TERRESTRIAL
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Methodology for Safety Classification of IMSR® Structures, Systems and Components

Abstract
This white paper describes the methodology for establishing the safety classification of structures, systems, and components (SSCs) of the Integral Molten Salt Reactor (IMSR®) design. The white paper correlates the safety classification categories used in license applications with the Canadian Nuclear Safety Commission to the safety classification categories used in license applications with the United States Nuclear Regulatory Commission.

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Non-Proprietary

Contents

I. Purpose

The purpose of the white paper is to describe the methodology used by Terrestrial Energy Inc. (TEI) to establish the classification of SSCs that comprise the IMSR400 facility. The safety classification terminology used during the Canadian Nuclear Safety Commission (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. TEI design guides specify the safety design criteria required to meet Terrestrial Energy's objective of ensuring public safety, which includes meeting or exceeding the licensing requirements issued by the Canadian Nuclear Safety Commission (CNSC) and U.S. Nuclear Regulatory Commission (NRC). Terrestrial Energy USA (TEUSA) will be implementing and referencing the TEI design guides to support its domestic U.S. licensing goals, expect when specifically noted otherwise.

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 requirements in these design guides provide the basis for the design requirements that are applied to each SSC, so that overall, the plant meets worker and public safety requirements.

II. Introduction

Licensing Strategy and Objective

Terrestrial Energy USA's (TEUSA) long-term licensing objective for the commercial deployment of the IMSR® design in the U.S. is to first obtain an SDA for the IMSR® Core-unit under 10 CFR Part 52, Subpart E. The IMSR® Core-unit represents a significant technical portion of the IMSR® facility and consists of the following primary components:

a. Reactor Vessel (RV) (this includes the vessel, chimney, downcomer duct, reactor core supports, reactor core support plates, insulation, and thimbles).

b. Core (also referred to as the Reactor Moderator).

c. Primary Heat Exchangers (PHXs); and

d. Primary Pumping System.

TEUSA has developed and submitted a Regulatory Engagement Plan (REP) (Reference 1) to the NRC. The REP outlines a series of technical documents which TEUSA plans to submit to the NRC for review and comment or review and approval. Consistent with the REP, TEUSA has submitted several white papers that have 1) provided an overview of major plant buildings and SSCs that make up the IMSR® facility, 2) identified the interfacing systems that provide important functions in support of the operation and safety of the IMSR® facility, and that interact directly with the IMSR® Core-unit, 3) provided a proposed set of principal design criteria (PDC) that will be used for the IMSR® facility, and 4) provided a preliminary set of postulated initiating events (PIEs). The TEUSA REP provides additional details regarding TEUSA's licensing activities and objectives.

III. Scope

The objective of safety classification of SSCs is to identify those SSCs that perform safety functions within the design envelope of the plant and establish their relative importance to ensure that the SSCs are designed, constructed, fabricated and maintained to the appropriate quality and reliability commensurate with their importance to safety. While the business plan for the IMSR400 has evolved towards a two-unit per site configuration, the number of units per site will not affect the methodology for classification of SSCs for the IMSR® plant because there is no intent to share safety systems between operating units. The scope of assessment for the methodology is the complete complement of SSCs that comprise the IMSR® plant.

IV. Safety Classification Process

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V. Correlation of Safety Categories

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VI. Abbreviations and Acronyms

ASME – American Society of Mechanical Engineers

AOO – Anticipated Operational Occurrence

BDBA – Beyond Design Basis Accidents

CNSC – Canadian Nuclear Safety Commission

CSA – Canadian Standards Association

DBA – Design Basis Accident

DG – Design Guide

DEC – Design Extension Conditions (BDBA)

IMSR – Integral Molten Salt Reactor

IRVACS – Integral Reactor Vessel Auxiliary Cooling System

NRC – Nuclear Regulatory Commission

NSRST – Non-safety related with special treatment

PIE – Postulated Initiating Event

PD – Principal Design Criteria

PSA – Probabilistic Safety Assessment

SC – Safety Category

SCL – System/Safety Classification List

SDA – Standard Design Approval

SFC – Single Failure Criterion

SRD/E – System Responsible Designer/Engineer

SSC – Structure, System and Component

TEI – Terrestrial Energy Inc.

VII. References

1. TEUSA, "Integral Molten Salt Reactor (IMSR®) – U.S. Regulatory Engagement Plan,"
2. CNSC Regulatory Document, REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants, May 2014.
3. TEI Design Guide IMSR400-30000-DG-013, Defence in Depth
4. TEI Design Guide IMSR400-30000-DG-003, Qualifications of SSCs Important to Safety
5. TEI Design Guide IMSR400-30000-DG-001, General Safety Design Guide
6. TEI Design Guide IMSR400-30000-DG-002, Common Cause Events
7. TEI Design Guide IMSR400-30000-DG-005, Seismic Qualification of Safety Related Structures.
8. TEI Design Guide IMSR400-30000-DG-008, Means of Shutdown
9. TEI Design Guide IMSR400-30000-DG-007, Containment
10. TEI Design Guide IMSR400-30000-DG-010, Radiation Safety
11. IMSR400-30710-MAN-001, Manual Management System – Terrestrial Energy
12. CSA N286-12 Management System Requirements for Nuclear Facilities
13. CSA N299.1 Quality Assurance Program Requirements for the Supply of Items and Services for Nuclear Power Plants Category 1.
14. CSA N286.7 Quality Assurance of Analytical, Scientific and Design Computer Programs.
15. IMSR400-30711-PRO-009, Use of Experience.
16. IMSR400-30717-PRO-005, Information Management
17. IMSR400-30711-PRO-002, Design Work Planning
18. IMSR400-30711-PRO-008, Design Verification