ATTACHMENT

Proposed Improvements to Tier 1 and the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Small Modular Reactors

Nuclear Energy Institute

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CHAPTER 1 - INTRODUCTION

The purpose of this paper is to propose improvements to Tier 1 and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for small modular reactors (SMRs) as a basis for discussion with the NRC. The goal is to standardize Tier 1 and ITAAC to the maximum extent practical and to enhance the efficiency of ITAAC review and implementation processes. These improvements have been identified based upon the lessons learned from the development of Tier 1 and ITAAC for several design certification (DC) applications and the implementation of ITAAC by combined license (COL) holders, and consideration of the NRC's lessons learned in RIS-2008-05. These proposals also reflect potential improvements and efficiencies made possible by the modular design and factory construction attributes of small modular reactors.

ITAAC are a fundamental element of the licensing process established in 10 CFR Part 52. 10 CFR Part 52.47(b)(1) establishes the following requirement for a design certification application (DCA): *"The proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations."* As additional background, several NRC SECY papers and associated Commission Staff Requirements Memoranda have set forth policy positions associated with design certification and ITAAC. See, e.g., SECYs 90-241, 90-377, 91-178, 91-210, 92-053, 92-214, 92-287, 92-294, and 92-327.

Although 10 CFR Part 52.17(b)(3) and 10 CFR Part 52.80(a) also require ITAAC for an early site permit (ESP) and for a COL application (COLA), the focus of this paper is on ITAAC for DCAs, because there is a more urgent need to address ITAAC for DCAs. It is noted that future activities could address improvements to ITAAC for ESPs and COLAs, once the improvements to Tier 1 and ITAAC for DCAs have matured. It is further noted that although the improvements to Tier 1 and ITAAC are proposed specifically for light water SMR DCAs, these improvements could also benefit DCAs for large light water nuclear reactors.

Achieving greater efficiency and effectiveness for Tier 1 and ITAAC is a high priority for the industry. We believe the suggested improvements to Tier 1 and ITAAC discussed herein would significantly enhance the NRC regulatory framework for SMRs. Under 10 CFR Part 52, ITAAC play a major role in demonstrating completion of construction and are essential to receipt of NRC authorization for operation within a predictable timeframe. Experience to date has shown that ITAAC are not always clear and of the appropriate scope, and inconsistencies across, and even within, approved DCAs have introduced inefficiencies in DCA reviews and implementation. This has created challenges for COL holders (Licensees) as they implement the ITAAC and challenges for the NRC as it seeks to verify the ITAAC closure. In that regard, ITAAC have tended to proliferate with each NRC review of a DCA. Therefore, improvements to Tier 1 and ITAAC are necessary in order to achieve NRC and industry goals for clarity and predictability. It is important to note that the improvements proposed in this paper would not result in any reduction in safety or protection of the public health and safety. Furthermore, we

believe that the proposed improvements can be completely implemented through guidance and we are not proposing to change the regulations as part of improving Tier 1 and ITAAC.

This paper discusses the following proposed improvements:

- Standardized ITAAC
    1. Clarify ITAAC scope by establishing standardized ITAAC types
    2. Clarify ITAAC meaning by establishing standardized ITAAC language
- ITAAC Processes
    3. Create a process to close ITAAC prior to installation in the final location
    4. Create a process to close ITAAC only once for SSCs that are shared by multiple reactor units
- Standardized Tier 1
    5. Establish standardized Tier 1 organization
    6. Clarify Tier 1 by establishing standardized Tier 1 formatting and content

Industry understands that the NRC has begun updating NUREG-0800 "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP) Section 14.3 and related sub-sections, with many of the same ITAAC improvement goals. This paper is intended to provide input to the staff's update to SRP Section 14.3.

CHAPTER 2 - STANDARDIZED ITAAC

Development of standardized ITAAC is the most effective way to address concerns regarding the inconsistent scope and language of ITAAC, while at the same time improving the efficiency of design certification reviews and the ITAAC closure process. Standardized ITAAC would clearly identify the scope of ITAAC that apply generally to most reactor facilities, and would contain standard language to be used by all DC applicants.

Based on a review performed by the NEI SMR ITAAC Improvement Task Force, of all the ITAAC proposed by DCAs and accepted by the NRC, the vast majority of these ITAAC (i.e., approximately 90%) fall within standardized ITAAC types. Generic development of standardized ITAAC types will establish nearly all of a DCA's scope of ITAAC, resulting in improved consistency, efficiency and predictability of the NRC review. The remaining ITAAC that are needed for a DCA would be based upon the nature of any design features unique to that DCA.

Improvement #1: Clarify ITAAC Scope by Establishing Standardized ITAAC Types

a) Description of Issue

"First principles" for determining whether an ITAAC is needed are documented in the agency's policy statements (see SECYs previously referenced) and are also addressed in SRP Section 14.3. These first principles provide useful guidance for the DC applicant in proposing ITAAC and for NRC staff reviewers as they consider the scope of ITAAC that are "necessary and sufficient" for these applications. However, the experience gained from development of ITAAC for completed and pending DCAs has indicated that

some ITAAC may not adhere to these principles, because the principles were either not clear or their application was not consistent. It is therefore important that any effort to improve ITAAC should provide clarity on how to determine whether an ITAAC is "necessary and sufficient".

Approximately 90% of ITAAC can be standardized, with the remaining 10% being design specific ITAAC. The ability to standardize such a large majority of ITAAC is due to the common regulatory foundation from which the designs are developed, and to the resulting inherent similarities in reactor facility designs. For example, all reactor facility designs have safety-related thermal-hydraulic systems, electrical systems, instrumentation and control systems, and structures. However, experience has shown that there is a large variation in the ITAAC related to these SSCs among the certified designs and DC applicants. Experience has also shown that there is no need for variations in the ITAAC that are necessary for similar design features that meet the same regulations, because the ITAAC for top level design and performance characteristics are not sensitive to specific details of the design. Finally, these variations among DCAs have resulted in confusion and reduced regulatory predictability. It is therefore important that any effort to improve ITAAC should include development of standardized ITAAC that are consistent with first principles.

b) Proposed Improvement

<u>First Principles</u>

Enhanced clarity on how to determine whether an ITAAC is needed should include a more explicit articulation of the first principles in the SRP and associated guidance, as appropriate, on how they should be applied to aid in the development of ITAAC. This would help establish a common understanding of these first principles. ITAAC are created to verify, and therefore limited to, the design functions described in Tier 1, but not all Tier 1 design descriptions need an associated ITAAC (e.g. functional arrangement). Thus, in order to determine the appropriate scope of ITAAC, it is important to apply both the first principles for determining the top-level design and performance characteristics to be included in Tier 1 design descriptions, and the first principles for determining whether a Tier 1 design description needs an ITAAC.

The first principles for determining in the scope of Tier 1 design descriptions are as follows:

1. Tier 1 information (e.g., design descriptions and information included in tables and figures) is derived solely from the Tier 2 design information.
2. Tier 1 is not relied upon for the NRC safety determination provided in an SER. The NRC safety determination is based solely on the Tier 2 design information.
3. Tier 1 information is limited to the top-level design and performance characteristics.
4. The principles for determining the top-level design and performance characteristics for SSCs to be included in Tier 1 are based on whether the SSC
    a. performs a safety-related function;
    b. performs a risk-significant function as determined by the results of a PRA;
    c. provides a function necessary or important to severe accident mitigation;
    d. is associated with key assumptions or performance characteristics as determined in the various accident analyses specific to the design; or

e. is otherwise necessary to comply with NRC regulations.

The level of detail in Tier 1 is based on a graded approach commensurate with safety significance. The following first principles are important in applying this concept:

1. The amount of detail in Tier 1 for a system should be proportional to the safety significance of the system.
2. Tier 1 should include only those details that are important to the safety functions of structures and systems.
3. Tier 1 for a system does not need to include every safety-related component for that system, but instead should only include those components that are important to accomplishing the safety function of the system.
4. Tier 1 should not contain a level of detail (e.g., minor dimensional details) that would restrict a licensee from making changes that do not affect a safety function.
5. To the extent that Tier 1 includes quantitative information, the numbers should be identified as bounding numbers or should include ranges.
6. In general, Tier 1 should not include references to Tier 2 or to codes, standards, or guidance, with the possible exception of the ASME Code.
7. In general, Tier 1 should not include references to particular vendors of components, and should allow for the use of a range of vendors for a particular component.

ITAAC are used to verify that a facility is constructed and will operate in conformity with its license, and thus serve a different purpose than the Tier 1 design descriptions. Additional first principles for selecting ITAAC based upon Tier 1 design descriptions are as follows:

1. ITAAC are created to verify, and therefore limited to, the design functions as they are described in Tier 1.
2. ITAAC are not relied upon for the NRC safety determination provided in an SER. The NRC safety determination is based solely on the Tier 2 design information.
3. Not all Tier 1 design descriptions require an ITAAC.
4. ITAAC verify the top-level design and performance characteristics of SSCs.
5. ITAAC address the design at a system or structure functional performance level of detail. Numeric acceptance criterion values are specified only when failure to meet the stated acceptance criteria would clearly indicate a failure to properly implement the design.
6. ITAAC is an important part of the construction verification program, but does not verify every design and construction attribute included in the certified design. ITAAC are not meant to be a one-for-one check of detailed design and construction attributes that are verified in the quality programs already in place.
7. ITAAC design commitments are consistent with the Tier 1 design descriptions.
8. ITAAC are not necessary if the top-level design or performance characteristic is already verified by another ITAAC.

Based upon the above first principles, an initial review of ITAAC found in previous DCAs was performed. The following are a few examples of ITAAC that do not meet first principles and; therefore, should not be ITAAC for future DCAs:

- Functional arrangement ITAAC

- ITAAC that reference other ITAAC
- ITAAC for First Plant and First Three Plant only Tests
- Attributes that are not top level design or performance characteristics, such as Class 1E equipment labeling, and Electrical equipment grounding

Based on these principles and ITAAC experience to date, standardized ITAAC types can be developed, as discussed below.

Standardized ITAAC Types

In Appendix B, we propose a set of standardized ITAAC types to be used in developing a DCA. This proposed set of standardized ITAAC types has been developed based upon a review of over 5,000 ITAAC included in previous DCAs and based upon application of the first principles discussed above. Further discussion with the NRC on the proposed set of standardized ITAAC types is sought to determine any necessary deletions, changes or additions. A common understanding of the scope of standardized ITAAC types will also facilitate industry development of standardized ITAAC language for NRC endorsement and incorporation into the SRP, and/or into industry guidance. The following is a discussion on the approach to develop and use standardized ITAAC types, and should be used when reviewing Appendix B.

Similarities vastly outweigh the differences in the design of light water reactors, including SMRs. In light of this, it is proposed that standardized ITAAC types be developed. Standardized ITAAC types are developed around top level design and performance attributes that satisfy one or more ITAAC first principles. Thus, ITAAC types are families of specific ITAAC which share similar design commitments and closure methods. For a given design, an ITAAC type may apply to multiple SSCs. The standard Design Description and Acceptance Criteria would include bracketed information that would be replaced in a design certification application by design specific information from the Tier 1 design descriptions. However, the method for performing the ITAAC (e.g. Inspection, Test or Analysis) will be the same for any of the specific ITAAC, and therefore little or no bracketed information is likely to exist in the ITA column.

To help organize ITAAC types, ITAAC categories and Top Level Design Requirements are identified, and then arranged in a Table. The ITAAC categories are broad groupings of ITAAC types that are arranged based upon the method of closure and the stage during construction when the closure occurs (e.g., Design, As-Built, Pre-Operational). The Top Level Design Requirements are design functions that generally have design descriptions in Tier 1 (e.g. ASME Section III Piping Design and Installation, Class 1E I&C Independence, Seismic Qualification). Top Level Design Requirements can be further associated with higher level Design Areas (e.g. Containment Pressure Boundary, I&C). For a given Top Level Design Requirement (Row), the proposed standard ITAAC types are found in the cells where applicable ITAAC Categories (Columns) intersect. It is important to note that not all cells require associated ITAAC types. An excerpted row from Appendix B, including the column headings, is included below for illustration.

Top Level Design Requirement	Design Acceptance Criteria ITAAC	Design Analysis ITAAC	Equipment Qualification ITAAC	As-Built Inspection and Test ITAAC	Preoperational Test ITAAC
Safety Related Valve Qualification	No ITAAC Necessary	No ITAAC Necessary	• Safety-Related Valve Harsh Environment Equipment Qualification • Valve Functional Qualification	• Safety-Related Valve Harsh Environment Equipment Installation Verification	• Safety-Related Remotely Operated Valve Functional Test during System Normal Alignment· • Safety-Related Check Valve Functional Test during Normal System Alignment • Safety-Related Remotely Operated Valve Fail Position on Loss of Motive Power

The ITAAC categories are described as follows:

Design Acceptance Criteria (DAC) ITAAC

- DAC ITAAC are used to verify satisfactory design completion in those areas in which the design could not be fully completed prior to approval of the DCA. The goal for SMR design certifications is to minimize the use of DAC, where appropriate, and thus minimize the number of ITAAC related to DAC. It is envisioned that DAC would likely still be needed for piping design, human factors engineering, and digital I&C but could be minimized. It is not anticipated that DAC will be utilized in the area of radiation protection.

Design Analysis ITAAC

- By definition, an analysis is a calculation, mathematical computation, or engineering/technical evaluation. Analyses in this category do not require manufacture of equipment nor do they require physical work at a vendor, at a module manufacturer, or at a facility under construction (e.g., Fire and Flood). As such, Design Analysis ITAAC could be closed independent of physical work, and could be closed once for a multi-unit facility.

Equipment Qualification ITAAC

- Type tests, analyses, or a combination of type tests and analyses will be performed to qualify equipment. The qualification activities are documented in an equipment qualification package (e.g., environmental and seismic qualification) or similar document(s). Equipment Qualification ITAAC will not require physical work at a vendor on the specific component to be installed in the plant, at a module manufacturer, or at a facility under construction, although separate as-built ITAAC may be necessary to ensure proper installation of a qualified component. As such, Equipment Qualification ITAAC can be closed independent of physical work on plant components, and can be closed once for a multi-unit facility.

As-Built Inspection and Test ITAAC

- As-built (including as-fabricated) status of the SSC is required in order to perform this ITAAC. As-built inspections and/or tests may be performed at the final installed location or at a vendor/ module manufacturer.

Preoperational Test ITAAC

- A Preoperational Test ITAAC is performed in accordance with a Preoperational Test Procedure. Typically, the system is as-built and then released to the startup organization in order to perform these ITAAC.

Standardized ITAAC types are generalized and the number of types is relatively small compared to the total number of ITAAC that will exist for a DCA, because specific ITAAC for multiple units and for multiple SSCs for a given unit will be based on a single standard ITAAC type. In order to develop the specific ITAAC for a DCA, the ITAAC types must be applied to the SSCs in the Tier 1 design descriptions. In this manner, a single ITAAC type may result in multiple specific ITAAC. To illustrate this process, consider the reactor coolant system. To determine which specific ITAAC are needed for this system, a review of all the ITAAC types would be performed to determine which correspond to the reactor coolant system Design Descriptions in Tier 1. For example, the "ASME Section III Installation Inspection" ITAAC type would apply to the reactor coolant system, and therefore a specific ITAAC for the "Reactor Coolant System ASME Section III Installation Inspection" would be developed for the DCA. ITAAC types are listed in the cells below an ITAAC category, indicating that the ITAAC type belongs to that ITAAC category for a particular Top Level Design Requirement.

The intent is that ITAAC based on the standardized ITAAC types, together with any necessary design specific ITAAC, will comprise the scope of ITAAC that are necessary and sufficient for a design certification application to meet the requirements of 10 CFR52.47(b)(1).

This system of organizing ITAAC types permits a systematic approach to develop specific standardized ITAAC based on ITAAC first principles. It is important to emphasize that ITAAC first principles still need to be applied to determine if any design-specific ITAAC need to be developed for the DCA. Design specific ITAAC may be necessary, but are not automatically required, for unique design features outside the scope of standardized ITAAC types.

Improvement #2: Clarify ITAAC Meaning by Establishing Standardized ITAAC Language

a) Description of Issue

Experience from development and implementation of ITAAC for previous DCAs has shown a wide variation in the specific language used in ITAAC of the same type. This variation is most obvious when comparing different DCAs, but it also exists between different engineering disciplines within the same DCA. This has increased the resources required to develop and review such ITAAC and has resulted in some ITAAC not being clear in the implementation phase. Thus, it is important that any effort to improve ITAAC should include development of standardized ITAAC language that is clear and precise.

b) Proposed Improvement

Industry has begun developing standardized language for the standardized ITAAC types that are proposed in this paper. Once there is agreement with the NRC on the approach to establish standardized ITAAC types and on their scope, industry will propose, for NRC consideration, standardized language for all ITAAC types. This standardized language will incorporate best practices used for

developing ITAAC in existing certified designs and proposed in DCAs that have attained an appropriate level of NRC review, and would focus on ensuring that the ITAAC are clear for those who will close and verify them (i.e., COL holder and NRC). In addition to developing the standard language for each ITAAC type, the best practices would be documented so that they can be used to develop language for design-specific ITAAC.

CHAPTER 3 - ITAAC PROCESSES

Due to their more compact and modular design features, the SMR designs increasingly utilize the concepts of manufacturing and construction at factories and venues other than final installed locations as well as the concept of shared SSCs. Therefore, SMR designs could benefit greatly from an enhanced ITAAC framework and processes that permit 1) closure of ITAAC prior to installation in the final location, and 2) closure of ITAAC for SSCs shared by multiple reactor units only once.

Improvement #3: Create a Process to Close ITAAC Prior to Installation in the Final Location

a) Description of Issue

SMR designs have increased the ability to manufacture and construct much of the nuclear facility in vendor or module manufacturing facilities. Many of the techniques to manufacture and construct in locations other than the final installed location of the SSC are enabled through the modularity and smaller scale inherent in these designs. Thus, not only are individual components manufactured in a factory, entire systems and modules can be assembled at a module manufacturing facility prior to the placement in the site for installation in the final location. Per Regulatory Guide 1.215, "Guidance for ITAAC Closure Under 10 CFR Part 52", the NRC endorsed NEI 08-01 “Industry Guideline for the ITAAC Closure Process Under 10 CFR Part 52” in connection with the <u>performance</u> of as-built ITAAC at locations other than the final installed location. However, there is no clear guidance on the acceptability, and the process, to <u>close</u> the ITAAC prior to placing the SSC in its final installed location. The ability to close ITAAC earlier, when the ITAAC are performed at a vendor or module manufacturing facility, would reduce the ITAAC “bow wave” that occurs toward the end of construction. ITAAC Maintenance requirements per 10 CFR 52.99(c)(3) will take effect upon ITAAC closure at other than the final installed location, providing assurance that the NRC is notified if subsequent actions materially affect the ITAAC conclusion. It is noted that implementation details would still need to be established.

b) Proposed Improvement

Industry plans to propose enhancements to the process to perform ITAAC at a location other than the final installed location that would also permit closure of the ITAAC prior to permanent placement of SSCs in the final installed location. This process would clarify whether any additional actions are necessary for ITAAC closure and maintenance in these situations and identify those processes that need to be invoked to ensure ITAAC integrity from closure at the factory to installation in the final location. Other topics that may need to be addressed include: vendor inspections for ITAAC closure, closeout of ITAAC findings at vendor facilities, traceability of installed components to closure documentations, and

Licensee's ITAAC maintenance programs. It is envisioned that, once agreed upon by the NRC, guidance in NEI 08-01 would be supplemented to describe this process.

Improvement #4: Create a Process to Close ITAAC Only Once for SSCs that are Shared by Multiple Reactor Units

Shared ITAAC are defined as ITAAC that are applicable to a SSC or activity that is common or shared by multiple reactor units and for which the closure and verification of the ITAAC can be demonstrated for all associated units (i.e., units at a facility that rely on the shared SSC or activity) at one time. Thus a Shared ITAAC that is closed for the first associated unit (i.e., lead unit) would also represent closure for all other associated units. Shared ITAAC could be either 1) SSCs that are common or shared by multiple units, including common or shared facilities and structures, and for which the interface and functional performance requirements between the common or shared SSC and each unit are identical, or 2) analyses or other generic design and qualification activities which are identical for each unit (e.g., piping DAC or seismic and environmental qualification of equipment).

a) Description of Issue

Currently, if a site is constructed with multiple identical reactors located next to each other, then each reactor must include an identical set of ITAAC. This is true even in cases where the activities to close identical ITAAC for each unit are only performed once, and are credited for the ITAAC of multiple units. The nature of the modular design and construction of SMRs places increased reliance on Shared ITAAC, and in particular ITAAC for common or shared SSCs. The proposed approach would clarify that Shared ITAAC need only be performed once and can be credited for multiple units.

The license structure for multi-unit (i.e., multi-module) facilities related to SMRs has been considered by the NRC and industry for several years. NRC considerations and industry proposals for licensing multi-unit facilities have been documented in policy and position papers dating from the early 2000's to 2011. One of the more recent policy and position papers is SECY 11-0079. Any discussion of multi-unit facility licensing, however, must include a discussion of multiple findings under 10 CFR 52.103(g) and ITAAC closure upon which these findings are made. Most policy and position paper discussions have focused on licensing proceedings, hearing opportunities, finality considerations, decommissioning, etc. However there has been no specific focus and discussion on the development of ITAAC for DCAs to support multiple 10 CFR 52.103(g) findings. By definition, modular design means a nuclear power station that consists of two or more essentially identical nuclear steam supply systems (reactor units). Each unit is a separate nuclear reactor capable of being operated independent of the state of completion or operating condition of any other unit co-located on the same site, even though the nuclear power station may have some shared systems (ref. 10 CFR 52.1). Definitions and provisions should be developed for "Unit Specific" ITAAC and "Shared" ITAAC to facilitate multiple 10 CFR 52.103(g) findings. "Unit Specific" ITAAC are associated with SSCs that are specific to and support operation of a single individual reactor unit. For example, unit specific reactor coolant systems, reactor vessels, feedwater systems, steam generators, main steam isolation valves, etc. "Shared ITAAC" are associated with shared SSCs and activities that support two or more or all reactor units. For example, cooling system for shared spent

fuel storage pool, ultimate heat sink, building that houses multiple reactor units, HVAC systems for a building, main control room that supports multiple units, etc.

b) Proposed Improvement

Industry plans to propose a process to identify and close Shared ITAAC once for multiple units, and for the Shared ITAAC to be associated with the lead unit (i.e., first associated unit that relies on the shared SSC or activity) with a 52.103(g) finding. The NRC evaluated and agreed that this could be a viable approach for licensing as stated in SECY-11-0079: "*NEI's recommended approach may not introduce significant issues for the control of common SSCs and license renewal for the facility until a facility approached the end of the license term for the first module. Therefore, although the connection of common SSCs to the first module would not necessarily provide the optimum approach for multi-module facilities, it would support initial licensing, and the staff and industry could pursue alternate approaches to address the license renewal of common SSCs in subsequent years after the NRC has issued the license*."

In our proposal for the process to close Shared ITAAC only once, we will address 1) when an ITAAC can be declared as shared, 2) the actions necessary to demonstrate closure of this ITAAC for multiple units, and 3) how to address the process in the COLA. As part of establishing this process, the format of Tier 1 in the DCA could be structured to enhance clarity on which ITAAC are shared (this is described in the Standardized Tier 1 improvement below). In order to close a Shared ITAAC, the Shared ITAAC must be written to apply to all associated units of the SMR facility.

An important consideration for the establishment of a process to close Shared ITAAC once for multiple units is the requirement for the NRC finding of all ITAAC met under 10 CFR Part 52.103(g). In the proposed process, all Shared ITAAC would be closed, together with all Unit Specific ITAAC, for the lead unit to receive a 52.103(g) finding. Subsequent associated units would close only their Unit Specific ITAAC to receive the 52.103(g) finding because operational programs implemented to support the lead unit and facility would ensure the operability and availability of the shared SSCs and activities to support subsequent units after ITAAC closure for the lead unit. ITAAC Maintenance and post-closure notifications of 10 CFR Part 52.99(c)(2) are no longer relevant for Shared ITAAC after the NRC makes the 52.103(g) finding for the lead unit. The SSCs subject to Shared ITAAC fall under the lead unit's operating license and are controlled by its operating programs, which provides assurance that the Tier 1 design commitments continue to be met for subsequent associated units.

CHAPTER 4 - STANDARDIZED TIER 1

Enhancements to Tier 1 are proposed based upon lessons learned from the development and implementation of Tier 1 for previous DCAs and to facilitate implementation of improvements to ITAAC described above. Implementation of these Tier 1 enhancements would improve the clarity and predictability of ITAAC during review and implementation. Although there are numerous enhancements, they are generally grouped into 1) organization of Tier 1, and 2) formatting and content of Tier 1.

Improvement #5: Establish Standardized Tier 1 Organization

a) Description of Issue

Tier 1 has traditionally and generally been organized by system-based ITAAC (Chapter 2) and non-system based ITAAC (Chapter 3). However, this format would not be efficient for organizing Unit Specific and Shared ITAAC. Thus, in order to fully implement a process that permits closure of Shared ITAAC only once, reorganization of Tier 1 is proposed.

b) Proposed Improvement

We propose a Tier 1 organization structured around Unit Specific (Chapter 2) and Shared (Chapter 3) design descriptions and ITAAC that would better facilitate multi-unit facility ITAAC implementation and closure, construction and operation.

Tier 1, Chapter 2 on "Unit Specific ITAAC" would include all of the design descriptions and ITAAC that are wholly associated with a specific unit, and which would be duplicated for each unit. For example, if each unit requires a primary coolant system that is solely and wholly designated for one and only one unit, then it would be considered unit specific. Due to the nature of SMR designs, it is expected that all or most unit specific SSCs will include identical design features. However, if there are any differences in the design descriptions of any individual unit, as compared to another unit, these differences would be included in the Unit Specific ITAAC. A DC applicant would identify identical Unit Specific ITAAC only once, and the COL applicant would specify the number of units to be licensed.

Tier 1, Chapter 3 would include all of the design descriptions and ITAAC for "Shared ITAAC". Examples of shared structures or systems include radwaste systems, spent fuel pool cooling and handling, security system, emergency response facilities. Examples of shared analyses and other design and qualification activities include DAC, environmental and seismic qualification, human factors, and pipe break analysis.

The structure of Tier 1 should support the issuance of a license to a COL applicant for a multi-unit facility containing shared systems and buildings in accordance with the NRC preferred approach identified in SECY-11-0079. Current DCAs do not utilize shared systems and buildings which therefore requires Appendix C to each combined license to repeat all of the ITAAC for each unit. Shared ITAAC need only be closed once for multiple units of the facility. When a combined license is issued, Chapter 4, Interface Requirements, and Chapter 5, Site Parameters, of a referenced DCD are not included in Appendix C to the combined license; therefore, there is no anticipated change in their structure. The structure of Chapter 1, Introduction, also will not change because this chapter will need to be issued in each Appendix C to the combined license. It is the structure of chapters and sections containing ITAAC that should change to support SMR multi-unit licensing. Unit Specific ITAAC will need to be included in each Appendix C to a combined license. Shared ITAAC will only be included in Appendix C to a combined license of the lead unit (i.e., first associated unit for the facility with a 52.103(g) finding), because these ITAAC must be closed to support the lead unit. For the subsequent associated units, operational programs implemented to support the lead unit and facility would ensure the operability and availability of the shared SSCs and activities to support subsequent units after ITAAC closure for the lead unit. High-level and abridged table of contents for the current and proposed Tier 1 structures are shown below.

Enhanced Tier 1 Structure (proposed)	Current Tier 1 Structure (typical)
1. Introduction 2. Unit-Specific Design Descriptions and ITAAC 3. Shared Design Descriptions and ITAAC Design Acceptance Criteria (DAC) Shared structures, systems and components Design Reliability Assurance Program 4. Interface Requirements 5. Site Parameters	1. Introduction 2. System-Based Design Descriptions and ITAAC 3. Nonsystem-Based Design Descriptions and ITAAC Design Acceptance Criteria (DAC) Initial Test Program Design Reliability Assurance Program 4. Interface Requirements 5. Site Parameters

Improvement #6: Clarify Tier 1 by Establishing Standardized Tier 1 Formatting and Content

a) Description of Issue

Inconsistencies in the type of information contained in the DCA, and the manner in which is it presented, have been noted in the existing certified designs. There have been some instances where the inclusion of information that would benefit the user of the DCD, but which does not influence the design description, has caused problems when this information has become certified. For example, when this “helpful” information has changed or is no longer correct. In these cases, the end user may struggle to comply with the certified design, or contemplate an amendment request to change information that is not essential to the design or standardization policy goals. In other instances, content is included in the certified design that does not provide any useful information.

Lessons learned from existing certified designs and proposed DCAs indicate that the following areas could be improved:

- Standard Introduction, Section 1
- Minimization of DAC
- Elimination of the Initial Test Program from Tier 1
- Elimination of systems from Tier 1 that do not have any ITAAC (i.e. “No Entry”)
- Elimination of Component Numbers in Tier 1
- Minimization and simplification of Figures used in Tier 1
- Elimination of List of Acronyms and Abbreviations from Tier 1

b) Proposed Improvement

We propose the following improvements to enhance standardization of Tier 1 formatting and content in order to resolve confusion and regulatory inefficiencies revealed to date by industry’s development and implementation of ITAAC for DCAs and COLs. Standardized Tier 1 formatting and content would identify both the information that is appropriate to include in the DCA, and information which, although potentially useful, could complicate future compliance by a COL if it were included. This standardized Tier 1 formatting and content would improve regulatory predictability and enhance regulatory efficiency, and would not have any adverse safety consequences. It is important to note that none of

the items proposed for standard Tier 1 formatting and content detract from or are at cross-purposes to the NRC's policy on design standardization.

6.1. Standard Introduction, Section 1

Section 1 contains the definitions and general provisions used in Tier 1 and ITAAC. In particular, the general provisions describe the general format of ITAAC. Due to the nature of the contents, Section 1 could be standardized and adopted by any DCA. This section could include definitions for Unit Specific ITAAC and Shared ITAAC for multi-unit SMR facilities. A proposed standard Tier 1 Chapter 1 is included in Appendix A. The definitions used in Appendix A come from various NRC accepted sources, but may need to be adapted for SMRs.

6.2. Minimization of DAC

Historically, DCDs for certified designs have included the use of DAC in design areas where rapidly changing technology was involved or where design information was not complete (i.e., piping, radiation protection, digital I&C, and human factors). SMR design certification applications will continue to employ DAC, as appropriate, however its use can be minimized.

Consistent with the approach used in more recent DCDs and DCAs, it is not expected that SMR design applicants will be proposing the use of DAC in the area of radiation protection design. Separate discussions with the NRC regarding minimizing the use of piping DAC have already begun and are focused on defining the appropriate level of piping design completion without the use of DAC to provide the level of assurance needed by the NRC to make a safety finding in their safety evaluation report. The nuclear industry will monitor those activities for applicability to its improvement initiatives. It is likely, however, that SMR design applicants will continue to propose DAC for digital I&C and human factors engineering (HFE) as these design activities lend themselves more appropriately to the application of the DAC process due to their nature.

In consideration of the above, this proposal stresses that the design activities for these types of shared facility applications are appropriate for treatment as Shared ITAAC and, therefore, will be performed once and will be sufficient to close out the DAC. For example, the design process for completing piping design for identical units in a multi-unit facility is performed and completed only once but is implemented as many times as there are identical units. Likewise, the design processes for digital I&C are performed and completed only once. Additionally, the design process associated with HFE is performed and completed only once for the entire facility as it is applicable to the entire facility.

Based on the above discussions, our proposed approach is to develop a process to close DAC once and obtain agreement from the NRC such that SMR DC applicants could include a description of this process in Tier 2, Section 14.3. This proposed DAC closure process is consistent with a similar process described in the ESBWR DCD, Tier 2, Section 14.3A, for closure of DAC for a lead ESBWR unit that would also be applicable to subsequent ESBWR units. This process would be applicable to systems that are shared by multiple units of a facility as well as unit specific systems. Additionally, the discussion would clarify that verification of the implementation of the design for each unit via Unit Specific ITAAC would be performed as applicable. This approach dovetails with the proposal on Unit Specific and Shared ITAAC.

6.3. Elimination of the Initial Test Program from Tier 1

There is no regulatory requirement for a DC applicant to provide a description of the initial test program (ITP) in the design control document (DCD); however most DCAs include a discussion of the ITP in their Tier 1 document that represents a commitment that COL applicants referencing the certified design will implement an ITP. The summation for most ITP descriptions in these Tier 1 sections is that ITAAC are neither necessary nor required to verify implementation of the ITP. Inclusion of the ITP in Tier 1 is 1) unnecessary because it is duplicative of requirement in 10 CFR 52.79(a)(28), and 2) creates an undue burden on the COL applicant by requiring a License Amendment Request and Exemption to make changes to the ITP.

DCAs also typically include a discussion of the ITP and test abstracts in Tier 2, Section 14.2, of the DCD. Although not required by regulations associated with DCAs, this is as a matter of practicality since the design applicant knows the operation and testing requirements for its design. Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants", Rev. 4 also recognizes these facts. If a COL applicant desired to change the information regarding the ITP, then they could make changes via the 10 CFR 50.59 or 50.59-like change process rather than via license amendment and exemption process.

Based on the above discussion, it is proposed that SMR DCA's not include a Tier 1 section that provides a discussion of the ITP and a commitment for a COL to implement an ITP. DC applicants will continue to include a discussion of the ITP in Tier 2.

6.4. Elimination of systems from Tier 1 that do not have any ITAAC (i.e. "No Entry")

Historically, DCDs for certified designs have included a complete listing of the systems that comprise the certified design in the Table of Contents and in the body of the Tier 1 document. Not all systems included in those lists were considered to require ITAAC for verification of acceptance criteria associated with top-level design requirements or safety-related or risk-significant design functions. The Tier 1 Table of Contents identified those SSCs that did not require ITAAC by system/structure titles that were underlined and footnoted to indicate that only the system title was provided and there were no ITAAC for this system. In addition, there were no design descriptions provided for those systems/structures in the associated section in the body of the Tier 1 document.

SSCs that do not require ITAAC are screened out using appropriate project procedures that are based on NRC guidance contained in NUREG-0800, Design Specific Review Standards, and in Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)". Many DCDs have included the results of these ITAAC screenings in Tier 2, Section 14.3, and clearly identified those SSCs that do not need verification by ITAAC. Therefore, including system titles in Tier 1 for systems that do not have ITAAC appears to be unnecessary and not consistent with the first principles for inclusion of SSCs in ITAAC. In addition, including system titles in Tier 1 for systems that do not have Tier 1 design descriptions or ITAAC does not appear to be consistent with the intent of the goals of nuclear power plant standardization as such system standardization would be in name only. Finally, inclusion of system

titles imposes an unnecessary and overly burdensome change process associated with Tier 1 information for a COL that references such a design.

Based on the above discussion, the proposed resolution is that SMR DCA's not include system titles in the Table of Contents and body of Tier 1 for those systems that have been determined to not require Tier 1 design descriptions or ITAAC. The results of the ITAAC screenings of SSCs will continue to be provided in Tier 2, Section 14.3, and will clearly identify those SSCs that require ITAAC and those that do not require ITAAC. A description of the system will still be provided in Tier 2 for the certified SMR design without the need for system titles to be included in the Tier 1 document.

6.5. Elimination of Component Numbers Used in Tier 1

It is problematic when actual component numbers or tag numbers, as shown in Tier 2, are used in Tier 1 and become certified material, because these actual numbers are subject to change during the COL and construction processes. In order to change these numbers, a COL applicant would need to request a License Amendment Request and Exemption, which would be an unnecessary burden for a change that does not affect any high level design or performance characteristic and is not necessary for standardization of the design.

Based on the above discussion, the proposed resolution is that a generalized component identifier or a descriptive identifier will be used in Tier 1. This will provide the same level of information as previous DCAs, and would not result in complications by certifying actual component numbers.

6.6. Minimization and Simplification of Figures Used in Tier 1

Previous DCAs have included figures that are not necessary, as they are not needed to describe a high level design or performance characteristic and are not necessary for standardization of the design. Many times the information required for Tier 1 is already included in the text of the design description or in a table. As such, the proposed resolution is that a figure only be included in Tier 1 if it is necessary to describe something that cannot be adequately described in the design description and tables in Tier 1. To the extent figures are included in Tier 1, figure legends will be provided in Tier 2 only to avoid past problems with maintaining legends in accordance with Tier 1 change control requirements.

6.7. Elimination of List of Acronyms and Abbreviations in Tier 1

The List of Acronyms and Abbreviations in Tier 1 duplicates the list of acronyms and abbreviations in Tier 2. Including the list in the Tier 1 certification rule, while potentially useful to the user of Tier 1 information, can result in complications for COL applicants that reference the certified design. Inclusion of the list of acronyms and abbreviations imposes an unnecessary and overly burdensome change process associated with Tier 1 information for a COL that references such a design. Thus, it is proposed to not include the List of Acronyms and Abbreviations in Tier 1.

CHAPTER 5 - PROPOSED PATH FORWARD FOR ITAAC IMPROVEMENTS

The next DC applications are expected to be for SMR designs, with a few currently scheduled to be submitted in 2014 and 2015. Therefore, an expedited schedule to develop Tier 1 and ITAAC improvements is needed to enable the near-term applicants to benefit from these improvements. The extent to which Tier 1 and ITAAC improvements can be developed and implemented by these near-term applicants also depends upon whether a phased DCA submittal alternative would be acceptable to the NRC. Industry proposed this alternative in NEI letter to the NRC *"Request for NRC Acceptance of an Alternative Process for Small Modular Reactor Design Certification Application Submittals,"* dated December 20, 2013 [ML13357A751 and ML13357A752] and is awaiting NRC's response.

This paper discusses the following proposed improvements:

- Standardized ITAAC
    1. Clarify ITAAC scope by establishing standardized ITAAC types
    2. Clarify ITAAC meaning by establishing standardized ITAAC language
- ITAAC Processes
    3. Create a process to close ITAAC prior to installation in the final location
    4. Create a process to close ITAAC only once for SSCs that are shared by multiple reactor units
- Standardized Tier 1
    5. Establish standardized Tier 1 organization
    6. Clarify Tier 1 by establishing standardized Tier 1 formatting and content

Industry understands that the NRC has begun updating NUREG-0800 "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP) Section 14.3 and related sub-sections. It is anticipated that the NRC's update of the SRP will address improvements for Standardized ITAAC. Industry is willing to submit more detailed proposals in order to facilitate NRC consideration and endorsement of them. This includes developing guidance to address all or a portion of the proposed improvements in a manner that complements NRC's update to the SRP.

In order to support near-term DC applicants, issuance of final guidance and NRC endorsement of ITAAC improvements is desired by the end of 2014. In order to achieve this schedule, NRC agreement on the issue descriptions and proposed Tier 1 and ITAAC improvements described in this paper are desired as soon as possible. This would permit issuance of draft guidance, and if necessary more detailed proposals, to be submitted in mid-2014.

APPENDIX A – STANDARDIZED TIER 1 CHAPTER 1

CHAPTER 1 - INTRODUCTION

1.1 Definitions

The definitions below apply to terms which may be used in the Design Descriptions and associated Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC).

Acceptance Criteria refers to the performance, physical condition, or analysis result for a structure, system or component (SSC), or program which demonstrates the Design requirement/Commitment is met.

Analysis means a calculation, mathematical computation, or engineering or technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar SSC.

As-built means the physical properties of a SSC following the completion of its installation or construction activities at its final location at the plant site. In cases where it is technically justifiable, determination of physical properties of the as-built SSC may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

ASME Code means Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

ASME Code Data Report means a document which certifies that a component or system was constructed in accordance with the requirements of the ASME Code. Code Data shall be recorded on a form approved by the ASME.

Component, as used in Tier 1 for reference to ASME Code components, means a vessel, concrete containment, pump, pressure relief valve, line valve, storage tank, piping system, or core support structure that is designed, constructed, and stamped in accordance with the rules of the ASME Code.

Design Acceptance Criteria (DAC) are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. DAC are designated as "{{DAC}}" in the inspections, tests, and analyses column and acceptance criteria column of the ITAAC tables where appropriate.

Design Commitment means that portion of the Design Description that is verified by ITAAC.

Design Description means that portion of the design that is certified.

Component Identification Number or **Component Identifier** as used in Tier 1 means the component designation in a Tier 1 table or on a Tier 1 figure. That number may not be representative of an actual component number or tag number.

Inspect or Inspection mean visual observations, physical examinations, or reviews of records based on visual observation or physical examination that compare a) the SSC condition to one or more Design Commitments or b) the program implementation elements to one or more program commitments, as applicable. Examples include walkdowns, configuration checks, measurements of dimensions, or non-destructive examinations.

Reconciliation or Reconciled means the reconciliation of differences between the approved design and the as-built plant feature. For ASME piping systems, it is the reconciliation of differences between the approved design and the as-built piping system. For structural features, it is the reconciliation of differences between approved design and the as-built structural feature.

Report, as used in the Acceptance Criteria column, means a document that verifies that the acceptance criteria of the subject ITAAC have been met and references the supporting documentation. The use of "A report concludes" is limited to use only in the Acceptance Criteria of Design Acceptance Criteria and design analysis ITAAC.

[for a modular design] **Shared ITAAC** means ITAAC that are associated with common or shared SSCs and activities that support multiple reactor units. This includes 1) SSCs that are common or shared by multiple reactor units, and for which the interface and functional performance requirements between the common or shared SSC and each unit are identical, or 2) analyses or other generic design and qualification activities which are identical for each unit (e.g., seismic and environmental qualification of equipment). For a multi-unit facility, satisfactory completion of a Shared ITAAC for the lead unit shall constitute satisfactory completion of the Shared ITAAC for all associated units.

Test means the actuation or operation, or establishment of specified conditions, to evaluate the performance or integrity of as-built SSC, unless explicitly stated otherwise, to determine whether an ITAAC acceptance criterion is met.

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

[for a modular design] **Unit Specific ITAAC** means ITAAC that are associated with SSCs that are specific to and support operation of a single individual reactor unit.

1.2 General Provisions

The following general provisions are applicable to the Design Descriptions and associated ITAAC.

1.2.1 Design Descriptions

The Design Descriptions in Tier 1 pertain only to the design of SSC of the standard design and not to their operation, maintenance, and administration after fuel load. In the event of an inconsistency between the Design Descriptions and the Tier 2 information, the Design Descriptions in Tier 1 shall govern.

The Design Descriptions include tables and simplified schematic figures in Tier 1 as required. The Design Description states the system purpose and safety functions. Also included in the Design Description are statements of whether or not the system is safety-related, system location, key design features, seismic and ASME Code classifications, interlocks, Class 1E power sources and divisions, significant performance characteristics, and interface requirements, as applicable.

The absence of any discussion or depiction of an SSC in the Design Description shall not be construed as prohibiting a licensee from utilizing such an SSC, unless it would prevent an SSC from performing its safety functions, or impairing the performance of those safety functions, as discussed or depicted in the Design Description.

When the term Physical Arrangement is used relative to a building, it refers to the arrangement of the building features (e.g., floors, ceilings, walls, basemat and doorways) and of the building within, as specified in the building Design Description.

When the term Functional Arrangement is used relative to a system, it refers to the arrangement of the system and components to provide the safety function for which the system is intended and that is described in the Design Description and as shown in the figures, as necessary.

In some cases, the Design Descriptions refer to matters that relate to operation, such as normal valve or breaker alignment during normal operation. Such discussions are provided solely to place the Design Description provisions in context (e.g., to explain automatic features for opening or closing valves or breakers upon off-normal conditions). Such discussions shall not be construed as requiring operators during operation to take any particular action (e.g., to maintain valves or breakers in a particular position during normal operation). When the term "operate," "operates" or "operation" is used with respect to a component discussed in the Acceptance Criteria, it refers to the actuation or control of the component.

1.2.2 Interpretation of Tables

In general, cells with no values have a dash to denote that the cell is "not applicable."

1.2.3 Interpretation of Figures

Figures are provided for some systems or structures with the amount of information depicted based on their safety significance. These figures may represent a functional diagram, general structural representation, or another general illustration. Unless specified explicitly, these figures are not indicative of the scale, location, dimensions, shape, or spatial relationships of as-built SSCs. In particular, the as-built attributes of an SSCs may vary from the attributes depicted on these figures, provided that those safety functions discussed in the Design Description pertaining to the figure are not adversely affected. Where figures are not required, generally for simple non-safety-related systems, the Design Description is sufficient to describe the system. Valve position indications shown on these figures do not represent a specific operational state.

1.2.4 Implementation of ITAAC

Design Commitments, Inspections, Tests, Analyses (ITA), and Acceptance Criteria (AC) are provided in tables with the following four-column format:

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria

Each Design Commitment in the Design Commitment column of the ITAAC tables has one or more associated requirements for Inspections, Tests or Analyses specified in the ITA column. The identification of a separate ITA entry for each Design Commitment shall not be construed to require that separate inspections, tests, or analyses must be performed for each Design Commitment. Instead, the activities associated with more than one ITA entry may be combined, and a single set of inspections, tests, or analyses may be sufficient to implement more than one ITA entry.

An ITA may be performed by the licensee or by its authorized vendors, contractors, or consultants. Furthermore, an ITA may be performed by more than a single individual or group, may be implemented through discrete activities separated by time, and may be performed at any time prior to fuel load (including before issuance of the Combined License for those ITAAC that do not require as-built equipment). Additionally, ITA may be performed as part of the activities that are required to be performed such as preoperational testing. Therefore, an ITA need not be performed as a separate or discrete activity. Testing of automatic control functions actuated by activity monitors, e.g., radiation or radioactivity monitors, can be performed at any value within the range of the activity monitors using an established trip setpoint. If a test requirement does not specify the temperature or other conditions under which a test must be run, then the test conditions are not constrained.

For those nonsystem-based ITAAC, which address piping and equipment qualification, the ITA and Acceptance Criteria may be satisfied on a system-by-system basis.

For the Acceptance Criteria, appropriate documentation may be a single document or a collection of documents that show that the stated Acceptance Criteria are met. Examples of appropriate documentation include design reports, test reports, inspection reports, analysis reports, evaluation reports, design and manufacturing procedures, certified data sheets, commercial dedication procedures and records, quality assurance records, calculation notes, and equipment qualification data packages.

APPENDIX B – TABLE OF STANDARDIZED ITAAC TYPES

{The Table of Standardized ITAAC Types is incorporated by reference and is labeled "ATTACHMENT 2".}