# Technology Inclusive Management of Safety Case (TIMaSC) White Paper Outline

## I. Introduction

### A. Purpose and Scope

*This subsection will include the objectives that underly the fundamental purpose.*

*The high-level objectives of the TIMaSC effort are:*

- *Clarify how a risk-informed, performance-based (RIPB) safety case fits into the licensing basis for an advanced reactor under the existing NRC regulatory frameworks;*
- *Identify how changes to the RIPB safety case can be managed in a right-sized manner (i.e., such that the regulator can confirm reasonable assurance of adequate protection while optimizing focus on non-trivial changes);*
- *Prioritize future work to further reduce uncertainty and risk associated with the licensing of advanced reactors; and*
- *Socialize the outcomes, results, and insights with key stakeholders (including regulators and industry) to maximize alignment.*

*The purpose of this white paper is to provide information on (1) the scope of the guidance that will be developed as part of the TIMaSC effort and (2) the general approach that will be used to develop the guidance. Gaining alignment on these two elements before developing the guidance will maximize the efficiency of future interactions and project activities.*

### B. Perspective on Technology Inclusive RIPB Regulation

*This subsection will define the terms, describe the evolution in reactor regulation, and the rationale for applying RIPB approaches to advanced reactors. It will define an advanced reactor licensing basis (to be discussed in greater detail in Section II) that follows the NEI 18-04 approach to providing reasonable assurance of adequate protection of public health and safety during off-normal operations. Discussion in this subsection will distinguish between the scope of the "LMP-based safety case" and the advanced reactor licensing basis. It also will discuss the anticipated attributes of advanced reactors that facilitate the use of RIPB approaches for their regulation.*

### C. Background

1. NEI 18-04 and Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.233[1]
2. NEI 21-07 and NRC RG 1.253[2]
3. NRC Advanced Reactor Content of Application Project (ARCAP)[3]
4. NEI 22-05[4]
5. Other past and ongoing risk-informed, performance-based initiatives for advanced reactors
    - *10 CFR Part 53*[5]
    - *November 2023 NRC emergency preparedness rule (i.e., 10 CFR 50.160 and RG 1.242)*
    - *Draft proposed NRC security rule on Alternative Physical Security Requirements for Advanced Reactors*
    - *NRC siting guidance – draft revisions to RG 4.7*
    - *Advanced Reactor Construction Oversight Process (ARCOP)*
    - *Risk-informed codes and standards [e.g., ASME Section XI Division 2, OM-2, IEEE 497 2026 Edition, ASCE 43-19 (DG-1410)]*

## II. Advanced Reactor RIPB Licensing Basis

*This section will discuss, in detail, the holistic approach to the advanced reactor licensing basis, including the treatment of defense-in-depth. It will introduce the Network Diagram (see Figure 1 for illustration) and address the relationship between the different elements. Note that Figure 1 is an early version that is expected to evolve as the White Paper progresses.*

*The starting point for defining the scope of an advanced reactor licensing basis is the list of elements in DANU-ISG-2022-01, "Interim Staff Guidance: Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap." Additional insights can be gained from the Southern Company white paper entitled "Follow-on RIPB Implementation Guidance Needed for Advanced Non-Light Water Reactors" (ML21237A051).*



[1] Often referred to as the Licensing Modernization Project or LMP, the NEI document and its associated RG describe a process for advanced reactors for establishing licensing basis events; categorizing structures, systems, and components and associated special treatments for those that are safety-significant; and establishing adequate defense-in-depth.

[2] Often referred to as the Technology Inclusive Content of Application Project or TICAP, the NEI document and its associated RG address the content of portions of the safety analysis report for an advanced reactor following LMP.

[3] A compendium of guidance documents addressing advanced reactors seeking regulatory approval under 10 CFR Part 50 or 52.

[4] Often referred to as the Technology Inclusive Risk Informed Change Evaluation or TIRICE, the draft NEI guidance document addresses change control for advanced reactors following LMP.

[5] A risk-informed, performance-based regulation for advanced reactor licensing under development by the NRC.

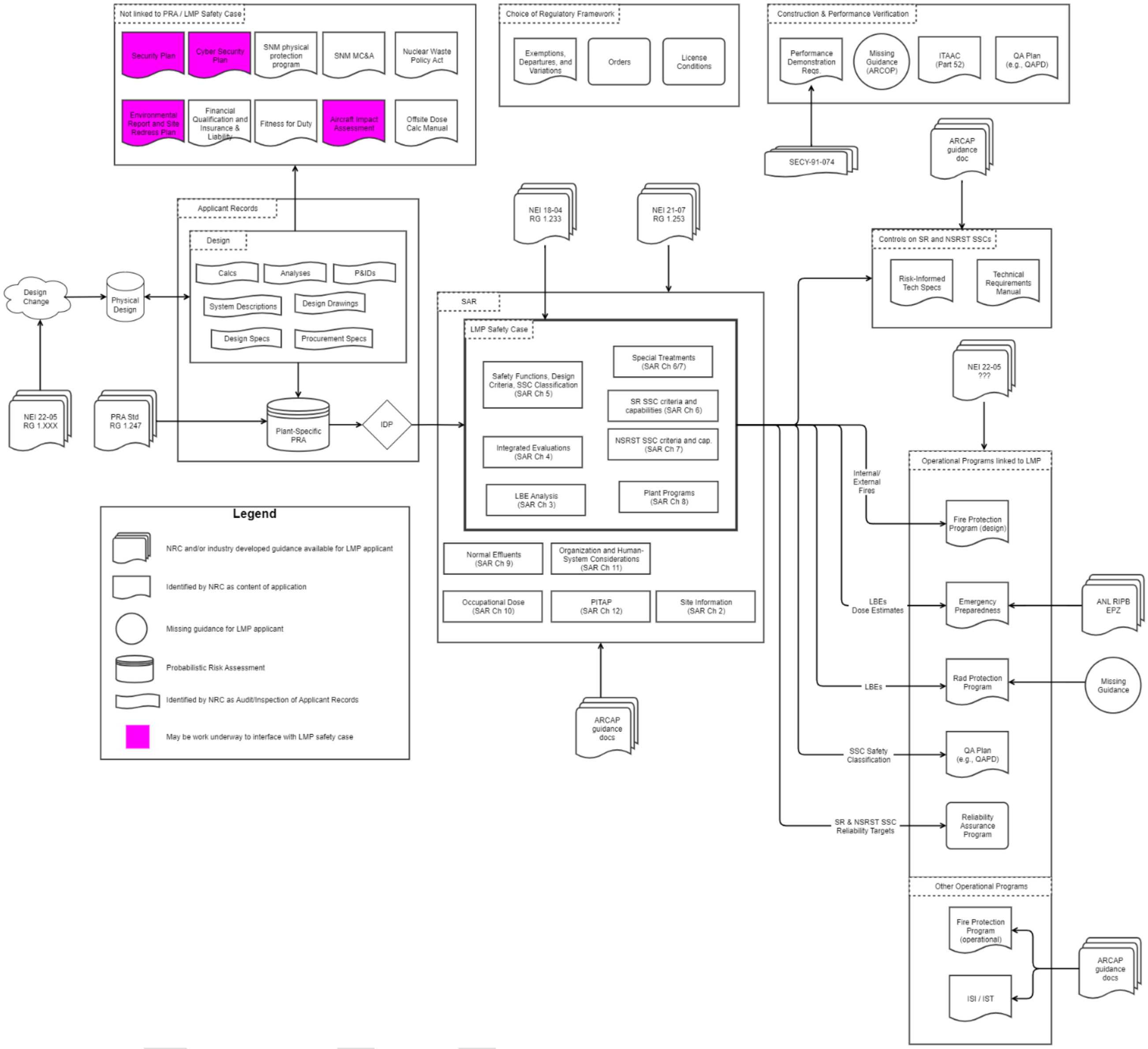


Figure 1: Preliminary draft of advanced reactor licensing basis network diagram

# III. Probabilistic Risk Assessment (PRA)

*A reactor technology and design-specific PRA plays a central role in the establishment and maintenance of the licensing basis for reactors following NEI 18-04. Because of the use of the PRA to assess the design and performance of structures, systems, and components within a facility, it is acknowledged that changes in PRA results (which are influenced by a variety of factors) may lead to alterations in the LMP-based safety case and potentially other elements of the licensing basis.*

*It is anticipated that the existing guidance (e.g., NEI 22-05) provides an approach to managing some, but not all, of the changes to the licensing basis that may result from changes to the PRA. One potential gap is related to changes in analytical methods that do not affect the outcomes of the LMP methodology. To this end, this section will provide background and describe the state-of-the-practice of the methodology, especially as it relates to changes to the PRA and PRA results. It will address the following topical areas, and possibly others.*

## A. Evolution of Advanced Reactor PRAs

## B. Role of PRA in Establishing the Licensing Basis under NEI 18-04

## C. Non-LWR PRA Standard[6] and Supporting Peer Reviews

## D. PRA Configuration Control, Updates and Change Management[7]

*Note that this topic includes the analytical methods used in the PRA. Changes to analytical methods used in the PRA may be more significant for the licensing basis of an advanced reactor that uses the LMP methodology (compared to the current fleet) given that the PRA model is more likely to involve detailed analysis (e.g., systems-level modeling) to support calculation of a dose consequence for licensing basis events.*

## E. Changes in the State of Knowledge

## F. Cautions and Limitations

# IV. Potential Areas for Inclusion in TIMaSC Report

*This section will discuss specific topic areas that impact the advanced reactor licensing basis and are amenable to RIPB treatment due to their compatibility with the LMP-based safety case. These areas could be covered in the TIMaSC product. More specifically, the goals of the TIMaSC guidance will be to (1) identify the linkage between a given element of the licensing basis and the LMP-based safety case and (2) provide an approach for evaluating the regulatory threshold(s) associated with changes to an element of the licensing basis. Examples of criteria*

[6] ANSI/ASME/ANS RA-S-1.4-2021, Probabilistic Risk Assessment Standard for Advanced Non-Light Water Reactor Nuclear Power Plants.

[7] With the increasing role of risk-informed programs for light water reactors, the NRC is very interested in the topic of PRA configuration control [see NRC Operating Experience Smart Sample (OPpESS) 2023/22]. The need for periodic PRA updates is recognized in the non-LWR PRA Standard, but a formal PRA update is a labor intensive and costly process.

*that are used in NEI 22-05 to determine when the NRC must review and approve a proposed change to a facility before implementation include (but are not limited to) risk-significance of LBEs and/or changes to SSC classification.*

### A. Aircraft Impact (accidental)

*Accidental aircraft impact is distinguished here from the Aircraft Impact Assessment required by 10 CFR 50.150.*

### B. Emergency Preparedness

*An ongoing project by Argonne National Laboratory is developing guidance for determining portions of the Emergency Preparedness program using information contained in the LMP-based safety case.*

### C. Physical and Cyber Security

*The recent development of alternate physical security requirements under Part 73 and cyber security guidance in Part 53 may enable these elements of the licensing basis to be tied to risk and/or an LMP-based safety case.*

### D. In-service Inspection / In-service Testing (ISI/IST)[8]

## V. Areas for Further Discussion

*This section will discuss specific topic areas that are potentially related to an LMP-based safety case but for which no decision has been made to include in the TIMaSC report. This list will include areas that may be appropriate for guidance for a licensee using the LMP methodology, but for which no clear guidance currently exists and none is apparently forthcoming.*

### A. Risk-informed Technical Specifications[9]

*It is generally expected that Risk-Informed Technical Specifications (RITS) could be affected by changes to the LMP-based safety case; however, without established guidance on how RITS will be derived from and/or linked to the LMP methodology, it may be difficult to provide clear guidance on how these changes can be managed and/or evaluated for importance from a safety perspective.*

### B. Quality Assurance and Quality Implementing Activities

*The Quality Assurance Plan is likely to be described at the programmatic level such that changes to the LMP-based safety case may not affect the plan itself; however, some quality implementing activities (e.g., Design Control or Procurement) may change as a result of changes to the LMP-based safety case.*

[8] See DANU-ISG-2022-07 Risk-informed ISI

[9] See DANU-ISG-2022-08 Risk-informed Tech Specs

### C. Reliability Assurance Program[10]

### D. Reactor Oversight Process[11]

### E. Fire Protection

### F. Risk Metrics[12]

# VI. Summary

## Appendix A – Areas Not Covered

*This appendix will address briefly those areas that are not included in TIMaSC, and why they are not. This list would essentially cover licensing basis elements that are not amenable to being made RIPB via the use of the LMP methodology by a licensee (e.g., those in the upper left of the Network Diagram, see Figure 1).*



[10] See (i) DANU-ISG-2022-01 ISG Roadmap and (ii) NUREG-0800, Section 17.4.

[11] The current form of the Reactor Oversight Process began use around 2000 and has been applied exclusively to light water reactors. The current form incorporates RIPB elements into its overall framework.

[12] Commonly used risk metrics for light water reactors are core damage frequency and large early release frequency, which are technology-specific surrogates for risk to public health and safety. Such metrics are unlikely to be suitable or, in some cases even usable, for advanced reactors.