C.II.2. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)

The *proposed* requirements in Title 10, Section 52.80(b), of the *Code of Federal Regulations* [10 CFR 52.80(b)] specify that a combined license (COL) application must include the proposed inspections, tests, and analyses (including those that apply to emergency planning) that the licensee shall perform. In addition, the application must include 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 combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

In Section 14.3 of final safety analysis report (FSAR), the COL applicant should provide its proposed methodology for selecting structures, systems, and components (SSCs) that will be subject to inspections, tests, analyses, and acceptance criteria (ITAAC), as well as its proposed criteria for establishing the necessary and sufficient ITAAC in accordance with 10 CFR 52.80(b). 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, "Submittal Guidance," 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.

The ITAAC format discussed below has been used by previous design certification applicants and is acceptable to the NRC staff. The ITAAC format for design certification was developed with a system-based focus on SSCs. COL applicants are not required to follow the format provided in this guidance, and 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 focused, 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 system- 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, early site permits (ESPs), design certification documents (DCDs), neither, or both, the scope of ITAAC development for a COL applicant will differ depending on which of these documents are referenced 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 complete set of facility ITAAC (or COL-ITAAC) will be incorporated into the COL as a license condition to be satisfied prior to fuel load. Guidance on ITAAC for COL applicants that reference an ESP, a DCD, or both is provided in Section C.III.7, "ITAAC for COL Applications Referencing a Certified Design and/or Early Site Permit," of this regulatory guide.

C.II.2.1 *Design Descriptions and ITAAC Format and Content*

Design Description and ITAAC Design Description

The content of proposed ITAAC should be based on 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 provide the top-level performance standards for the SSCs, which are derived from the Tier 2 document. In addition, the design description contains tables and figures that are referenced in the Design Commitments (DC) 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 motor-operated valves (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’s descriptions should be called “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.

The NRC staff anticipates that any ITAAC Design Descriptions, tables or figures that are developed specifically for (and referenced in) the ITAAC should be included in the COL application section containing the ITAAC, and should be maintained separate from the FSAR portion of the COL application. If the COL applicant chooses not to develop separate ITAAC Design Descriptions, the proposed ITAAC should reference specific sections, tables, and figures in the FSAR portion of the COL application.

In addition, the reader should note 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. This is 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). Further guidance regarding the change process is provided in Section C.IV.3, “General Description of Change Processes,” of this regulatory guide.

ITAAC Tabular Format and Content

An ITAAC should be formatted as a three-column table, as shown in Table C.II.2-1, "Sample ITAAC Format," which appears at the end of this section. Please note that input provided in this sample table is intended only to establish an acceptable format (e.g., ITAAC terminology, such as "basic configuration," that was used in previously certified designs has been replaced with more specific terminology, such as "functional arrangement." For further discussion of terminology, refer to Section C.III.7 of this regulatory guide.

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 or the ITAAC Design Descriptions. Any differences in text should be minimized, 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 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.

Inspections are defined in Section C.II.2.1.1, and include visual and physical observations, walkdowns or record reviews.

Tests are defined in Section C.II.2.1.1, and 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 pre-operational tests can be used to satisfy an ITAAC and licensees must document the pre-operational tests, or portions thereof, that are credited in successful completion of ITAAC. However, the pre-operational 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 initial test program (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.

Analyses are defined in Section C.II.2.1.1, and may refer to detailed supporting information in the applicable sections of the COL application, simple calculations, or comparisons with operating experience or design of similar SSCs. The details of the analysis method must be specified in either the ITAAC or in the applicable sections of the COL application. The ITAAC should not reference the applicable sections of the COL application, but COL application sections may reference the appropriate ITAAC. For example, detailed analysis methods of seismic and environmental qualification supporting detailed design descriptions for SSCs are contained in Chapter 3 of the COL application, as is 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, which, 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 credited in the safety analyses, rather than the design values).

The type of information and the level of detail included in the ITAAC is 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 importance in various safety analyses, and their functions for defense-in-depth considerations. At a minimum, the COL applicant's development of proposed ITAAC should address 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 probabilistic risk assessment (PRA) with respect to the safety-significance of SSCs.
- Ensure that the ITAAC reflect the resolutions of technically relevant unresolved and generic safety issues (USIs/GSIs), NRC generic correspondence (such as bulletins and generic letters), and relevant industry operating experience.
- Ensure that the ITAAC are consistent with the technical specifications, including their bases and limiting conditions for operation.
- Ensure that the ITAAC are consistent with the pre-operational test program described in Section C.I.14.2, since many of the pre-operational tests for SSCs may be used to satisfy ITAAC.
- The ITAAC should emphasize testing of the *as-built* facility and use the definitions for testing provided in Section C.II.2.1.1.
- Ensure that the ITAAC include SSCs for which the features or functions are necessary to satisfy the NRC's regulations in 10 CFR Parts 20, 50, 52, 73, or 100.
- Ensure that ITAAC include severe accident design features and plant features designed for protection against hazards.
- SSCs for which there is no discernible safety-significance should 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 integrity of the fundamental analyses for the facility design is preserved in the as-built facility. These analyses include flooding, overpressure protection, containment, core cooling, fire protection, transients, anticipated transients without scram, steam generator tube rupture [pressurized-water reactors (PWRs) only], radiological concerns, USIs/GSIs, Three Mile Island (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 each key assumption and insight has been captured in ITAAC, as well as the technical specifications (including administrative controls), reliability assurance activities, emergency procedure guidelines, and initial test program. These cross-references may be developed along with the detailed facility-specific PRA and severe accident analyses, and should be provided 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.2.2 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 specific guidance has primarily been developed to be consistent with NRC staff review responsibilities, as defined in the Standard Review Plan (NUREG-0800). By contrast, the general guidance has been developed to be consistent with functional engineering disciplines, and may include specific guidance for topics that are unique to design certifications and advanced and/or evolutionary reactors.

C.II.2.1.1 <u>Definitions</u>

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

Acceptance Criteria means 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. Engineering or technical evaluations may include, but are not limited to, comparisons with operating experience or design of similar SSCs.

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 Description for a COL application that does not reference a certified design means the detailed design information contained in the FSAR. For a certified design, the design description is part of Tier 1 information (see appendices to 10 CFR Part 52 for definitions associated with certified designs) and is the design basis that is verified by ITAAC. Tier 1 information is strictly controlled by regulations and can be considered to be a summation of the detailed design information contained in the FSAR (or Tier 2) for a certified design.

Design Requirement/Commitment means that portion of the detailed design information provided in the COL application that is verified by ITAAC. It may also be documented in Tier 1 information or in ITAAC Design Descriptions.

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 which 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.

Exists means that the item is present and meets the design description provided in the COL application.

Functional Arrangement (for a system) means the physical arrangement of systems and components to provide the service for which the system is intended, and which is described in the system design description.

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 nondestructive examinations.

ITAAC means the set of inspections, tests, analyses, and acceptance criteria that the licensee proposes and the staff approves to verify that the facility design requirements (as committed to in the license) can be met, thereby ensuring that the facility is constructed and can be operated in accordance with the licensed design.

ITAAC Design Description is an optional 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, and may, at a minimum, consist only of tables and figures that are referenced in the ITAAC.

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 building design description.

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 conversely).

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.2.2 *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 of 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 Standard Review Plan (SRP). That is, the guidance provided herein regarding information that a COL applicant must submit to the NRC will be reviewed in accordance with the SRP to assess compliance with the applicable regulations. To better facilitate the interface between DG-1145 and the SRP, the specific guidance for developing ITAAC has been organized in the same manner as the SRP. That is, SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria: Design Certification," provides introductory and general guidance for the following associated SRPs, which have been organized in accordance with the primary review responsibilities of the NRC's technical staff branches:

SRP 14.3.1	Site Parameters (Tier 1)
SRP 14.3.2	Structural and Systems Engineering (Tier 1)
SRP 14.3.3	Piping Systems and Components (Tier 1)
SRP 14.3.4	Reactor Systems (Tier 1)
SRP 14.3.5	Instrumentation and Controls (Tier 1)
SRP 14.3.6	Electrical Systems (Tier 1)
SRP 14.3.7	Plant Systems (Tier 1)
SRP 14.3.8	Radiation Protection and Emergency Preparedness (Tier 1)
SRP 14.3.9	Human Factors Engineering (Tier 1)
SRP 14.3.10	Initial Test Program and D-RAP (Tier 1)
SRP 14.3.11	Containment Systems and Severe Accidents (Tier 1)

Based on NRC staff discussions, the following changes to SRP sections will be made:

- Separate SRP Section 14.3.8 into two distinct SRPs: one for Radiation Protection (14.3.8) and one for Emergency Planning (14.3.10).
- Develop a new SRP Section 14.3.12 for Physical Security Hardware ITAAC.
- Delete SRP Section 14.3.10 for Initial Test Program and D-RAP (Tier 1), which should be incorporated into SRP Section 14.2.

The reader should note, however, that SRP Section 14.3 and its associated SRP sections were developed with a greater focus on reviewing design certification applications in accordance with Subpart B of 10 CFR 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 DG-1145 guidance 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 their COL ITAAC. This general guidance has been developed to be consistent with functional engineering disciplines, and 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.2-1, "Sample ITAAC Format," which appears at the end of this section; and apply the general guidance, as applicable, provided in Appendix A to this section.

C.II.2.2.1 ITAAC for Site Parameters (SRP 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 site parameters specific to the chosen site will be used in the design basis for the proposed facility. 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, 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.2.2.2 ITAAC for Structures and Systems (SRP 14.3.2)

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

Ideally, ITAAC for structures and systems should be developed and grouped 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 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 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV); and major building structures (primary containment, reactor building, control building, turbine building, service building, radwaste building, etc.). In addition, other structures and systems that are considered to be risk-significant based on insights from the COL applicant's PRA should be included. Using the general design criteria (GDC) specified in Appendix A to 10 CFR Part 50, the following design attributes for the major structures and systems in the proposed facility should be verified by ITAAC proposed by the COL applicant:

(13) pressure boundary integrity (GDCs 14, 16, and 50)

(14) normal loads (GDC 2)

(15) seismic loads (GDC 2)

(16) suppression pool hydrodynamic loads (GDC 4)

(17) flood, wind, and tornado (GDC 2)

(18) rain and snow (GDC 2)

(19) pipe rupture (GDC 4)

(20) codes and standards (GDC 1)

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

- ITAAC should be established to verify the pressure boundary integrity of the RPV, PUR, steam generator, piping, and primary containment, as these are needed to ensure the defense-in-depth principle.
- For the RPV, PUR, steam generator, and piping, ITAAC should require hydrostatic tests and pre-operational nondestructive examination (NDE) performed in conjunction with Sections III and V of the ASME Code (ASME BPV III and ASME BPV V, respectively).
- For the primary containment, ITAAC should require a structural integrity test to be performed on the pressure boundary components of the primary containment in accordance with ASME BPV III.

Normal Loads

- ITAAC should be established 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 Code requirements to ensure 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

- ITAAC should be developed to verify that safety-related systems and structures have been designed to seismic loadings.
- Component qualification for seismic loads should be addressed by 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.
- ITAAC should be developed to verify that, under seismic loads, the collapse 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.
- ITAAC should be developed, as needed, to verify that failure of non-seismic Category I SSCs will not impair the ability of nearby safety-related SSCs to perform their safety-related functions.
- ITAAC should be developed to verify that, under seismic loads, the fire protection standpipe systems will remain functional in areas containing safety-related SSCs.

Suppression Pool Hydrodynamic Loads (BWRs only)

- ITAAC should be developed to verify that the safety-related systems and structures have been designed to suppression pool hydrodynamic loadings, which include safety relief valve discharge and loss-of-coolant-accident (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

- ITAAC should be developed 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 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 flood doors and flood barrier penetrations are provided with flood protection features.
- ITAAC should require inspections to verify that watertight doors exist; penetrations in the divisional walls are at an acceptable level above the floor; and 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 penetrations in external walls below flood level are provided with flood protection features.

Pipe Break

- ITAAC should be developed to verify that safety-related and risk-significant SSCs have been designed to withstand the dynamic effects of pipe breaks.
- Component qualification for the dynamic effects of pipe breaks should be addressed by ITAAC developed for the specific systems containing these components.
- ITAAC for the RPV 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.
- ITAAC should be developed to verify by inspections 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

- ITAAC should be developed 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 Code requirements.

As-Built Reconciliation

- ITAAC should be developed 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.
- ITAAC should be developed 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, ITAAC should be developed 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, system-specific ITAAC should be developed to demonstrate that the as-built Seismic Category I mechanical and electrical equipment (including connected instrumentation and controls) and associated anchorages in the given system are qualified to withstand design-basis dynamic loads without loss of safety function.

C.II.2.2.3 <u>ITAAC for Piping Systems and Components (SRP 14.3.3)</u>

This subsection primarily involves piping system design and components, and includes treatment of MOVs, power-operated valves (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 BPV Code Class 1, 2, and 3 piping and supports. Rather, the scope includes buried piping, instrumentation lines, interaction of non-seismic 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 leak-before-break (LBB) approach, as applicable to the COL applicant's facility design.

ITAAC for piping systems should address the following considerations:

- ITAAC should be developed 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.
- ITAAC should be developed 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 an SSE 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, ITAAC should be developed 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 configuration(s) with the LBB design assumptions. Detailed information that supports this ITAAC should be contained in FSAR Chapter 3.
- ITAAC should be developed to require the existence of an as-built piping stress report, which documents the results of an as-built reconciliation analysis confirming that the as-built 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.

- ITAAC should be developed to require the existence of reports that document fastener compliance with ASME Section III requirements

ITAAC for components and systems should be developed to verify the piping and component classification, fabrication, dynamic and seismic qualification, and selected testing and performance requirements:

- The ASME BPV Code class requirements may be verified by either a generic piping ITAAC, as described above, or by system-specific ITAAC.
- System-specific ITAAC should be developed to verify the welding quality of as-built pressure boundary welds for ASME Code Class 1, 2, and 3 SSCs.
- System-specific ITAAC should be developed to verify pressure integrity for ASME Code Class 1, 2, and 3 SSCs by specifying hydrostatic testing.
- System-specific ITAAC should be developed to verify by inspection the dynamic qualification records (e.g., seismic, LOCA, and safety relief valve discharge loads) of Seismic Category I mechanical and electrical equipment (including connected instrumentation and controls) and associated equipment anchorages.
- System-specific ITAAC should be developed to verify by inspection the vendor test records that demonstrate the ability of MOVs to function under design conditions.
- System-specific ITAAC should be developed to verify through in-situ testing that installed MOVs, POVs, check valves, and dynamic restraints have the capability to perform their intended functions under expected ranges of fluid flow, differential pressure, electrical, and temperature conditions up to and including design-basis conditions.

C.II.2.2.4 ITAAC for Reactor Systems (SRP 14.3.4)

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

- ITAAC should be developed to verify important input parameters used in the transient and accident analyses for the facility design.
- ITAAC should be developed to verify net positive suction head (NPSH) for key pumps.
- ITAAC should be developed to verify elevation differences between the reactor core and storage pools and/or tanks credited in the safety analyses for passive plants.
- ITAAC should be developed to verify the design pressures of the piping systems that interface with the reactor coolant boundary to validate intersystem LOCA analyses.
- ITAAC should be developed to verify the following design aspects of reactor systems:
    (1) functional arrangement
    (2) seismic and ASME code classification
    (3) weld quality and pressure boundary integrity
    (4) valve qualification and operation
    (5) controls, alarms, and displays
    (6) logic and interlocks
    (7) equipment qualification for harsh environments
    (8) interface requirements with other systems
    (9) numeric performance values

(10) Class 1E electrical power sources and divisions, if applicable
(11) system operation in various modes

C.II.2.2.5 ITAAC for Instrumentation and Controls (SRP 14.3.5)

This subsection primarily involves instrumentation and controls (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. Further guidance in these areas can be found in the "Instrumentation and Control Systems" portion of Appendix A to this section.

ITAAC for instrumentation and controls should be developed to address the following:

(1) Compliance with 10 CFR 50.55a(h), "Criteria for Protection Systems for Nuclear Generating Stations," 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:

(2)	Section 4.1	Identification of design-basis events
(3)	Section 4.4	Identification of variables monitored and analytical limits
(4)	Section 4.5	Minimum criteria for manual initiation and control of protective actions
(5)	Section 4.6	Identification of the minimum number and locations of sensors
(6)	Section 4.7	Range of transient and steady-state conditions
(7)	Section 4.8	Identification of conditions that have the potential to cause functional degradation of safety system performance
(8)	Section 4.9	Identification of the methods used to assess the reliability of the safety system design
(9)	Section 5.1	Single-failure criterion
(10)	Section 5.2	Completion of protective action for protective actions
(11)	Section 5.3	Quality
(12)	Section 5.4	Equipment qualification
(13)	Section 5.5	System integrity
(14)	Section 5.6	Independence
	<	Physical independence
	<	Electrical independence
	<	Communications independence
(15)	Section 5.7	Capability for test and calibration
(16)	Section 5.8	Information displays
(17)	Section 5.9	Control of access
(18)	Section 5.10	Repair
(19)	Section 5.11	Identification
(20)	Section 5.12	Auxiliary features
(21)	Section 5.13	Multi-unit stations
(22)	Section 5.14	Human factors considerations
(23)	Section 5.15	Reliability

[1]Refer to DG-1145, Section C.I.7, Appendix 7B for additional discussion on conformance with IEEE Standard 603.

(24) Sections 6.1 and 7.1 Automatic control
(25) Sections 6.2 and 7.2 Manual control
(26) Section 6.3 Interaction between the sense and command features and other systems
(27) Section 6.4 Derivation of system inputs
(28) Section 6.5 Capability for testing and calibration
(29) Sections 6.6 and 7.4 Operating bypasses
(30) Sections 6.7 and 7.5 Maintenance bypass
(31) Section 6.8 Setpoints
(32) Section 7.3 Completion of protective action for executive features
(33) Section 8 Power source requirements

(34) Compliance with each of the following GDCs set forth in Appendix A to 10 CFR Part 50:

(35) GDC 1, as it pertains to quality standards for design, fabrication, erection, and testing
(36) GDC 2, as it pertains to protection against natural phenomenon
(37) GDC 4, as it pertains to environmental and dynamic effects
(38) GDC 13, as it pertains to instrumentation and control requirements
(39) GDC 19, as it pertains to control room requirements
(40) GDC 20, as it pertains to protection system design requirements
(41) GDC 21, as it pertains to protection system reliability and testability requirements
(42) GDC 22, as it pertains to protection system independence requirements
(43) GDC 23, as it pertains to protection system failure modes requirements
(44) GDC 24, as it pertains to separation of protection systems from control systems
(45) GDC 25, as it pertains to protection system requirements for reactivity control malfunctions
(46) GDC 29, as it pertains to protection against anticipated operational occurrences

(47) Documentation of a high-quality software design process:

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

< Software management plan
< Software development plan
< Software test plan
< Software quality assurance plan
< Integration plan
< Installation plan
< Maintenance plan
< Training plan
< Operations plan
< Software safety plan
< Software verification and validation plan
< Software configuration management plan

(49) 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
< Verification and validation analysis and test reports
< Configuration management reports
< Requirement traceability matrix

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

< Requirements
< Design
< Implementation
< Integration
< Validation
< Installation
< Operations
< Maintenance

(50) 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:

< Software requirements specifications

< Hardware and software architecture descriptions

< Software design specifications

< Code listings

< Build documents

< Installation configuration tables

< Operations manuals

< Maintenance manuals

< Training manuals

< The system test procedures and test results (validation tests, site acceptance tests, pre-operational and start-up tests) should provide assurance that the system functions as intended.

< The application should confirm that defense-in-depth and diversity design conforms to the guidance in BTP 7-19, “Guidance for Evaluation of Defense-in-Depth and Diversity in Digital Computer-Based Instrumentation and Control Systems.”

< The application should commit to, or confirm that digital safety system security guidance is in conformance with, NRC Regulatory Guide 1.152, Revision 2, “Criteria for Use of Computers in Safety Systems of Nuclear Power Plants.”

C.II.2.2.6 ITAAC for Electrical Systems (SRP 14.3.6)

This subsection primarily involves the entire station electrical system, including Class 1E portions of the system, major portions of the non-Class 1E system, and portions of the plant lighting system. 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.

ITAAC for electrical systems and equipment should be developed to verify the following:

(1) Equipment Qualification for Seismic and Harsh Environments

- ITAAC should be developed to verify that Class 1E equipment is Seismic Category I, and equipment located in a harsh environment is qualified.

(2) Redundancy and Independence

- ITAAC should be developed to verify the Class 1E divisional assignments and independence of electric power by both inspections and tests.

(3) Capacity and Capability

- ITAAC should be developed 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).
- ITAAC should be developed to verify by analysis the ability of the as-built electrical system and installed equipment [e.g., diesel generators, transformers, switchgear, direct current (DC) systems and batteries, etc.] to power the loads, including tests to demonstrate the operation of equipment.
- ITAAC should be developed to verify the initiation of the Class 1E equipment necessary to mitigate postulated events for which the equipment is credited (e.g., LOCA, loss of normal preferred power, and degraded voltage conditions).
- ITAAC should be developed to verify by analysis how the as-built electrical power system responds to a LOCA, loss of voltage, combinations of LOCA and loss of voltage, and degraded voltage, including tests to demonstrate actuation of the electrical equipment in response to postulated events.

(4) Electrical Protection Features

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

(5) Displays, Controls, and Alarms

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

(6) Offsite Power

(51) ITAAC should be developed 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.

(52) ITAAC should be developed to verify by inspection appropriate lightning protection and grounding features.

(7) Containment Electrical Penetrations

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

(8) Combustion Turbine Generator (if applicable)

- ITAAC should be developed to verify, through inspection and testing, the combustion gas turbines and their auxiliaries as an alternative AC power source for station blackout events, as well as its independence from other AC sources.

(9) Lighting

- ITAAC should be developed 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.

(10) Electrical Power for Non-Safety Plant Systems

- ITAAC should be developed to verify the functional arrangement of electrical power systems provided to support non-safety plant systems.

(11) Physical Separation and Independence

- ITAAC should be developed to verify separation and independence of redundant electrical equipment, circuits, and cabling for post-fire safe shutdown.

C.II.2.2.7 <u>ITAAC for Plant Systems (SRP 14.3.7)</u>

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; heating, ventilation, and air conditioning (HVAC) systems; and fire protection systems:

- ITAAC should be developed to require as-built plant reports for reconciliation with flood analyses to ensure consistency with design requirements of SSCs for flood protection and mitigation.
- ITAAC should be developed to require as-built plant reports for reconciliation with post-fire 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, etc.).
- ITAAC should be developed to verify heat removal capabilities for design-basis accidents, as well as tornado and missile protection.
- ITAAC should be developed to verify NPSH for key pumps.
- ITAAC should be developed to verify physical separation for appropriate systems.
- ITAAC should be developed to verify that the minimum inventory of alarms, controls, and indications, as derived from emergency procedure guidelines, Regulatory Guide 1.97, and PRA insights, is provided for the main control room and remote shutdown station(s).
- ITAAC should be developed to verify the following design aspects for plant systems:
  (1) functional arrangement
  (2) key design features of systems
  (3) seismic and ASME code classifications
  (4) weld quality and pressure boundary integrity, as necessary
  (5) valve qualification and operation

(6) controls, alarms, and displays
(7) logic and interlocks
(8) equipment qualification for harsh environments
(9) required interfaces with other systems
(10) numeric performance values

C.II.2.2.8 ITAAC for Radiation Protection (SRP 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:

- ITAAC should be developed to verify the adequacy of as-built walls, structures, and buildings as radiation shields, as applicable.
- ITAAC should be developed to verify the plant airborne concentrations of radioactive materials through adequate design of ventilation and airborne monitoring systems.
- ITAAC should be developed to verify the functional arrangement of ventilation systems.
- ITAAC should be developed to verify equipment leakage characteristics (e.g., tanks, pumps, blowers, dampers, valves, primary containment penetrations, ductwork, etc.) assumed in developing plant radiation zone maps and accident doses.
- ITAAC should be developed to verify environmental qualification of radiation detection and monitoring equipment, as necessary, including damper motors.
- ITAAC should be developed to verify radiation and airborne radioactivity levels within plant rooms and areas to ensure the adequacy of plant shielding and ventilation system designs.
- ITAAC should be developed to verify that radiation levels are commensurate with area access requirements and as low as reasonably achievable (ALARA) principles during normal plant operations and maintenance.
- ITAAC should be developed 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.
- ITAAC should be developed to verify that the radiation dose to the public is within a small fraction of the dose limit that the U.S. Environmental Protection Agency (EPA) established in 40 CFR Part 190.
- ITAAC should be developed to verify performance requirements of components and systems assumed in accident consequence evaluations (e.g., minimum radioiodine removal efficiency of charcoal adsorbers, maximum delay time, maximum time for drawing specified negative pressure, ventilation system flow rates, etc.).

C.II.2.2.9 ITAAC for Human Factors Engineering (SRP 14.3.9)

This section primarily involves human factors engineering 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 involves the minimum inventory of alarms, controls, and indications appropriate for the main control room and the remote shutdown station.

Because the implementation of human factors engineering (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).

HFE-related ITAAC should be developed 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); these ITAAC should also 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 local control stations (LCSs) and those LCSs 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 Chapter 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.2.2.10 <u>ITAAC for Emergency Planning (SRP 14.3.10)</u>

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(b). In so doing, the applicant may provide proposed EP-ITAAC that are consistent with those provided in Table C.II.2-B1 of Appendix C.II.2-B and 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, "Submittal Guidance," of this regulatory guide.

C.II.2.2.11 <u>ITAAC for Containment Systems and Severe Accidents (SRP 14.3.11)</u>

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:

- ITAAC should be developed 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.
- ITAAC should be developed to verify the existence of severe accident prevention and mitigation design features.
- ITAAC should be developed to verify the functional arrangements of containment isolation provisions.

- ITAAC should be developed to verify the design qualification of containment isolation valves.
- ITAAC should be developed to verify by in-situ testing the containment isolation functions of MOVs and check valves.
- ITAAC should be developed to verify containment isolation signal generation.
- ITAAC should be developed to verify containment isolation valve closure times.
- ITAAC should be developed to verify containment isolation valve leakage.

C.II.2.2.12 ITAAC for Physical Security Hardware (SRP 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.2-C and 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, "Submittal Guidance," of this regulatory guide.

Table C.II.2-1. 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) Pre-operational 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 what 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.2-1. SAMPLE ITAAC FORMAT		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
3a. The ______________ pumps have sufficient NPSH. 3b. The ________ storage tank/pool has sufficient capacity. * 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: (53) pressure losses for pump inlet piping and components (54) suction from the suppression pool with water level at the minimum value (55) 50% blockage of pump suction strainers (56) design-basis fluid temperature [212EF (100EC)] (57) containment at atmospheric pressure (58) 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 _____).

Table C.II.2-1. SAMPLE ITAAC FORMAT		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
6. Control room alarms, displays, and/or controls* provided for the _____ system are defined in Section ____.	6. Inspections will be performed on the control room alarms, displays, and/or controls* for the ____ system. *Delete any category for which no entries are included in the design description.	6. Alarms, displays, and/or controls* exist or can be retrieved in the control room as defined in Section ____.

Table C.II.2-1. SAMPLE ITAAC FORMAT

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. Remote shutdown system (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. Motor-operated valves (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 _____ valve(s) shown in Figure _______ closes (or opens) if either electric power to the valve actuating solenoid or pneumatic pressure to the valve(s) is lost.	9. Tests will be conducted on the as-built _______ valve(s).	9. The pneumatically operated ______ valve(s) shown in Figure _______ closes (opens) when either electric power to the valve actuating solenoid or pneumatic pressure to the valve(s) is lost.
10. Check valves (CV) 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.
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.2-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 (DDs) developed separately for the ITAAC, and any supporting tables and figures. Examples of this information may be found in the design control documents (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 DDs that may be developed separately from the detailed design information contained in the COL application, the following information should be included in the various DDs in a consistent order:

(1) System Purpose and Functions (minimum is safety functions, may include some non-safety functions)

The DD identifies the system's purpose and function, and captures the system components that are involved in accomplishing the system's direct safety function. Each DD should include wording (preferably in the first paragraph) that identifies whether the system is safety-related or non-safety-related. Exceptions should be noted if parts of the system are not safety-related, or if certain aspects of a non-safety system have a safety-significance.

(2) Location of the System

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

(3) Key Design Features of the System

The DD should describe the components that make up the system. Key features [such as the use of safety/relief valves (SRVs) to perform as the automatic depressurization system]. However, the DD need not include component design details [such as internal workings of the main steam isolation valves (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, that component or function should be described in the DD. Any features (such as flow limiters, backflow protection, surge tanks, severe accident features, etc.) should be described in the DD as follows:

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

Keep Fill Systems. These systems should be included in the DD 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 emergency core cooling system (ECCS) test loop], which is critical to demonstrate the capability of the system/component to perform its direct safety function. These online test features should be described in the DD.

Filters. Filters that are required for a safety function (such as control room HVAC radiation filtering) should be described in the DD. 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. These features should be described in the DD, and the functional arrangement ITAAC should verify that they exist. In general, the ITAAC need not include the capabilities of these features. Detailed analyses should be retained in the applicable section(s) of the COL application.

Hazard (e.g., flood, fire) Protection Features. The appropriate system DD should include special features (switches, valves, dampers) that are used to provide protection from hazards. Other features (such as walls, doors, curbs, etc.) should also be covered; however, in most cases, these should be addressed in an ITAAC for buildings or structures.

Special Cases for Seismic Qualification. Some non-safety equipment may require special treatment because of its importance to safety. One example is the seismic analysis of the boiling-water reactor (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.

(4) Seismic and ASME Code Classifications

The safety classification of fluid systems and components should be described in each system's DD. 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, design pressures and temperatures for fluid systems need not be specified in the DD, except in special cases (such as inter-system LOCA) where the system has to meet additional requirements.

(5) System Operation

The DD 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 DD for the systems should describe the important system alarms, displays (do not use 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 DD 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/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 (start, isolation, etc.). The DD captures these aspects related to the system's direct safety function.

(8) Interlocks

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

(9) Class 1E Electrical Power Sources/Divisions

The DD 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, etc. Electrical separation should also be addressed in the ITAAC developed for the electrical and I&C systems.

(10) Equipment To Be Qualified for Harsh Environments

Electrical equipment that is used to perform a necessary safety function must be demonstrated to be 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. Documentation related to equipment qualification should be completed for all equipment important to safety in accordance with the requirements of 10 CFR 50.49. 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 DD (or the accompanying figures), and connected instrumentation and controls, connected electrical components (such as cabling, wiring, and terminations), and lubricants necessary to support performance of the safety functions of Class 1E electrical components. The qualification of I&C equipment for "other than harsh" environments should be addressed in the I&C ITAAC.

(11) Accessibility for Inservice Inspection and Testing

Accessibility requirements should be discussed in the applicable sections of the COL application. Verification of accessibility should be provided in ITAAC associated with systems for which the design includes accessibility requirements.

(12) Numeric Performance Values

Numeric performance values for SSCs should be specified as ITAAC acceptance criteria to demonstrate satisfaction of a design commitment (DC). The numeric performance values need not be specified as DCs and documented in the DD unless there is a specific reason to include them. However, key numbers and physical parameters used in the Chapter 6, 14.3, and 15 safety analyses and significant parameters of the PRA should be included in the DD.

B. Figures

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

(2) All components discussed in the design description should be shown on the figure.

(3) System boundaries with other systems should be clearly delineated in the figures. 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 pre-operational 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, and welding and bolting requirements.

(5) As a minimum, the instruments (pressure, temperature, etc.) required to ensure plant safety and perform in accordance with technical guidelines for human factors as discussed in Chapter 18 of a COL application should be shown on the figures or described in the DD.

(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 DDs or shown on figures. The figures should show other "essential" alarms [e.g., associated with shutdown cooling system (SCS) high-pressure (inter-system LOCA), SCS performance monitoring indications] that are not part of the minimum inventory.

(7) Identification of all alarms, displays, and controls on the RSP should be included in the system diagram or (alternatively) ITAAC associated with 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 DD.

(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 (CVs) that have a safety-related active function. (A complete list of such valves is contained in the IST plan.) Valves that are remotely operable from the MCR must be shown if their mispositioning could affect the system safety function. Other valves are evaluated for exclusion on a case-by-case basis. Figures for non-safety-related systems may have less detail.

(10) Fail-safe positions of the pneumatic valves need not be shown on figures or discussed in the DD 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 DD if there is no figure. The demonstration of CIV performance to a containment isolation signal, electrical power assignment to the CIVs, and failure response to the CIVs, as applicable, may be included in the system ITAAC or in a separate containment isolation system ITAAC that encompasses all CIVs. Leak rate testing of the CIVs should be addressed in the DD, and may be addressed in the containment ITAAC.

(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., RCP seal water cooling).

C. Style Guidelines for Design Descriptions and Figures

(1) Standard terminology should be used in favor of new terminology, which should be avoided (i.e., use terms that are commonly used 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) "LOCA signal" should be used (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, the term "associated" should be avoided 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 DD should be consistent in the use of present or future tense.

(7) "Division" should be used 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) The correct system name should be used consistently.

II. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)

A. Operational and Functional Aspects of the System

The DD 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

The critical assumptions from transient and accident analyses should be verified by ITAAC. Cross-references should be provided in Section 14.3 of the COL application, showing how the key physical parameters from these safety analyses are captured and verified in ITAAC. 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 critical input parameters are included, as appropriate, in the applicable system ITAAC.

C. PRA and Severe Accident Insights

If the PRA results indicate that a particular system component or function is risk-significant, that component or function should be verified by ITAAC. PRA insights should be identified in Chapter 19 of the COL application. Roadmaps for PRA, including shutdown safety analyses and severe accidents, should be included in Section 14.3 of the COL application, 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. These online test features should be verified by ITAAC.

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 RCW surge tank inventory to meet the specific system leakage assumptions.

F. Special Cases for Seismic Qualification

Some non-safety 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 (start, isolation, etc.). 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

Interlocks needed for direct safety functions should be included in the system DD or COL application design information and in the ITAAC. Examples include the interlocks to prevent inter-system LOCA, and those that switch the system or component from one mode to a safety function mode. Other interlocks that are more equipment protective in nature should not be included in the ITAAC. 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

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

J. Single Failure

The DD should not state that the system meets the single-failure criterion (SFC), and there should not be an ITAAC to verify that the system meets the SFC. Rather, the ITAAC should address the system attributes (such as independence and physical separation) that relate to the SFC.

K. Flow Control Valves

In general, the CV flow control capability need not be tested in ITAAC, unless flow control is credited in the safety analyses. However, flow control valves should be shown on the figure if they are required to fail-safe or receive a safety actuation signal. The fail-safe position should be noted on the figure, or discussed in the DD or in the COL application design information 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

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 (DC)] should be as close as possible to the DD 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 pre-operational tests, defined in relevant sections of the COL application and Regulatory Guide 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 pre-operational test, the test methodology should be described in the relevant section of the COL application. 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.2.1.1 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. Refer only to inspections, not “visual” inspections.

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

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

K. “Division” should be used instead of train, loop, or subsystem (unless it is a subsystem).

L. ITAAC should be written clearly to avoid the use of clarifying phrases.

M. The correct system name should be used consistently.

INSTRUMENTATION AND CONTROL SYSTEMS

This section provides guidance and the related rationale regarding what a COL applicant should include in the ITAAC for instrumentation and control systems, including any DDs developed separately for the ITAAC, and any supporting tables and figures. Examples of this information may be found in the DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52.

I. Design Descriptions and Figures

The DD should address instrumentation and control (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 following information:

A. Hardware architecture descriptions:
- descriptions of all hardware modules
- cabinet layout and wiring
- seismic and environmental control requirements
- power sources

B. Software architecture descriptions:
- software design specifications
- code listings
- build documents
- installation configuration tables

C. Regulatory guides (RGs) which have specific recommendations. This may be an area where a specific design aspect addressed by an RG is identified as a design commitment, but the acceptance criteria allow alternative approaches, which are then discussed in the FSAR portion of the COL application.

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

E. Policy issues raised for the standard designs.

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

G. Insights or key assumptions identified through the PRA.

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

I. Post-TMI requirements (e.g.,post-accident monitoring).

II. ITAAC Entries (for the above equipment)

The I&C ITAAC should be developed to address the following considerations:

A. Compliance with 10 CFR 50.55a(h), "Criteria for Protection Systems for Nuclear Generating Stations," and IEEE Standard 603-1991 (and the Correction Sheet Dated January 30, 1995)[2]

- Section 4.1 — Identification of the design-basis events. 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 causing 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 non-safety-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.

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[2]Refer to DG-1145, Section C.I.7, Appendix 7B for additional discussion on conformance with IEEE Standard 603.

- 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 non-detectable 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.
- 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 the safety system equipment has been designed, manufactured, inspected, installed, tested, operated, and maintained in accordance with a prescribed quality assurance 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 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 Multi-Unit Stations. The ITAAC should include analysis or demonstration to show that safety systems that are shared between units at multi-unit 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 operator(s) and maintainer(s) 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.
- Sections 6.1 Automatic Control. The ITAAC should verify that all protective actions can be automatically initiated and controlled.
- Sections 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 non-safety 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.

- Sections 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 initiate the appropriate safety function(s).
- Sections 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 General Design Criteria in Appendix A to Part 50

The ITAAC should address each of the following GDCs:

- 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 quality assurance 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, tsunami, 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, as it pertains to instrumentation and control 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, anticipated operational occurrences, 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 reactor coolant pressure boundary, 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 (TEDE) of 0.05 Sv (5 rem) specified in 10 CFR 50.2.
- GDC 20, 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 anticipated operational occurrences, (2) sense accident conditions, and (3) initiate the operation of systems and components important to safety.
- GDC 21, 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) removing 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 this capability includes testing channels independently to identify any failures or losses of redundancy that may have occurred.
- GDC 22, 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, 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 anticipated operational occurrences. 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 anticipated operational occurrences.

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[3]:
  - 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 quality assurance 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.

[3]Refer to DG-1145, Section C.I.7, Appendix 7C for additional discussion on conformance with IEEE Standard 7-4.3.2.

- 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.
- 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 verification and validation (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 who is responsible for archiving the various versions of the software: 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; pre-developed 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
  - Verification and validation analysis and test reports
  - Configuration management 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, pre-operational 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, "Guidance for Evaluation of Defense-in-Depth and Diversity in Digital Computer-Based Instrumentation and Control Systems."

  - The ITAAC should verify that the application conforms with the digital safety system security guidance provided in Revision 2 of Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants."

  - 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 (DC)] should be as close as possible to the DD 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 pre-operational tests, defined in relevant sections of the COL application and Regulatory Guide 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 pre-operational test, the test methodology should be described in the relevant section of the COL application. 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.2.1.1 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. Refer only to inspections, not "visual" inspections.

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

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

K. "Division" should be used instead of train, loop, or subsystem (unless it is a subsystem).

L. ITAAC should be written clearly to avoid the use of clarifying phrases.

M. The correct system name should be used consistently.

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 DDs developed separately for the ITAAC, and any supporting tables and figures. Examples of this information may be found in the DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52.

I. Design Descriptions and Figures

The DD should address electrical equipment that is involved in performing the direct safety function. As 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 DD 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, these should probably be included in the DD. 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 BOP loads), the DD may include a brief design description. The DD for this portion should focus on the aspects, if any, needed to support the Class 1E portion. Therefore, based on the above, the following equipment should be treated in the DD:

A. Overall Class 1E electric distribution system. This would include any high-level treatment for AC and DC cables, buses, breakers, disconnect switches, switchgear, 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, UATs, RATS, etc.
- DC system (battery/battery chargers)
- Emergency diesel generator (EDG), including load sequencing and EDG support systems (these may be included for passive designs also due to risk-significance)
- Class 1E vital AC inverters, regulating transformers, transfer devices
- Alternate AC (AAC) power sources for Station Blackout (SBO) (AAC power sources may be included for passive plants also due to risk significance)

C. Other electrical features, including the following:

- Containment electrical penetrations
- Lighting (emergency control room, remote shutdown panel). The basis for inclusion may relate more to defense-in-depth, support function, operating experience, or PRA, rather than “accomplishing a direct safety function.”

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. No analyses to demonstrate adequacy should be included in the ITAAC.

F. Lighting.

G. Requirements specified by GDCs 17 and 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 to minimize the likelihood of losing all electric power as a result of a coincident loss of more than one power supply. This is a case where some DD and ITAAC or interface requirements are needed for a "non-Class 1E" area, because of its "importance to safety."

H. Other specific rules and regulations that are applicable to electric systems. For example, the Station Blackout Rule (10 CFR 50.63) is met by an Alternate AC (AAC) source or a coping analysis, and the DD should include appropriate features. These are non-Class 1E aspects, but are "important to safety."

I. Regulatory guides that have specific recommendations. This may be an area where a specific design aspect addressed by an RG is identified as the design commitment, but the acceptance criteria allow alternative approaches that are then discussed in the FSAR portion of the COL application.

J. Safety-significant operating experience problems that have been identified [particularly through electrical distribution system functional inspections (EDSFIs), generic letters, 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. For example, on the advanced boiling-water reactor (ABWR), new design features include the main generator breaker for backfeed purposes, the potential for harmonics introduced by new reactor internal pumps (RIPs), and main feedwater (MFW) 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, therefore, in some cases, it is important that a particular pump motor is on a particular bus within a given division. This arrangement was included in the ITAAC based on the PRA insights. NOTE: 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 feature(s) 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 [e.g., power to power-operated relief valve (PORV) block valve, pressurizer heaters, etc.).

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 DD 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. Electrical equipment located in a "mild" environment should only be discussed in the applicable sections of the COL application. 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. ITAAC should be included 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 inter-ties (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 post-fire 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 section(s) of the COL application should discuss those analyses. In addition, the ITAAC should include testing to verify EDG capacity and capability based on the Technical Specifications. (NOTE: 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 section(s) 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:

- The ITAAC should include analyses to verify equipment short-circuit capability and breaker coordination, and the relevant section(s) of the COL application should describe those analyses.
- Similarly, the ITAAC should consider diesel generator protective trips (and bypasses, if applicable).

- If the post-fire safe shutdown circuit analyses rely on fire-induced faults to be cleared, this may need to be treated in the DD 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 loading of the EDG). This is a direct safety function in response to a design-basis loss of power. Problems with relay settings should be considered in this requirement.

F. Controls, Displays, and Alarms

ITAAC should be included to verify the minimum inventory for emergency operating procedures, etc., as discussed in the applicable section of the COL application (e.g., Chapter 18).

G. Test Features

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

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

Because of the potential degradation of Class 1E sources and fire-induced cable damage, ITAAC should be included 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, ITAAC should be included 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 DDs developed separately for the ITAAC, and any supporting tables and figures. Examples of this information may be found in the DCDs for the certified designs referenced in the applicable appendices to 10 CFR Part 52. The following information should be included in the building structure DDs:

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. Do 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 section(s) 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 DD should specify — and the ITAAC should verify — the embedment depth (from the top of the foundation to the finished grade).

C. Building structure DDs 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, foundation mat, etc.

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

II. Protection Against Hazards

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

B. External flooding. The DDs 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 DDs 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 (tornados, 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.2-B

DEVELOPMENT GUIDANCE FOR EMERGENCY PLANNING ITAAC

A generic set of acceptable emergency planning (EP) ITAAC was developed through coordination efforts between the NRC and the Nuclear Energy Institute (NEI). This coordination effort resulted in the development of generic EP-ITAAC that are provided in Table C.II.2-B1[1]. The combined license applicant should consider this set of EP-ITAAC in the development of their application-specific EP-ITAAC that is tailored to the specific reactor design and emergency planning program requirements for their proposed plant site. A smaller set of EP-ITAAC is acceptable if the application contains information that fully addresses emergency preparedness requirements associated with any of the generic ITAAC contained in Table C.II.2-B1. Table C.II.2-B1 is not all-inclusive, or exclusive of other ITAAC an applicant may propose. Additional plant-specific EP-ITAAC (i.e., beyond those listed in Table C.II.2-B1) may be proposed, and they will be examined to determine their acceptability on an applicant-specific basis.

[1]See SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005; and SRM SECY-05-0197, February 22, 2006. The generic emergency planning ITAAC in SECY-05-0197 formed the basis for Table C.II.2-B1.

Table C.II.2-B1
EMERGENCY PLANNING
Generic Inspections, Tests, Analyses, & Acceptance Criteria (EP ITAAC)[2,3]

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
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 emergency planning zones (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.]

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

b. 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.

[2] See also SRM SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005 (ADAMS Accession No. ML052770225), and associated February 22, 2006, Staff Requirements Memorandum (SRM) (ML060530316). These COL EP ITAAC are identified as asterisked "*" & **bolded** text.

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

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
3.0 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.	***3.1 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]**	***3.1 An inspection of the control room, technical support center (TSC), and emergency operations facility (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.**	***3.1 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.]**
4.0 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.	***4.1 The means exists to notify responsible State and local organizations within 15 minutes after the licensee declares an emergency. [E.1]** ***4.2 The means exists to notify emergency response personnel. [E.2]** ***4.3 The means exists to notify and provide instructions to the populace within the plume exposure EPZ. [E.6]**	***4.1 – 4.3 A test will be performed of the capabilities.**	***4.1 The responsible State and local agencies receive notification within 15 minutes after the licensee declares an emergency.** ***4.2 Emergency response personnel receive the notification and mobilization communication. [The COL applicant will provide specific acceptance criteria.]** ***4.3 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.]**

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
5.0 Emergency Communications			
10 CFR 50.47(b)(6) – Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public.	***5.1 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]** ***5.2 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]**	***5.1 & 5.2 A test will be performed of the capabilities.**	***5.1 Communications are established among the control room, TSC, EOF, principal State and local EOCs, and radiological field assessment teams.** ***5.2 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.**
6.0 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.	***6.1 The licensee has provided space which may be used for a limited number of the news media. [G.3.b]**	***6.1 An inspection of the as-built facility/area provided for the news media will be performed.**	***6.1 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[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
7.0 Emergency Facilities and Equipment			
10 CFR 50.47(b)(8) – Adequate emergency facilities and equipment to support the emergency response are provided and maintained.	***7.1 The licensee has established a TSC and onsite OSC. [The TSC and OSC may be combined at a single location.] [H.1, H.9]**	***7.1 An inspection of the as-built TSC and OSC will be performed, including a test of the capabilities.**	***7.1.1 The TSC size is consistent with NUREG-0696.** ***7.1.2 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.]** ***7.1.3 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.]** ***7.1.4 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.]**

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
			***7.1.5 The TSC has the means to receive, store, process, and display plant and environmental information, and to initiate emergency measures and conduct emergency assessment. [The COL applicant will adopt design certification criteria, if applicable, or otherwise identify specific capabilities.]** ***7.1.6 The OSC is located onsite, separate from the control room and TSC. [The COL applicant will adopt design certification criteria, if applicable, or otherwise specify OSC location and identify specific capabilities.]** ***7.1.7 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.]**
	***7.2 The licensee has established an EOF. [H.2]**	***7.2 An inspection of the as-built EOF will be performed, including a test of the capabilities.**	***7.2.1 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.]** ***7.2.2 The EOF habitability is consistent with Table 2 of NUREG-0696. [The COL applicant will specify the acceptance criteria for EOF habitability.]** ***7.2.3 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[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
			***7.2.4 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.]**
	7.3 The means exists to initiate emergency measures, consistent with Appendix 1 of NUREG-0654/FEMA-REP-1, Rev. 1. [H.5] 7.4 The means exists to acquire data from, or for emergency access to, offsite monitoring and analysis equipment. [H.6] 7.5 The means exists to provide offsite radiological monitoring equipment in the vicinity of the nuclear facility. [H.7] 7.6 The means exists to provide meteorological information, consistent with Appendix 2 of NUREG-0654/FEMA-REP-1, Rev. 1. [H.8]	7.3 – 7.6 A test will be performed of the capabilities.	7.3 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.] 7.4 The means exists to acquire data from, or for emergency access to, offsite monitoring and analysis equipment. [The COL applicant will identify specific capabilities.] 7.5 The means exists to provide offsite radiological monitoring equipment in the vicinity of the nuclear facility. [The COL applicant will identify specific capabilities.] 7.6 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[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
8.0 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.	***8.1 The means exists to provide initial and continuing radiological assessment throughout the course of an accident. [I.2]** ***8.2 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]** ***8.3 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]**	***8.1 – 8.9 A test will be performed of the capabilities.**	***8.1 The means exists to provide initial and continuing radiological assessment throughout the course of an accident. [The COL applicant will identify specific capabilities.]** ***8.2 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.]** ***8.3 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.]**

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
	***8.4 The means exists to acquire and evaluate meteorological information. [I.5]**		***8.4 Meteorological data is available at the EOF, TSC, control room, offsite NRC center, and to the State. [The COL applicant will identify specific capabilities].**
	8.5 The means exists to determine the release rate and projected doses if the instrumentation used for assessment is off-scale or inoperable. [I.6]		8.5 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 specific capabilities.]
	8.6 The means exist for field monitoring within the plume exposure EPZ. [I.7]		8.6 The means exists for field monitoring within the plume exposure EPZ. [The COL applicant will identify specific capabilities.]
	***8.7 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]**		***8.7 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.]**
	***8.8 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]**		***8.8 Radioiodine can be detected in the plume exposure EPZ, as low as 10^{-7} µCi/cc. [The COL applicant will identify specific capabilities.]**
	***8.9 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]**		***8.9 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[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
9.0 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.	***9.1 The means exists to warn and advise onsite individuals of an emergency, including those in areas controlled by the operator, including:[J.1]** **59. employees not having emergency assignments;** **60. visitors;** **61. contractor and construction personnel; and** **62. other persons who may be in the public access areas, on or passing through the site, or within the owner controlled area.** 9.2 The means exist to radiological monitor people evacuated from the site. [J.3] 9.3 The means exists to notify and protect all segments of the transient and resident populations. [J.10] 9.4 The means exists to register and monitor evacuees at relocation centers. [J.12]	***9.1 – 9.4 A test will be performed of the capabilities.**	***9.1 The means exists to warn and advise onsite individuals. [The COL applicant will identify specific capabilities.]** 9.2 The means exist to radiological monitor people evacuated from the site. [The COL applicant will identify specific capabilities.] 9.3 The means exists to notify and protect all segments of the transient and resident populations. [The COL applicant will identify specific capabilities.] 9.4 The means exists to register and monitor evacuees at relocation centers. [The COL applicant will identify specific capabilities.]

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
10.0 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.	10.1 The means exists to provide onsite radiation protection. [K.2] 10.2 The means exists to provide 24-hour-per-day capability to determine the doses received by emergency personnel and maintain does records. [K.3] 10.3 The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. [K.5.b, K.7] 10.4 The means exists to provide onsite contamination control measures. [K.6]	10.1 – 10.4 A test will be performed of the capabilities.	10.1 The means exists to provide onsite radiation protection. [The COL applicant will identify specific provisions.] 10.2 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.] 10.3 The means exists to decontaminate relocated onsite and emergency personnel, including waste disposal. [The COL applicant will identify specific provisions.] 10.4 The means exists to provide onsite contamination control measures. [The COL applicant will identify specific provisions.]
11.0 Medical and Public Health Support			
10 CFR 50.47(b)(12) – Arrangements are made for medical services for contaminated, injured individuals.	11.1 Arrangements have been implemented for local and backup hospital and medical services having the capability for evaluation of radiation exposure and uptake [L.1] 11.2 The means exists for onsite first aid capability. [L.2] 11.3 Arrangements have been implemented for transporting victims of radiological accidents, including contaminated injured individuals, from the site to offsite medical support facilities. [L.4]	11.1 – 11.3 A test will be performed of the capabilities.	11.1 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.] 11.2 The means exists for onsite first aid capability. [The COL applicant will identify specific provisions.] 11.3 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.]

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
12.0 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.	***12.1 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]**	***12.1 A full participation exercise (test) will be conducted within the specified time periods of Appendix E to 10 CFR Part 50.**	***12.1.1 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.]** ***12.1.2 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.]**
			***12.1.3 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.**
13.0 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.	13.1 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]	13.1 A test will be performed of the capabilities.	13.1 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.]

Planning Standard	EP Program Elements[a]	Inspections, Tests, Analyses	Acceptance Criteria[b]
14.0 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.	14.1 The emergency response plans have been forwarded to all organizations and appropriate individuals with responsibility for implementation of the plans. [P.5]	14.1 An inspection of the distribution list will be performed.	14.1 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.]
15.0 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.	***15.1 The licensee has submitted detailed implementing procedures for its emergency plan no less than 180 days prior to fuel load**.	***15.1 An inspection of the submittal letter will be performed.**	***15.1 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.2-C

DEVELOPMENT GUIDANCE FOR PHYSICAL SECURITY HARDWARE ITAAC

A generic set of acceptable physical security (PS) hardware ITAAC is currently in development. This effort is being coordinated between the NRC and the Nuclear Energy Institute (NEI) New Plant Security Task Force. 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 those that are site-specific. The combined license applicant should consider this generic set of PS-ITAAC in the development of their application-specific PS-ITAAC that is tailored to the specific reactor design and security program requirements for their proposed plant site.