Structural Information in Tier 1 Design Descriptions and ITAAC

This enclosure describes how the revised general principles for Tier 1 content will affect the Tier 1 structural design descriptions and inspections, tests, analyses, and acceptance criteria (ITAAC) for buildings within the scope of a certified design.

Background

The main body of this paper describes why design certifications have been organized into tiers, the principles for determining what information goes into each tier, and the applicable change processes for each tier. As discussed therein, design information has been designated as Tier 1, Tier 2, or Tier 2* in the certifications issued to date. Tier 2 has detailed design information for the plant, and a 50.59-like process applies to departures from Tier 2. Tier 1 is similarly broad in scope but has much less detail. Departures from Tier 1 require an exemption.

Departures from Tier 2* require a license amendment. As stated in SECY-17-0075, the Tier 2* designation should be applied to information only if it would qualify for inclusion in Tier 1 based on safety significance and there is a demonstrated need for the flexibility of the Tier 2* change process. Although the issued design certifications have Tier 2* information, the Advanced Power Reactor 1400 (APR1400) design approval and the NuScale design certification application do not have Tier 2*.

As discussed in the staff requirements memorandum for SECY-90-377, decisions on what information is included in Tier 1 are made during the staff's review. In practice, each applicant has proposed information to be included in Tier 1, and the staff has evaluated this information and engaged with applicants until there has been an agreement on the content of Tier 1. A similar process has been applied to Tier 2*. The issued design certifications include structural information in both Tier 1 and Tier 2*.

The amount of structural information in Tier 1 and Tier 2* has been evolving. For AP1000 buildings, the Tier 1 design description includes brief narrative descriptions, building diagrams, and detailed tables defining each wall, floor, and ceiling (including thicknesses and locations). Also, the AP1000 includes Tier 2* information in the following categories: (1) nuclear island structural dimensions, (2) a design summary of critical sections, (3) structural codes, (4) the definition of critical locations and thicknesses, (5) seismic qualification methods and standards, and (6) steel composite structural module details. The APR1400 design, which has been approved by the staff and is in the design certification rulemaking phase, has structural information in Tier 1 that is similar to the Tier 1 information in the AP1000. However, the APR1400 does not have Tier 2* information. Some of the information that was designated as Tier 2* in the AP1000 is in the APR1400 Tier 1 (e.g., structural codes, demand/capacity ratios for critical sections).

Through experience associated with the construction of Vogtle Units 3 and 4, the staff has learned that NRC approval has been required for departures from the AP1000 that have minimal safety significance. This has caused the staff to reevaluate what information should be included in Tier 1. The principles for determining what information should be in Tier 1 also apply to Tier 2*, as discussed in SECY-17-0075, with the exception of principles specifically pertaining to ITAAC, because ITAAC are in Tier 1 and not Tier 2*.

Structural Information That Should Generally Be Included in Tier 1 Design Descriptions and ITAAC

A list of the general principles for Tier 1 content is provided below. These include the general principles contained in Standard Review Plan (SRP) Section 14.3, as revised and supplemented by the main body of this paper.

- Tier 1 should include "the top-level design features and performance characteristics" that are "the most significant to safety."
- Tier 1 descriptions should typically be at a qualitative and functional level of detail.
- The level of detail is governed by a graded approach based on safety significance.
- Tier 1 should not include detail that could necessitate NRC approval for departures from the certified design that have minimal safety significance. Nonetheless, Tier 1 should still reflect the specific safety-significant features of the design and not just include general statements that apply to classes of reactors.
- The acceptance criteria in ITAAC should generally be "objective and unambiguous." This can be accomplished if the acceptance criteria clearly state the functional requirement and Tier 2 describes detailed methodologies and criteria for verifying that the functional requirement has been met.
- Numeric values in Tier 1 should be minimized. Numeric values could be used for basic design descriptions (e.g., numbers of modules) or where a deviation from the value clearly indicates a failure to meet fundamental design criteria. Otherwise, specific numeric values should be only in Tier 2.
- The use of codes and standards in Tier 1 should be minimized, as discussed in SRP Section 14.3. If a code is referenced in Tier 1, the specific edition, date, etc. should be specified in Tier 2 rather than Tier 1 to provide flexibility.

Applying these principles to the structural review, the staff has determined that Tier 1 design descriptions and ITAAC should generally include the following elements:

- The Tier 1 design description should include the following information, typically at a qualitative and functional level of detail:
    - The name of the building
    - The safety classification of the building
    - A description of each of the functions the structure performs, including that the structure maintains its integrity under design basis loads
    - General building arrangement, including major structural elements
    - A description of how the structure and its basemat are embedded in the ground
    - Materials of the building's structural elements (e.g., structural steel, reinforced concrete, composite of specific materials, etc.)
    - The major systems contained within the structure, their safety significance, and their general layout.
- To describe the items listed above, the applicant may choose to provide a combination of figures, tables, and text.
- For the structural integrity review, the ITAAC would generally be sufficient if they require verification through inspection and analysis (1) that the as-built safety-significant structures maintain their structural integrity under design basis loads in accordance with the supporting Tier 2 information, and (2) that as-built Seismic Category I structures are appropriately protected from adverse interaction with structures, systems, and

components that are not Seismic Category I. The specific analysis methods and acceptance criteria would reside in Tier 2.

These elements do not comprehensively describe all structure-related information that should be in Tier 1. For example, Tier 1 should also include information on other technical disciplines that involve structural elements, such as flooding and fire protection. Where this information appears in Tier 1 would depend on how the applicant organizes Tier 1, but, wherever it appears, interfaces with the structural design descriptions in Tier 1 should be discussed.

Compared with issued design certifications, the staff's new approach to Tier 1 content should significantly reduce the amount of structural design information for which departures automatically require NRC approval. As an example, from a structural integrity perspective, the following information would ordinarily not need to be included in Tier 1 (or Tier 2*):

- The structural codes and seismic analysis methods that were designated as Tier 2* for the AP1000;
- The critical section, critical location, and structural module descriptions that were Tier 2* for the AP1000; and
- Numeric values, such as structural dimensions and thicknesses, that were Tier 1 or Tier 2* for the AP1000.

This information could reside in Tier 2 and would be adequately controlled by a 50.59-like process from a structural integrity perspective. However, some numeric values (e.g., wall thicknesses) might also be relevant to other technical disciplines. A design certification applicant and the staff would need to assess the other uses of this numeric information and whether the relevant safety issues warrant Tier 1 treatment. If Tier 1 treatment is justified, it would be preferable to address the safety issues through less-detailed Tier 1 functional requirements instead of numeric detail.