Workshop #1

Advanced Reactor Digital I&C Licensing

February 23, 2023

NUCLEAR ENERGY INSTITUTE

Industry Team Overview

- Representation from:
  - 8 Advanced Reactor Vendors
  - 4 Licensing Consultant Firms
  - 2 Industry Groups (including NEI)
- Maintaining communication with NEI Digital I&C task forces and executive working group
- Regular meetings to identify generic issues and questions

Licensing Modernization and Design Review Guide

Questions – Design Review Guide

Design Review Guide (DRG): Instrumentation and Controls for Non-Light-Water Reactor (Non-LWR) Note 1 states:

> *The DRG was developed to address the immediate needs associated with the non-LWR community. Since the DRG is technology inclusive, it may be used for the review of LWR plant designs and other reactor technologies.*

Question 1: Please clarify any dependencies between NUREG-0800 (or NUREG-1537) and the DRG. Our understanding is the DRG is mutually exclusive of any other review guidance.

Question 2: For Advanced Reactor designs that are considered LWR plant designs, please provide clarification whether there are any restrictions to the use of the DRG.

Questions – Licensing Basis Events

NEI 18-04 Section 3.2.2, Task 5a provides direction to assign a Required Safety Function(s) (RSF) for high-consequence Beyond Design Basis Events (BDBEs). Task 5b further states:

> *SR SSCs are also selected for any RSF associated with any high-consequence BDBEs in which the reliability of the SSC is necessary to keep the event in the BDBE frequency region.*

DRG Section X.2.2.1.3, Point 4 states:

> *Equipment that is not safety-related can be used to provide the diverse means provided it is of sufficient quality to perform the necessary function under the associated event conditions in a reliable manner.*

Questions – Licensing Basis Events

Question 1: LMP (and NEI 18-04 Figure 3-1, right) requires a quantitative PRA approach to determine Licensing Basis Events (LBEs); however, there is no consensus standard for determining software reliability quantitatively. Overly conservative quantitative values may result in the mis-classification of LBE's and/or associated SSC safety classification. Does the NRC plan to provide guidance on how to consider software reliability in the LBE selection process?

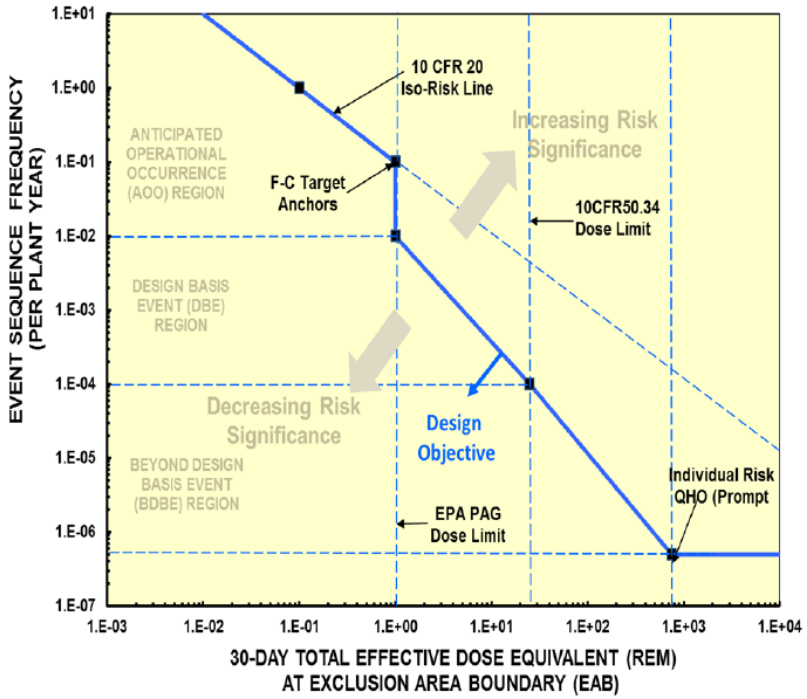

Figure 3-1. Frequency-Consequence Target

Questions – Licensing Basis Events

Common Cause Failure (CCF) is considered a high-consequence BDBE; however, SRM-SECY-93-087, BTP 7-19, and the DRG allow the use of non-safety related equipment as diverse means to mitigate CCF of the safety-related I&C system.

Question 2: The LMP process presents use-cases where safety-related SSCs may be required to mitigate CCF; however, Commission policy, and current practice among operating LWR plants, categorically allows the use of non-safety-related SSCs (SRM-SECY-93-087 Positions 3 and 4). Can non-safety functions be used to mitigate the effects of CCF as is currently implemented among operating LWR plants? Provide clarification regarding the acceptance criteria for strategies used to address CCF, such as diversity, and associated safety classification.

Questions – Non-Safety-Related Special Treatment

For Non-Safety-Related Special Treatment (NSRST), the DRG Section X.0.1.1, Scope of Review, states:

> *This DRG chapter provides review guidance on all aspects of safety-significant I&C systems, which include safety-related I&C systems and I&C systems that are not safety-related but warrant special treatment.*

However, NSRST criteria are specified by name in various sections, such as:

- X.2.2.1.1. Independence
- X.2.2.2.1 Quality
- Appendix A System Characteristics

Questions – Non-Safety-Related Special Treatment

Question 1: Are NSRST criteria limited to the sections that are specified, or should the entirety of the DRG be considered?

Question 2: DRG Appendix A provides clarification or re-emphasizes design criteria from IEEE Std 603. LMP primarily focuses its guidance for NSRST SSCs on process, not design criteria. Our understanding is that a vendor should select appropriate DRG Appendix A design criteria that support their reliability and robustness claims associated with the NRSRT function(s).

Question 3: Does NRC staff have Quality Assurance requirements/acceptance criteria established for NSRST SSCs?

Questions – Non-Safety-Related Special Treatment

- **Question 4**: Per NEI 18-04 Section 4, NSRST SSCs can be classified as "relied on to perform risk-significant functions" or "requiring special treatment for DID adequacy." Are special treatments differentiated between the two categories of NSRST SSCs? For example, are NSRST SSCs required for DID adequacy required to address single failure criterion, diversity, etc.?

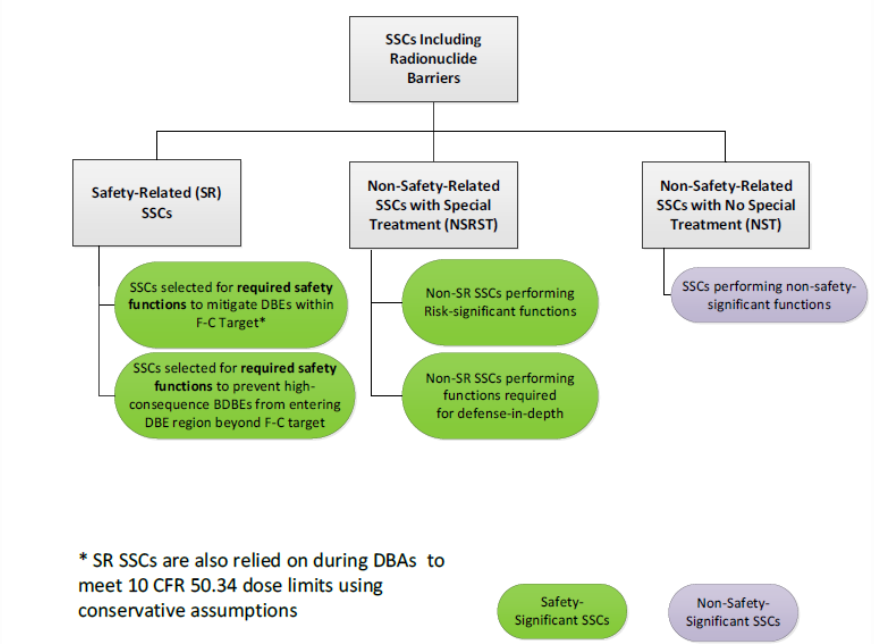

Figure 4-3. LMP SSC Safety Categories and Safety Significant SSCs

Alternative Frameworks

Questions – Alternative Frameworks

In determining I&C design criteria required to prevent or mitigate the effects of Anticipated Operational Occurrences, SRP Chapter 15 Section I.4 states:

> *The reviewer ensures that the application lists the settings of all the protection and safety systems functions that are used (i.e., credited) in the safety evaluation. Typical protection and safety systems functions include reactor trips, isolation valve closures, ECCS initiation and ECCS. In evaluations of AOOs and postulated accidents, the performance of each credited protection or safety system is required to include the effects of the most limiting single active failure.*

NEI 18-04 Table 3-1 states:

> *AOOs take into account the expected response of all SSCs within the plant, regardless of safety classification.*

Questions – Alternative Frameworks

Historically, there has been a perception that an applicant needs a safety-related system, instead of a set of anticipatory and/or non-safety SSCs, in order to meet AOO acceptance criteria.

Question 1: If a vendor proposes to use an alternative framework, can that vendor credit the expected response of all SSCs within the plant (e.g., other than safety-related instrumentation and controls), regardless of safety classification?

Questions – Alternative Frameworks

Question 2: If the vendor is able to credit the expected response of all SSCs within the plant, this will impact the selection and wording of Principal Design Criteria. Are there any specific considerations that vendors should be aware of when applying this concept?

For example, 10 CFR 50, Appendix A GDC 20 states:

> *Protection system functions. The protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety.*

The highlighted words may be defined and executed differently in different frameworks.

NRC Question Clarification

Remote, Monitoring, and Control Rooms. To what extent will advanced reactors employ remote monitoring of the plant for operational purposes? How could the design of I&C safety systems and control systems be impacted by the increased use of autonomous operations?

- How does the NRC define “remote”? For example, is outside of the Main Control Room considered “remote.”
- How does the NRC define “autonomous”? Is the NRC implying the use of Artificial Intelligence for control system response to a non-specified event?

Future Topics

- Industry Responses to NRC proposed questions
  - Presented generically
  - Currently aggregating responses
- Other Topics:
  - Codes and Standards
  - Application Format/Contents
  - Additional guidance/clarity for:
    - Digital Technologies
    - Model-Based V&V
    - Self-Diagnostics
    - Transitioning from LMP to Design Requirements