Non-Safety-Related with Special Treatment – Digital Considerations

Alan Campbell

March 14, 2024

©2024 Nuclear Energy Institute

Middle Ground Classifications/Categorizations

- Other “middle ground” classifications/categorizations (or graded approach) exist:
  - Regulatory Treatment of Non-Safety Systems (RTNSS)
  - Anticipated Transient Without SCRAM (ATWS)
  - Risk-Informed Safety Classification (RISC)
- These classifications or categorizations define design criteria and special treatments
- LMP introduces Non-Safety-Related with Special Treatment (NSRST) classification
  - What are appropriate special treatments for LMP?

©2024 Nuclear Energy Institute

Regulatory Treatment of Non-Safety Systems (RTNSS)

- SRP Chapter 19
- Applicability – “The RTNSS process applies broadly to those non-safety-related SSCs that perform risk significant functions and, therefore, are candidates for regulatory oversight”
- Criteria:
  - A. Relied on to meet Beyond Design Basis performance requirements
  - B. Relied on to ensure long-term safety and address seismic events
  - C. Relied on under to meet Commission goals for CDF and LERF
  - D. Needed to meet containment performance goal during severe accident.
  - E. Relied on to prevent significant adverse systems interactions between passive safety and active non-safety SSCs.

©2024 Nuclear Energy Institute

Regulatory Treatment of Non-Safety Systems (RTNSS)

- Staff Review
  - Identification of SSC functions based on criteria
  - Functional design of RTNSS SSCs to meet reliability/availability mission
  - PRA sensitivity studies used to identify RTNSS “C” SSCs
  - Augmented design standards that must be met by RTNSS SSCs including:
    - Seismic survivability
    - Protection against natural phenomena
    - Protection against internal hazards (e.g., internal floods)
    - Assuring SSC functions can be achieved expeditiously
  - Regulatory treatment proposed for RTNSS SSCs

©2024 Nuclear Energy Institute

Regulatory Treatment of Non-Safety Systems (RTNSS)

- Majority of acceptance criteria relate to technical requirements to ensure reliability including, but not limited to:
  - Functional requirements for SSC design, including supporting systems
  - Designed SSCs to include features associated with human actions necessary for successful implementation of the functional design requirement.
  - Focused PRA to determine:
    - the functional R/A missions of active systems needed to meet NRC regulations, Commission goals and the containment performance goal objectives, and
    - the risk-significance associated with failure to accomplish each R/A mission.
  - Use of augmented design standards to ensure safety functions can be accomplished following an accident
  - Augmented seismic criteria

©2024 Nuclear Energy Institute

Regulatory Treatment of Non-Safety Systems (RTNSS)

- "Treatment requirements" include operational programs, such as:
  - Pre-service and in-service testing and surveillance
  - Maintenance program
  - Quality Assurance activities for non-safety-related SSCs IAW SRP Section 17.5
  - Process also depends on Reliability Assurance Program (RAP) IAW SRP Section 17.4

©2024 Nuclear Energy Institute

Anticipated Transient Without SCRAM (ATWS)

- 10 CFR 50.62
- Applicability: “The requirements of this section apply to all commercial light-water-cooled nuclear power plants, other than nuclear power reactor facilities for which the certifications required under § 50.82(a)(1) have been submitted.”

©2024 Nuclear Energy Institute

Anticipated Transient Without SCRAM (ATWS)

- PWR Requirements:
  - Diverse auxiliary (or emergency) feedwater initiation
  - Diverse turbine trip
  - CE or B&W: Diverse SCRAM system
- BWR Requirements:
  - Diverse alternate rod injection
  - Standby liquid control system
  - Reactor coolant recirculating pump trip

©2024 Nuclear Energy Institute

Anticipated Transient Without SCRAM (ATWS)

- All:
  - Designed to perform its function in a reliable manner and be independent from the existing reactor trip system
- Generic Letter (GL) 85-06
  - Enclosure 1 provides QA guidance for non-safety-related ATWS equipment
- Examples of “augmented quality” performance requirements:
  - Environmental
  - Seismic
  - Electromagnetic compatibility

©2024 Nuclear Energy Institute

Risk-Informed Safety Classification (RISC)

- 10 CFR 50.69
- Applicability: (1) A holder of a license to operate a light water reactor (LWR) nuclear power plant under this part; a holder of a renewed LWR license under part 54 of this chapter; an applicant for a construction permit or operating license under this part; or an applicant for a design approval, a combined license, or manufacturing license under part 52 of this chapter; may voluntarily comply with the requirements in this section

©2024 Nuclear Energy Institute

Risk-Informed Safety Classification (RISC)

- Categories:
  - RISC-1: Safety-related SSC, safety significant function
  - RISC-2: Non-safety-related SSC, safety significant function
  - RISC-3: Safety-related SSC, low safety significant function
  - RISC-4: Non-safety-related SSC, low safety significant function

©2024 Nuclear Energy Institute

Risk-Informed Safety Classification (RISC)

- RISC-1 and RISC-2 shall perform their functions consistent with the categorization process assumptions
- RISC-3 and RISC-4 allowed to take “alternate treatments” for:

Impacted CFR	General Topic
10 CFR 21	**Reporting defects and non-compliance**
10 CFR 50.46a(b) requirements for Appendix B	Reactor cooling system vents
10 CFR 50.49	**Environmental qualification**
10 CFR 50.55(e)	Part 21 definitions
10 CFR 50.55a(h) IEEE 279 Sections 4.3/4.4, and 603-1991 Sections 5.3/5.4	**Quality and qualification**
10 CFR 50.65, except paragraph (a)(4)	Maintenance effectiveness monitoring
10 CFR 50.72	Notification requirements
10 CFR 50.73	Event reporting
10 CFR 50 Appendix B	**Quality assurance**
10 CFR 50 Appendix J Type B/C leakage testing	Primary reactor containment leakage testing
10 CFR 100 Appendix A, Sections VI(a)(1) and (2)	Safe shutdown earthquake and operating basis earthquake

Non-Safety-Related with Special Treatment (NSRST)

- NEI 18-04
- NRSRT Criteria
  - Non-Safety-Related SSCs performing risk-significant functions
  - Non-Safety-Related SSCs performing functions required for defense-in-depth
- NEI 18-04 states:
  - The term “special treatment” is used in a manner consistent with NRC regulations and Nuclear Energy Institute (NEI) guidelines in the implementation of 10 CFR 50.69. In Regulatory Guide 1.201, the following definition of special treatment is provided:

    “…special treatment refers to those requirements that provide increased assurance beyond normal industrial practices that structures, systems, and components (SSCs) perform their design-basis functions.”

©2024 Nuclear Energy Institute

Non-Safety-Related with Special Treatment (NSRST)

- NEI 18-04
- NRSRT Criteria
  - Non-Safety-Related SSCs performing risk-significant functions
  - Non-Safety-Related SSCs performing functions required for defense-in-depth
- NEI 18-04 states:
  - The term “special treatment” is used in a manner consistent with NRC regulations and Nuclear Energy Institute (NEI) guidelines in the implementation of 10 CFR 50.69. In Regulatory Guide 1.201, the following definition of special treatment is provided:

    “…special treatment refers to those requirements that provide increased assurance beyond normal industrial practices that structures, systems, and components (SSCs) perform their design-basis functions.”

©2024 Nuclear Energy Institute

Non-Safety-Related with Special Treatment (NSRST)

- NEI 18-04 Table 4-1 provides the following applicable “basic requirements” for NSRST:
  - Reliability Assurance Program IAW SRP 17.4
  - Design requirements for capability to mitigate LBEs
  - Maintenance Program
  - Licensee Event Reports
  - Quality Assurance Program for non-safety SSCs
    - QA requirements consistent with SRP 17.4 and 17.5

©2024 Nuclear Energy Institute

Non-Safety-Related with Special Treatment (NSRST)

- Additional Special Treatment “Requirements”
  - Technical Specifications, as needed
  - Seismic II/I
  - Pre-service and risk-informed in-service inspections, as needed
  - Pre-service and in-service testing, as needed

©2024 Nuclear Energy Institute

Non-Safety-Related with Special Treatment (NSRST)

- RG 1.233 provides:
  - “NEI 18-04 states that NSRST SSCs are not directly associated with RFDC but are subject to special treatment as a result of risk significance or assessments of DID.”
  - “Special treatment requirements for NSRST SSCs include the setting of performance requirements for SSC reliability, availability, and capability and any other treatments the IDPP responsible for evaluating the adequacy of DID deems necessary.”

©2024 Nuclear Energy Institute

Non-Safety-Related with Special Treatment (NSRST)

- Design Review Guide (DRG) - Provides consideration of some design concepts for NSRST SSCs, including:
  - Independence
  - System life cycle quality assurance practices
  - Operating and maintenance bypasses
  - Interlocks
  - Derivation of system inputs
  - Setpoints
  - Auxiliary features
  - Control of access, identification, and repair
  - Interaction between sense and command features and other systems
  - Multi-unit stations
  - Automatic and manual control
  - Displays and monitoring
  - Capability for testing and calibration

©2024 Nuclear Energy Institute

Conclusions

- NSRST scope most closely aligns with RTNSS
- NSRST design criteria guidance most closely resembles performance-based RTNSS guidance
- NSRST quality assurance guidance aligns with RTNSS guidance (SRP 17.4 and 17.5)
- NSRST other special treatments should follow similar special treatment categories provided in 10 CFR 50.69(b)
  - 10 CFR 21
  - 10 CFR 50.49
  - 10 CFR 50.55a(h) IEEE 279 Sections 4.3/4.4, and 603-1991 Sections 5.3/5.4
  - 10 CFR 50, Appendix B

©2024 Nuclear Energy Institute

Conclusions

- Potential for an NEI white paper/technical report that identifies digital special treatment categories including:
  - DRG design considerations
  - Software life-cycle activities/documentation
    - Development
    - Verification & Validation
    - Configuration Management
  - Environmental qualification testing/documentation (including EMC)
  - Software commercial grade dedication

©2024 Nuclear Energy Institute