

The U.S Nuclear Regulatory Commission Staff’s Comments Regarding Terrestrial Energy’s Methodology for Safety Classification of Integral Molten Salt Reactor (IMSR®) Structures, Systems and Components White Paper

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Note: **[[]]** denotes proprietary information.

1. Introduction

Terrestrial Energy USA, Inc. (TEUSA), submitted a white paper that describes the methodology used by Terrestrial Energy Inc. (TEI) for classifying structures, systems, and components (SSCs) of the IMSR® design. In the white paper, TEUSA states that it will be implementing and referencing the TEI’s design guides that specify the safety design criteria, except when specifically noted otherwise. The white paper correlates the safety classification categories used in license applications with the Canadian Nuclear Safety Commission (CNSC) to the SSC classification categories used in license applications with the U.S. Nuclear Regulatory Commission (NRC). TEUSA requested that the NRC staff review this white paper and provide written comments on areas where the white paper does not provide sufficient detail for the NRC staff to have a clear understanding of the methodology for safety classification of IMSR® SSCs. TEUSA also stated that written comments should be limited to areas where additional information on SSC classification methodology will be necessary to support a future license application.

Based on the request, the NRC staff focused its review on aspects that are needed for clear understanding of the methodology and are relevant to the NRC regulatory requirements and guidance on SSC classification. The NRC staff makes no regulatory findings in this document.

2. NRC staff comments

- a) The white paper states on page 3 that “The safety classification terminology used during the CNSC vendor design review will be translated to the traditional safety-related and non-safety related classifications used in licensing applications with the U.S. Nuclear Regulatory Commission.” On page 8, it also states that

[[[REDACTED] **]]**

The white paper subsequently states that **[[** [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

The NRC staff provides the following two comments on the discussion above.

- (1) The NRC's 'traditional' SSC classification is based on the definition in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.2, "Definitions," for safety-related SSCs¹. The white paper does not refer to this NRC definition of safety-related SSCs. The white paper should explain how the three categories above are related to the 10 CFR 50.2 definition.
- (2) The NRC staff's review is based on the understanding that TEUSA is not following the Licensing Modernization Project (Nuclear Energy Institute (NEI) 18-04²). The NRC staff notes that the three categories defined above are similar to, but not the same as, the SSC classification categories in NEI 18-04.

The NRC staff notes that the SSC classifications in NEI 18-04 are based on an integrated risk-informed and performance-based evaluation of the plant that includes a probabilistic risk assessment, identification of licensing basis events, and adequacy of defense-in-depth, in addition to SSC classifications and associated performance requirements and special treatment. In other words, NEI 18-04's SSC classifications should be understood with the underlying context of the integrated risk-informed and performance-based evaluation. Comparing TEUSA's proposed SSC classification to the SSC classification categories of NEI 18-04 can be complete or technically justifiable if an integrated evaluation that is similar or equivalent to the NEI 18-04 process is conducted by TEUSA.

- b) The white paper states that it [REDACTED]

The NRC staff requests that future submittals include discussion of how the specific NRC regulatory requirements regarding SSC classification and a

¹ *Safety-related structures, systems and components* means those structures, systems and components that are relied upon to remain functional during and following design basis events to assure:

- (1) The integrity of the reactor coolant pressure boundary
- (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

² NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development"

discussion on how such regulatory requirements are met. Discussion of pertinent NRC requirements can be found in regulations such as, 10 CFR 50.2, 10 CFR 50.49, "Environmental qualification of electric equipment important to safety for nuclear power plants," and 10 CFR Part 21, "Reporting of defects and noncompliance," for example. An exemption is needed for these regulatory requirements if the safety classification of SSCs is not in compliance with the 10 CFR 50.2 definition of safety-related SSCs.

- c) The white paper states on page 8 that [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

The NRC staff reads this criterion to be that SSCs available following anticipated operational occurrences (AOOs) are generally classified as [REDACTED] in accordance with the CNSC requirements and as safety-related in accordance with the U.S. SSC classification categories as defined by TEUSA above. The U.S. SSC classification category above for [REDACTED]

[REDACTED] Also, in [REDACTED] A discrepancy regarding the classification of SSCs available following AOOs appears to exist within TEUSA's white paper. The NRC staff requests that the discrepancy be resolved in order to clearly understand the methodology.

- d) On page 3, the white paper states "The 'basic nuclear safety functions' and the 'nuclear safety design practices' that are the basis of the IMSR® design safety case are provided in this white paper with references to the other relevant design guides."

The expressions 'basic nuclear safety functions' and 'nuclear safety design practices' should be defined or explained for clarity.

- e) On page 9, under IMSR Safety Category 3, it states [REDACTED]
[REDACTED] In addition, on page 16 under Section VI., "Abbreviations and Acronyms," the following exists:

DEC – Design Extension Conditions (BDBA)

The NRC staff requests that TEUSA explain the definition of a design extension condition as is used in TEI documentation and its comparison with a beyond-design-basis accident (BDBA) as used for the NRC. Design extension conditions are not the same as BDBAs per NRC requirements.

- f) On page 10, the white paper states [REDACTED]
[REDACTED]

The expression [REDACTED] should be defined along with how they are used in the SSC classification process.

g) The white paper states on page 11:

[REDACTED]

In addition, the white paper includes reference documents in other areas. It is not clear what are the roles of the referenced documents listed in the white paper regarding the NRC staff's review of this white paper. The NRC staff has not reviewed the details of these documents. TEUSA should clarify its expectations pertaining to NRC review of these documents if referenced in future submittals.

h) The white paper uses expressions for SSCs differently. Examples, in addition to SSCs, include:

- [REDACTED]

The NRC staff suggests the consistent use of the expressions throughout the document and in all license application documents and other documents that may be submitted to the NRC staff for formal review. If different expressions are used, they should be clearly defined including their relationship to SSCs.

i) The white paper uses the expression [REDACTED] For example, on page 7, it states [REDACTED]

[REDACTED]

[REDACTED]

It is not clear to the NRC staff what the [REDACTED] are as stated in the white paper. [REDACTED] It should be defined or explained for clarity.

- j) On page 14, [REDACTED]

Please explain the meaning of the [REDACTED] This information should be used consistently and clearly incorporated in all license application documents and other documents that may be submitted to the NRC staff for formal review, as appropriate.

[REDACTED]