SSC Safety Classification and Performance Requirements for Advanced Non-LWRs

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Abstract: The purpose of this paper is to summarize key elements of the risk-informed and performance-based methods developed within the Industry led Licensing Modernization Project (LMP). The LMP is jointly sponsored by the U.S. Department of Energy and the U.S. nuclear industry to assist the U.S. Nuclear Regulatory Commission (NRC) in the development of regulatory guidance for advanced non-light water reactors currently under development in the U.S. The purpose of this paper is to summarize a risk-informed and performance based approach for the safety classification and derivation of performance requirements for structures, systems, and components (SSCs) for advanced non-LWRs. This paper summarizes the approach which builds on a PRA model that is introduced early in the design process and ties into the selection and evaluation of Licensing Basis Events (LBEs) and evaluation of defense-in-depth adequacy as described in companion papers at this conference.

Keywords: PRA, Licensing Basis Events (LBEs), risk-informed and performance-based (RIPB).

1. INTRODUCTION

Many of the current regulatory requirements for US nuclear power plants are based on light water reactor (LWR) technology. To facilitate efficient, effective, and predictable licensing expectations for a spectrum of novel, advanced, non-LWRs additional regulatory guidance is needed. The Licensing Modernization Project (LMP), led by Southern Company and cost-shared by the U.S. Department of Energy (DOE) and other industry participants, is proposing changes to specific elements of the current licensing framework and a process for implementing the proposals. These proposals are described in a series of papers that have been submitted for review by the NRC [1][2][3][4] . The LMP approaches for safety classification of SSCs and for deriving performance requirements for SSC reliability and capability build on similar approaches that were developed for the Next Generation Nuclear Plant [5]. These papers are currently being used to assist the NRC in development of regulatory guidance for licensing advanced non-LWR plants. Use is made of relevant aspects of risk-informed SSC classification approaches that have been developed for existing and advanced Light Water Reactors (LWRs) and small modular reactors, including those defined for implementation of 10 Code of Federal Regulations (CFR) 50.69 [6].

In the development of a suitable approach for safety classification of SSCs a set of desirable attributes was adopted. According to these attributes, the process for the safety classification and derivation of performance requirements of SSCs for advanced non-LWRs should be:

- Systematic and Reproducible
- Sufficiently Complete
- Available for Timely Input to Design Decisions
- Risk-informed and Performance-Based:
- Reactor Technology Inclusive
- Consistent with Applicable Regulatory Requirements

The LMP SSC safety classification and performance requirements approach was developed to address the following objectives:

- Define an appropriate set of safety classes and unambiguous criteria for assigning each SSC into the appropriate safety class.
- Include an approach for determining the risk significance and safety significance of SSCs suitable for advanced non-LWRs using an appropriate set of risk metrics.
- Define requirements and set targets for SSC reliability and capability in the prevention and mitigation of accidents that refer to reactor and design specific LBEs.
- Include a top-down process for developing Functional Design Criteria (FDC) and lower level design criteria for implementation of SSC required safety functions
- Prescribe the process for the development of SSC special treatment requirements in performance of their functions in the prevention and mitigation of LBEs
- Identify by reference relevant supporting regulatory guidance, precedents, and available references to assist in implementing the proposed approach to SSC safety classification
- Identify potential technical issues associated with the proposed approach to SSC safety classification
- Provide the necessary links to the LMP approaches for probabilistic risk assessment (PRA) development, LBE selection and evaluation, and evaluation of defense-in-depth (DID) adequacy

2. OVERVIEW OF SSC SAFETY CLASSIFICATION AND PERFORMANCE REQUIREMENTS PROCESS

2.1. Definition of Safety Classes

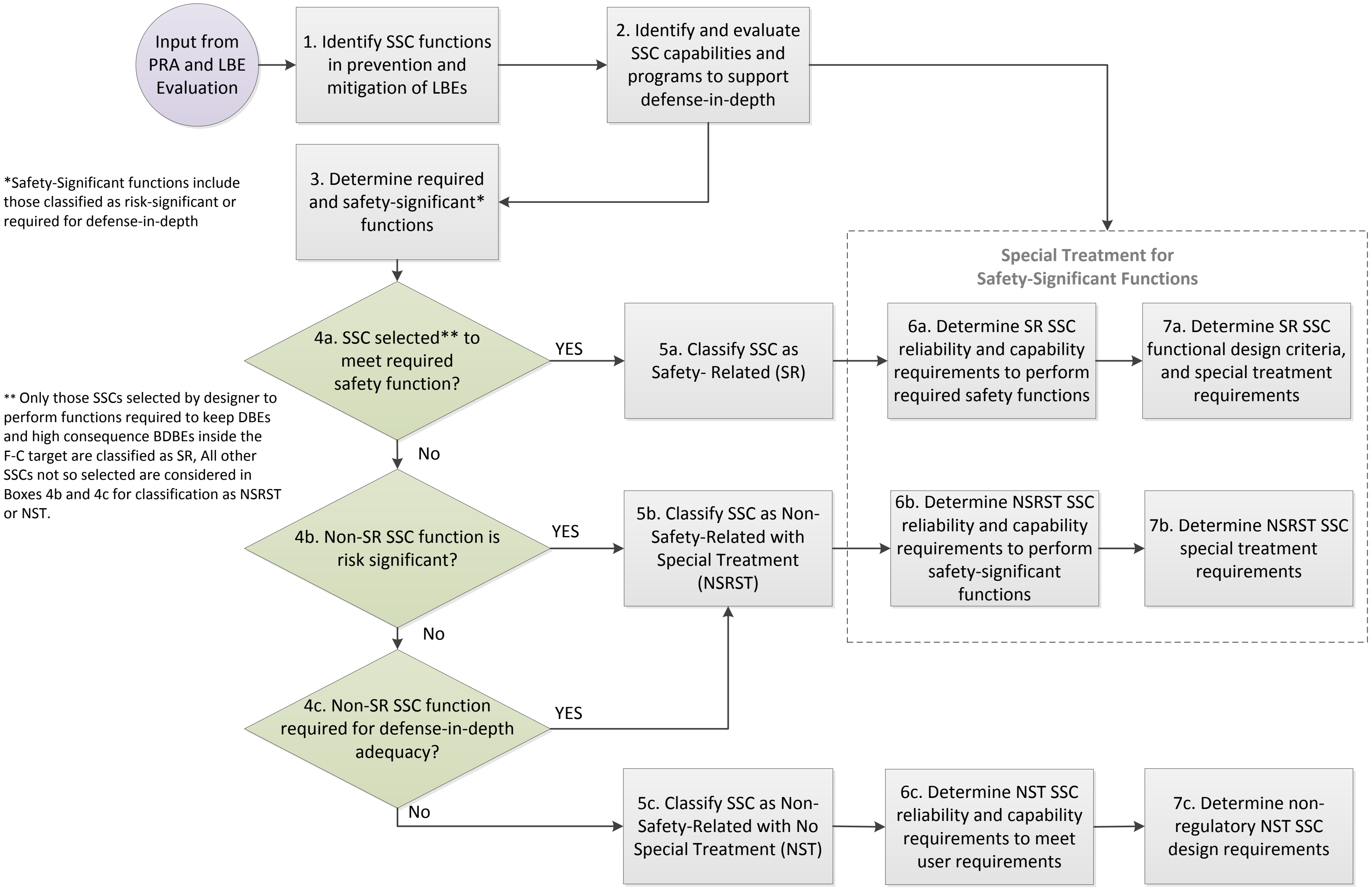
The use of safety classification categories developed from the NGNP white paper on SSC safety classification[1] while drawing on insights from 10 CFR 50.69,[9] and the bases for SSC classification in each category described below are acceptable to the NRC for advanced non-LWRs:

- **Safety-Related (SR):**
    - SSCs selected by the designer from the SSCs that are available to perform the required safety functions to mitigate the consequences of design basis events (DBEs) to within the LBE Frequency-Consequence evaluation target (F-C target), and to mitigate design basis accidents (DBAs) that only rely on the SR SSCs to meet the dose limits of 10 CFR 50.34 using conservative assumptions
    - SSCs selected by the designer and relied on to perform required safety functions to prevent the frequency of beyond design basis events (BDBE) with consequences greater than the 10 CFR 50.34 dose limits from increasing into the DBE region and beyond the F-C target
- **Non-Safety-Related with Special Treatment (NSRST):**
    - Non-safety-related SSCs relied on to perform risk significant functions. Risk significant SSCs are those that perform functions that prevent or mitigate any LBE from exceeding the F-C target, or make significant contributions to the cumulative risk metrics selected for evaluating the total risk from all analyzed LBEs.
    - Non-safety-related SSCs relied on to perform functions requiring special treatment for DID adequacy
- Non-Safety-Related with No Special Treatment (NST):
    - All other SSCs (with no special treatment required)

Safety significant SSCs include all those SSCs classified as SR or NSRST. None of the NST SSCs are classified as safety significant.

2.2. Summary of SSC Safety Classification Approach

The LMP SSC safety classification process is described in Figure 1. This process is designed to be used with the LMP process for selecting and evaluating LBEs as described in a companion paper at this conference.



*Safety-Significant functions include those classified as risk-significant or required for defense-in-depth

** Only those SSCs selected by designer to perform functions required to keep DBEs and high consequence BDBEs inside the F-C target are classified as SR, All other SSCs not so selected are considered in Boxes 4b and 4c for classification as NSRST or NST.

Figure 1: LMP SSC Function Classification Process

The SSC safety classification process is implemented in the seven tasks that are described below. This process is described as an SSC function classification process rather than a SSC classification process because only those SSC functions that prevent or mitigate accidents represented in the LBEs are of concern. A given SSC may perform other functions that are not relevant to LBE prevention or mitigation or functions with a different safety classification.

Task 1: Identify SSC Functions in Prevention and Mitigation of LBEs

The purpose of this task is to review each of the LBEs, including those in the Anticipated Operational Occurrence (AOO), DBE, and BDBE regions to determine the function of each SSC in the prevention and mitigation of the LBE. Each LBE is comprised of an initiating event, a sequence of conditioning events, and end state. The initiating events may be associated with an internal event such as an SSC failure or human error, an internal plant hazard such as a fire or flood, or an external event such as seismic event or external flood.

For those internal events caused by an equipment failure, the initiating event frequency is related to the unreliability of the SSC, i.e., SSCs with higher reliability serve to prevent the initiating event. Thus, higher levels of reliability result in a lower frequency of initiating events. For SSCs that successfully mitigate the consequences of the initiating event, their capabilities and safety margins to respond to the initiating event are the focus of the safety classification process and resulting special treatment. For those SSCs that fail to respond along the LBE, their reliabilities, which serve to prevent the LBE by reducing its frequency, are the focus of the reliability requirements derived from classification and treatment process. The output of this task is the identification of the SSC prevention and mitigation functions for all the LBEs.

Task 2: Identify and Evaluate SSC Capabilities and Programs to Support Defense-in-Depth

The purpose of this task is to provide a feedback loop from the evaluation of defense-in-depth (DID) adequacy, which is the topic of a separate LMP white paper [6]. This evaluation includes an examination of the plant LBEs, identification of the SSCs responsible for the prevention and mitigation of accidents, and a set of criteria to evaluate the adequacy of DID. A result of this evaluation is the identification of SSC functions, and the associated SSC reliabilities and capabilities that are deemed to be necessary for DID adequacy. Such SSCs and their associated functions are regarded as safety significant and this information is used to inform the SSC safety classification in subsequent steps.

Task 3: Determine Required and Safety Significant Functions

The purpose of this task is to define the safety functions that are required to meet the 10 CFR 50.34 dose requirements for all the DBEs and the high consequence BDBEs as well as other safety functions regarded as safety significant. Safety significant SSCs include those that perform risk significant functions and those that perform functions that are necessary to meet defense-in-depth criteria. As explained more fully in the LMP PRA paper, the scope of the PRA includes all the plant SSCs that are responsible for preventing or mitigating the release of radioactive material. Hence the LBEs derived from the PRA include all the relevant SSC prevention and mitigation functions.

As explained previously, there are some safety functions classified as “required safety functions” that must be fulfilled to meet the F-C target for the DBEs using realistic assumptions and dose requirements for the DBAs using conservative assumptions. In addition to these required safety functions, there are additional functions that are classified as safety significant when certain risk significance and defense-in-depth criteria are met as explained below. In most cases, there are several combinations of SSCs that can perform these required safety functions. How individual SSC safety functions are classified relative to these function categories is resolved in Task 4 and Task 5. Figure 2 illustrates the concepts used to classify SSC safety functions as risk significant and safety significant.

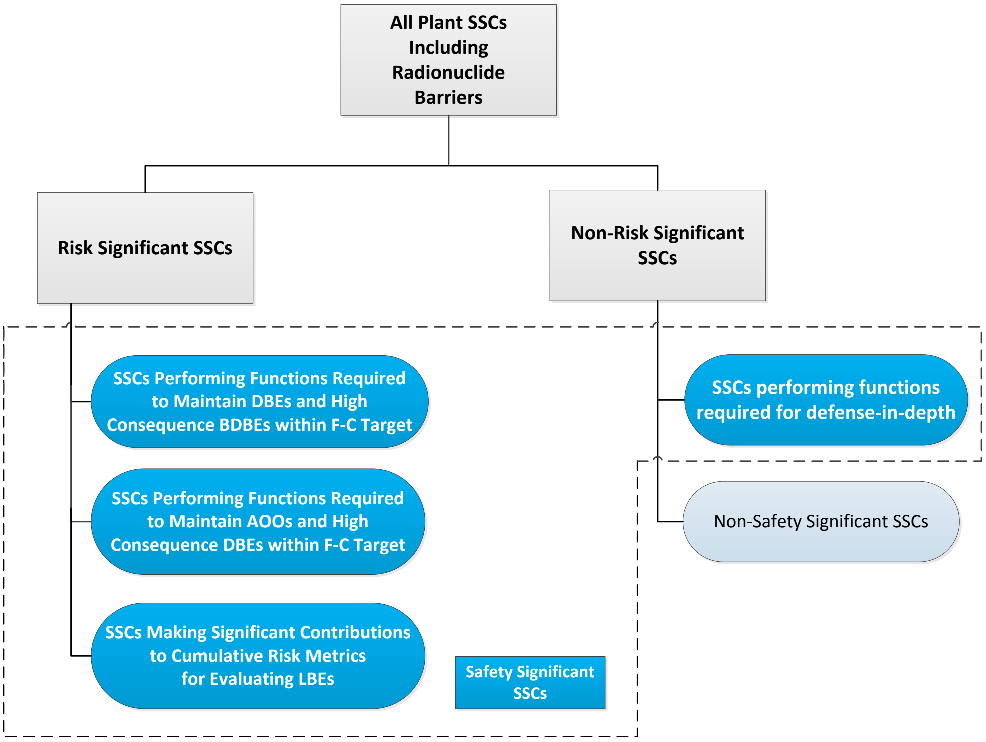


Figure 2: Definition of Risk Significant and Safety Significant SSCs

Tasks 4 and 5: Evaluate and Classify SSC Functions

The purpose of Tasks 4 and 5 is to classify the SSC functions modeled in the PRA into one of three safety categories: Safety-Related (SR), Non-Safety-Related with Special Treatment (NSRST), and Non-Safety-Related with No Special Treatment (NST).

Tasks 4A and 5A: In Task 4A, each of the DBEs and any high consequence BDBEs (i.e., those with doses above 10 CFR 50.34 limits) are examined to determine which SSCs are available to perform the required safety functions. The designer then selects one specific combination of available SSCs to perform each required safety function that covers all the DBEs and high consequence BDBEs. These specific SSCs are classified as SR in Task 5a and are the only ones credited in the Chapter 15 safety analysis of the DBAs. All the remaining SSCs are processed further in Steps 4b and 4c. An example of how SR SSCs were derived for the MHTGR is found in the Appendix. Additional examples of how SR SSCs are defined for the MHTGR and General Electric Power Reactor Innovative Small Module designs are found in the LMP LBE paper.

Tasks 4B and 5B: Because each SR classified SSC identified in Task 4A is necessary to keep one or more LBEs inside the F-C target, all SR SSCs are regarded in the LMP framework as risk significant. However, it is also possible that some non-SR SSCs will meet the LMP criteria for risk significance. In this task, each non-safety-related SSC is evaluated for its risk significance. A risk significant SSC function is one that is necessary to keep one or more LBEs within the F-C target or is significant in relation to one of the LBE cumulative evaluation risk metric limits that was defined in the LMP LBE white paper to evaluate the risk significance of LBEs. Examples of the former category are SSCs needed to keep the consequences below the AOO limits in the F-C target, and DBEs where the reliability of the SSCs must be controlled to prevent an increase of frequency into the AOO region with consequences greater than the F-C target. The SSC and LBE risk significance criteria are discussed in more detail in Section 2.4. If the SSC is classified as risk significant and is not an SR SSC, it is classified as NSRST in Task 5b. SSC functions that are neither safety related nor risk significant are evaluated further in Task 4c.

Tasks 4C and 5C: In this task, a determination is made as to whether any of the remaining non-safety-related and non-risk significant SSC functions should be classified as requiring special treatment in order to meet criteria for defense-in-depth adequacy. The criteria for defense-in-depth adequacy are discussed in Section 2.6 and in more detail in the companion LMP DID white paper. Those that meet these criteria are classified as NSRST in Task 5b and those remaining as NST in Task 5c.

At the end of this task, all SSC functions reflected in the LBEs will be placed in one of the three SSC function safety classes illustrated in Figure 2 4.

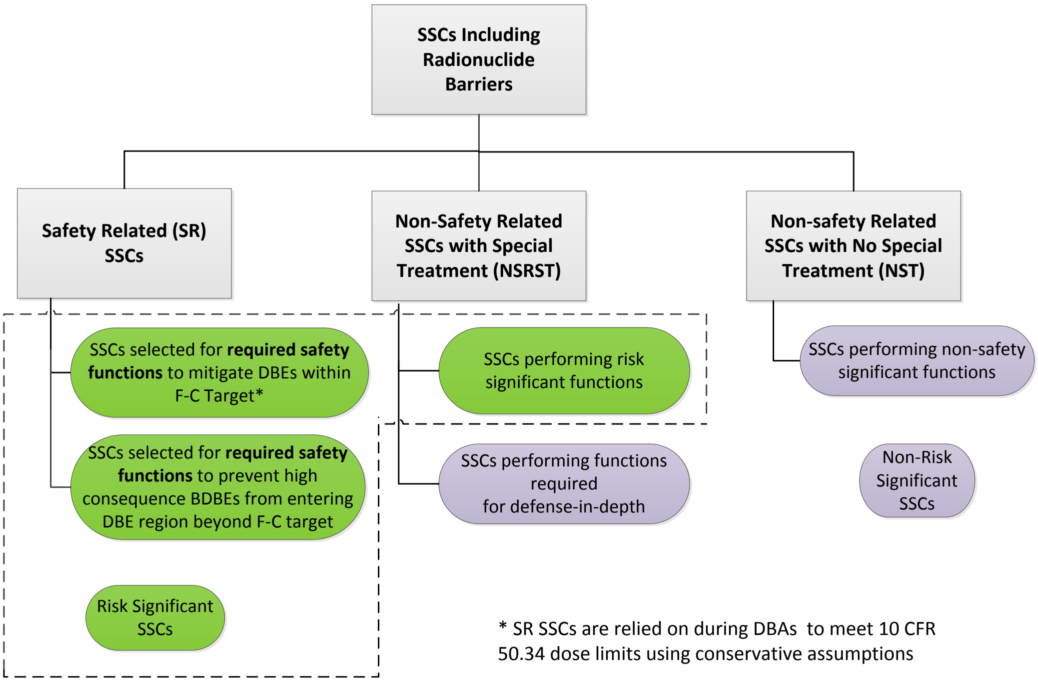


Figure 3: LMP SSC Safety Categories

Note that all SSC functions classified as either SR or NSRST are regarded as "safety significant." All non-safety significant SSC functions are classified in NST.

The three SSC safety categories in Figure 2 4 have the same names as those developed in the NGNP and Exelon PBMR approaches, although the logic in deriving them is somewhat different. The LMP approach makes use of the concept of SSC safety significance that is associated with the 10 CFR 50.69 approach and also addresses the possibility that an SSC that is not safety related nor risk significant may be classified as safety significant based on defense-in-depth considerations. The LMP approach to assigning risk significance uses the concept of evaluating the impact of the SSC function on the ability to meet the F-C target, as in the previous approaches, but also includes criteria based on risk significance metrics for the cumulative risk impacts of SSC functions across all the LBEs. Hence the LMP approach is in better alignment with the risk-informed safety classification process that is being implemented for 10 CFR 50.69.

Task 6: SSC reliability and capability requirements

For each of the SSC functions that have been classified in Task 5, the purpose of this task is to define the requirements for reliabilities and capabilities for SSCs modeled in the PRA. For SSCs classified as SR or NSRST, which together represent the safety significant SSCs, these requirements are used to develop regulatory design and special treatment requirements in Task 7. For those SSCs classified as NST, the reliability and capability requirements are derived from non-regulatory user requirements.

For SSCs classified as SR, FDC and lower level design criteria are defined to capture design specific criteria that may not be captured as part of the applicable GDC or Advanced Reactor Design Criteria. Examples of FDC that were developed for the MHTGR and the design specific required safety functions that associated with these criteria are presented in Table 1. These criteria are used to frame specific design requirements as well as special treatment requirements for SR classified SSCs. NSRST SSCs are not directly associated with FDC but are subject to special treatment as determined by the integrated decision making process for evaluation of defense-in-depth. Guidance on the development of FDC, design requirements, and special treatment requirements is found in Section 3 of this paper using examples developed previously for the MHTGR.

Table 1. MHTGR Required Safety Functions and Associated Functional Design Criteria [7]

Required Safety Function	Functional Design Criteria
Retain Radionuclides in Fuel Particles	I: The reactor fuel shall be designed, fabricated, and operated in such a manner that minor radionuclide releases from the fuel to the primary coolant will not exceed acceptable values.
Control Chemical Attack	II: The vessel and other components that limit or prevent the ingress of air or water shall be designed, fabricated, and operated in such a manner that the amount of air or water reacting with the core will not exceed acceptable values.
Control Heat Generation	III: The reactor shall be designed, fabricated, and operated in such a manner that the inherent nuclear feedback characteristics will ensure that the reactor thermal power will not exceed acceptable values. Additionally, the reactivity control system(s) shall be designed, fabricated, and operated in such a manner that during insertion of reactivity, the reactor thermal power will not exceed acceptable values.
Control Heat Removal	IV: The intrinsic dimensions and power densities of the reactor core, internals, and vessel, and the passive cooling pathways from the core to the environment, shall be designed, fabricated, and operated in such a manner that the fuel temperatures will not exceed acceptable values.
Control with Movable Poisons	V: Two independent and diverse sets of movable poison equipment shall be provided in the design. Either set shall be capable of limiting the heat generation of the reactor to acceptable levels during off-normal conditions.
Shutdown Reactor	VI: The equipment needed to sense, command, and execute a trip of the control rods, along with any necessary electrical power, shall be designed, fabricated, and operated in such a manner that reactor core shutdown is assured during off-normal conditions.
Shutdown Reactor Diversely	VII: The equipment needed to sense, command, and execute a trip of the reserve shutdown control equipment, along with any necessary electrical power, shall be designed, fabricated, operated, and maintained in such a manner that the shutdown of the reactor core is assured during off-normal conditions.
Maintain Geometry for Insertion of Movable Poisons	VIII: The design, fabrication, operation, and maintenance of the control rod guide tubes, the graphite core and reflectors, the core support structure, the core lateral restraint assemblies, the reactor vessel, and reactor vessel support shall be conducted in such a manner that their integrity is maintained during off normal conditions as well as provide the appropriate geometry that permits the insertion of the control rods into the outer reflector to effect reactor shutdown.
	IX: The design, fabrication, and operation of the reserve shutdown control equipment guide tubes, the graphite core and reflectors, the core support structure, the core lateral restraint assemblies, the reactor vessel, and reactor vessel support shall be conducted in such a manner that their integrity is maintained during off-normal conditions, as well as provide the appropriate geometry that permits the insertion of reserve shutdown control material to effect reactor shutdown.
Transfer Heat to Ultimate Heat Sink	X: A highly reliable, passive means of removing the heat generated in the reactor core and radiated from the reactor vessel wall shall be provided. The system shall

Required Safety Function	Functional Design Criteria
	remove heat at a rate which limits core and vessel temperatures to acceptable levels during a loss of forced circulation.
Limit Fuel Hydrolysis	XI: The steam, feedwater and other cooling systems shall include a reliable means to limit the amount of steam and water that can enter the reactor vessel to an acceptable level.
Limit Fuel Oxidation	XII: The primary system/boundary shall be designed and fabricated to a level of quality that is sufficient to ensure high reliability of the primary system/boundary integrity needed to prevent air ingress during normal and off-normal conditions. The plant shall be designed, fabricated, operated, and maintained in a manner that ensures that the primary system boundary design limits are not exceeded.
Conduct Heat from Core to Vessel Wall	XIII: The reactor core shall be designed and configured in a manner that will ensure sufficient heat transfer by conduction, radiation, and convection to the reactor vessel wall to maintain fuel temperatures within acceptable limits following a loss of forced cooling. The materials which transfer the heat shall be chosen to withstand the elevated temperatures experienced during this passive mode of heat removal. This criterion shall be met with the primary coolant system both pressurized and depressurized.
Radiate Heat from Vessel Wall	XIV: The vessel shall be designed in a manner that will ensure that sufficient heat is radiated to the surroundings to maintain fuel and vessel temperatures within acceptable limits. This criterion shall be met with the primary coolant system in both a pressurized and depressurized condition.
Maintain Geometry for Conduction and Radiation	XV: The design, fabrication, operation, and maintenance of the core support structure, graphite core and reflectors, core lateral restraint assembly, reactor vessel, reactor vessel support, and reactor building shall be in such a manner that their integrity is maintained during off-normal conditions so as to provide a geometry conducive to removal of heat from the reactor core to the ultimate heat sink and maintain fuel temperatures within acceptable limits.

Task 7: Determine SSC specific design and special treatment requirements

The purpose of this task is to establish the specific design requirements for SSCs which include FDC for SR classified SSCs, regulatory design and special treatment requirements for each of the safety significant SSCs classified as SR or NSRST, and user design requirements for NST classified SSCs. As explained more fully in Section 3 of this paper, the specific SSC requirements are tied to the SSC functions reflected in the LBEs and are determined utilizing the same integrated decision making process used for evaluating the adequacy of defense-in-depth.

The term “special treatment” is used in a manner consistent with NRC regulations and NEI guidelines in the implementation of 10 CFR 50.69. In Regulatory Guide 1.201 [10] 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.*

In RIEP-NEI-16 [12] a distinction is made between special treatment as applied to safety-related SSCs and alternative special treatment afforded by 10 CFR 50.69. Alternative treatment requirements are differentiated from special treatment requirements in the use of “reasonable confidence” versus “reasonable assurance.” More details on the development of specific SSC design and performance requirements are provided in Section 3 of this paper.

3. SPECIAL TREATMENT REQUIREMENTS FOR SSCs

3.1 Purpose of Special Treatment

The purpose of special treatment is reflected in the Regulatory Guide 1.201[10] definition of this term:

> *…**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.*

In the context of the LMP framework, this definition of special treatment is realized by those measures taken to provide "reasonable confidence" that SSCs will perform their functions reflected in the LBEs making use of the definition of alternative special treatment in RIEP-NEI-16 [12] The applicable functions include those that are necessary to prevent initiating events and accidents and other functions needed to mitigate the impacts of initiating events on the performance of plant safety functions. Assurance is first accomplished by achieving and monitoring the levels of reliability and availability that are assessed in the PRA and that are determined to be necessary to meet the LBE risk evaluation criteria. These measures are focused on the prevention functions of the SSCs. Assurance is further accomplished by achieving and monitoring the capabilities of the SSCs in the performance of their mitigation functions with adequate margins to address uncertainties. The relationships between SSC reliability and capability in the performance of functions to that are needed to prevent and mitigate accidents are defined further in the next section.

3.2 Relationships Between SSC Capability and Reliability for Mitigation and Prevention

The safety classification of SSCs is made in the context of how the SSCs perform specific safety functions for each LBE in which they appear. If the SSC function is successful along the event sequence, the SSC helps to mitigate the consequences of the LBE. The reliability of the SSC serves to prevent the occurrence of the LBE by lowering its frequency of occurrence.

The safety classification process and the corresponding special treatments serve to control the frequencies and consequences of the LBEs within the F-C target and to ensure that the cumulative risk targets are not exceeded. The LBE frequencies are a function of the frequencies of initiating events from internal events, internal and external hazards, and the reliabilities and capabilities of the SSCs (including the operator) to prevent and mitigate LBE. The SSC capabilities include the ability to prevent an initiating event from progressing to an accident, to mitigate the consequences of an accident, or both. In some cases, the initiating events are failures of SSCs themselves, in which case the reliability of the SSC in question serves to limit the initiating event frequency. In other cases, the initiating events represent challenges to the SSC in question, in which case the reliability of the SSC to perform a safety function in response to the initiating event needs to be considered. Finally, there are other cases in which the challenge to the SSC in question is defined by the combination of an initiating event and combinations of successes and failures of other SSCs in response to the initiating event. All of these cases are included in the PRA and represent the set of challenges presented to a specific SSC.

A simple model of three SSCs (hereinafter referred to as SSC-1, SSC-2 and SSC-3) involved in three related LBEs for a hypothetical reactor illustrated in Figure 4. The simplified event tree in this figure identifies a function of SSC-1 to prevent fuel damage from some initiating event caused by failure of SSC-3. If that function is successfully fulfilled, it leads to LBE-1 in which there is successful termination without fuel damage and no release. If SSC-1 fails in this function, fuel damage occurs and the function of SSC-2 is to mitigate or limit the release resulting in LBE-2 and a small offsite dose denoted as d_{low}. If SSC-2 fails to perform this function there is an unmitigated release resulting in LBE-3 with a higher offsite dose denoted as d_{high}.

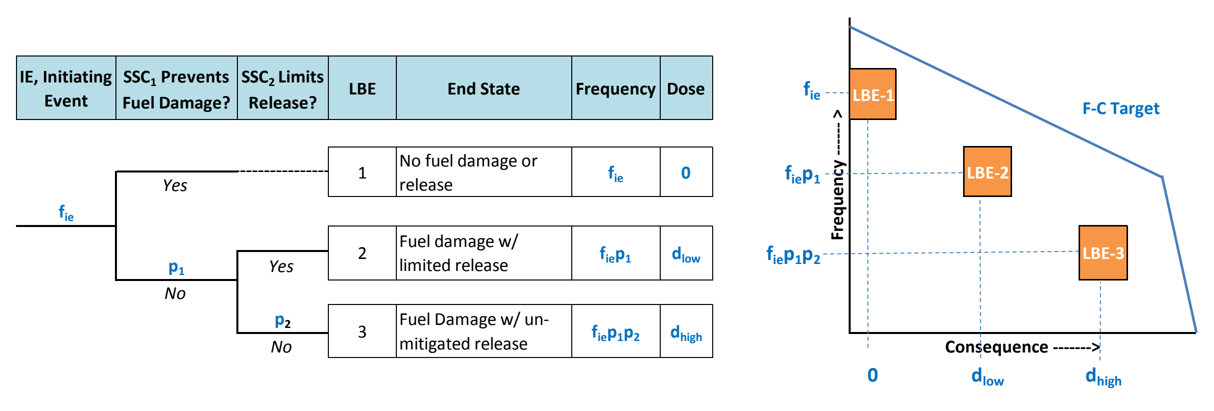


Figure 4: Capability and Reliability of an SSC to Mitigate and Prevent LBEs

Depending on the LBEs, the SSCs in this hypothetical problem perform both prevention and mitigation functions as shown in Table 2. Depending on the function, there are different performance attributes that would be the focus of any special treatment. The reliability of SSC-3 is an important attribute that would help reduce the frequency of the initiating event. The reliability of SSC-1 serves to prevent LBE-2 and LBE-3 by reducing their frequencies. The reliability of SSC-3 serves to reduce the frequency of LBE-3 and an un-mitigated release. The mitigation functions of SC-2 and SC-3, however point to different attributes. For SC-1 the capability of the SSC to mitigate the challenge caused by the initiating event in preventing fuel damage expands the definition of its requirements beyond those to have a high reliability for the prevention function. Similarly, the capability of SSC-2 to mitigate the challenges associated with fuel damage expands on the definition of its requirements beyond those to perform at a high reliability.

Table 2: Performance Attributes for SSC Prevention and Mitigation Functions

SSC	LBEs	Function	SSC Performance Attribute for Special Treatment
Initiating Event (caused by SSC3 failure)	1,2,3	Prevent initiating event	Reliability of SSC-3 to prevent initiating event
SSC1	1	Mitigate initiating event	Capability of SSC-1 to mitigate initiating event challenge
	2	Prevent fuel damage	Reliability of SSC-1 to prevent fuel damage
	3		
SSC2	2	Mitigate fuel damage	Capability of SSC-2 to mitigate fuel damage
	3	Prevent unmitigated release	Reliability of SSC-2 in preventing unmitigated release

This example is presented to show that in the formulation of special treatment requirements, it is important to understand how the treatments may influence the reliability of the SSCs in their prevention functions, as well as the capability of the SSCs in their mitigation functions. Some special treatments may influence the capability or reliability of the SSC, others may influence both capability and reliability.

3.3 Role of SSC Safety Margins

SSC safety margins play an important role in the development of SSC design requirements for reliability and performance capability. Acceptance limits on SSC performance are set with safety margins between the level of performance that is deemed acceptable in the safety analysis and the level of performance that would lead to damage or adverse consequences for all the LBEs in which the SSC performs a prevention or mitigation function. The magnitude of the safety margins in performance are set considering the uncertainties in performance, the nature of the associated LBEs, and criteria for adequate defense-in-depth, as explained more fully in the LMP defense-in-depth paper. The ability to achieve the acceptance criteria in turn reflects the design margins that are part of the SSC capability to mitigate the challenges reflected in the LBEs.

A second example of the use of margins is in the selection of reliability performance targets. The reliability targets are set to ensure that the underlying LBE frequencies and consequences meet the LBE evaluation criteria with sufficient margins. These safety margins are also evaluated in the defense-in-depth evaluation.

A third example of safety margins is the evaluation of margins between the frequencies and consequences of the LBEs and the F-C target and the margins between the cumulative risk metrics and the cumulative risk targets used for LBE evaluation. These risk margins are evaluated as part of the RIPB evaluation of defense-in-depth.

4. CONCLUSION

The LMP has developed a systematic and reproducible process for safety classification of SSCs and derivation of their performance requirements. The approach makes use of traditional engineering approaches as well as a technology and design specific PRA to risk-inform the safety classification process in a manner that is linked to a risk-informed process for selecting licensing basis events (LBEs). The role that each SSC plays in the evaluation of defense-in-depth adequacy is taken into account. The PRA models intended for this application have additional roles in the selection and evaluation of licensing basis events (LBEs) and in the risk-informed and performance based evaluation of defense-in-depth adequacy. Companion papers in this conference present the reactor technology inclusive LMP approaches for PRA development, licensing basis event selection and evaluation, and evaluation of defense-in-depth adequacy.

Acknowledgements

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