(12) – Arrangements are made for medical services for contaminated, injured individuals.	**12.1** Arrangements have been implemented for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake [L.1] **12.2** The means exists for onsite first aid capability. [L.2]	**12.1 - 12.3** A test will be performed of the capabilities.	**12.1** Arrangements have been implemented for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake. [The COL applicant will identify specific provisions.] **12.2** The means exists for onsite first aid capability. [The COL applicant will identify specific provisions.]

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
	12.3 Arrangements have been implemented for transporting victims of radiological accidents, including contaminated injured individuals, from the site to offsite medical support facilities. [L.4]		**12.3** Arrangements have been implemented for transporting victims of radiological accidents, including contaminated injured individuals, from the site to offsite medical support facilities. [The COL applicant will identify specific provisions.]
13.0 Recovery and Reentry Planning and Post-Accident Operations			
10 CFR 50.47(b)(13) - General plans for recovery and reentry are developed.			
14.0 Exercises and Drills			
10 CFR 50.47(b)(14) – Periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills are (will be) corrected.	***14.1 Licensee conducts a full participation exercise to evaluate major portions of emergency response capabilities, which includes participation by each State and local agency within the plume exposure EPZ, and each State within the ingestion control EPZ. [N.1]**	***14.1 A full participation exercise (test) will be conducted within the specified time periods of Appendix E to 10 CFR Part 50.**	***14.1.1 The exercise is completed within the specified time periods of Appendix E to 10 CFR Part 50, onsite exercise objectives have been met, and there are no uncorrected onsite exercise deficiencies. [The COL applicant will identify exercise objectives and associated acceptance criteria.]** ***14.1.2 Onsite emergency response personnel were mobilized in sufficient numbers to fill emergency response positions, and they successfully performed their assigned responsibilities. [The COL applicant will identify responsibilities and associated acceptance criteria.]** ***14.1.3 The exercise is completed within the specified time periods of Appendix E to 10 CFR Part 50, offsite exercise objectives have been met, and there are either no uncorrected offsite exercise deficiencies or a license condition requires offsite deficiencies to be addressed prior to operation above 5% of rated power.**

Planning Standard	EP Program Elements[3]	Inspections, Tests, Analyses	Acceptance Criteria[4]
15.0 Radiological Emergency Response Training			
10 CFR 50.47(b)(15) – Radiological emergency response training is provided to those who may be called on to assist in an emergency.	**15.1** Site-specific emergency response training has been provided for those who may be called upon to provide assistance in the event of an emergency. [O.1]	**15.1** An inspection will be performed of the capabilities.	**15.1** Site-specific emergency response training has been provided for those who may be called upon to provide assistance in the event of an emergency . [The COL applicant will identify the specific training program.]
16.0 Responsibility for the Planning Effort: Development, Periodic Review, and Distribution of Emergency Plans			
10 CFR 50.47(b)(16) – Responsibilities for plan development and review and for distribution of emergency plans are established, and planners are properly trained.	**16.1** The emergency response plans have been forwarded to all organizations and appropriate individuals with responsibility for implementation of the plans. [P.5]	**16.1** An inspection of the distribution list will be performed.	**16.1** The emergency response plans have been forwarded to all organizations and appropriate individuals with responsibility for implementation of the plans. [The COL applicant will identify specific distribution requirements.]
17.0 Implementing Procedures			
10 CFR Part 50, App. E.V – No less than 180 days prior to the scheduled issuance of an operating license for a nuclear power reactor or a license to possess nuclear material, the applicant's detailed implementing procedures for its emergency plan shall be submitted to the Commission.	***17.1 The licensee has submitted detailed implementing procedures for its emergency plan no less than 180 days prior to fuel load.**	***17.1 An inspection of the submittal letter will be performed.**	***17.1 The Licensee has submitted detailed implementing procedures for the onsite emergency plan no less than 180 days prior to fuel load. [The COL applicant will develop the implementing procedures.]**

APPENDIX C.II.1-C

DEVELOPMENT GUIDANCE
FOR PHYSICAL SECURITY HARDWARE ITAAC

A generic set of acceptable physical PS hardware ITAAC is currently in development. The NRC and the NEI's New Plant Security Task Force are coordinating this effort. The results of this effort are intended to provide acceptable examples of generic PS-ITAAC for security design features that are included in a certified design and for those that are site specific. The COL applicant should consider this generic set of PS-ITAAC in the development of its application-specific PS-ITAAC that are tailored to the specific reactor design and security program requirements for the proposed plant site.