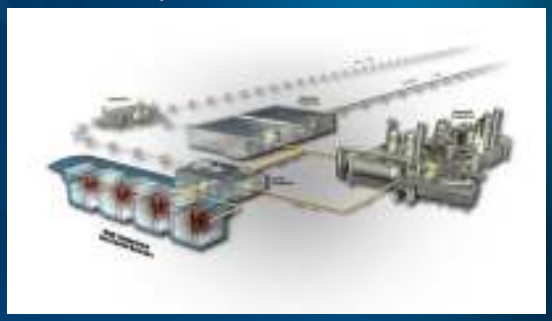
November 3, 2010

ATTACHED ARE THE SLIDES FROM THE "NGNP STRUCTURES, SYSTEMS, AND COMPONENTS SAFETY CLASSIFICATION" PRESENTATION, WHICH WAS GIVEN AT THE NOVEMBER 2, 2010 PUBLIC MEETING WITH INL/DOE REGARDING NGNP WHITE PAPERS

THESE SLIDES WERE PROVIDED ON THE DATE OF THIS COVER SHEET, AFTER THE MEETING WAS HELD.

NGNP Structures, Systems, and Components Safety Classification

Presentation to NRC Staff by
Next Generation Nuclear Plant Project
November 2, 2010



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NGNP Structures, Systems, and Components Safety Classification White Paper

September 2010

NRC ADAMS Accession Number: ML 102660144

SSC Safety Classification Overview

- White paper objectives
- Discussion issues
- Relationship to other white papers
- Regulatory foundation
- Approach to safety classification
- Outcome objectives
- Questions for discussion with NRC

SSC White Paper Objectives (1.2)

- Summarize the regulatory requirements, guidance, and precedents that apply to SSC safety classification in general, and specifically to advanced HTGR reactor designs including the NGNP
- Develop an acceptable structured approach for identifying safety significance appropriate to non-LWRs
- Establish appropriate safety classification categories
  - Safety-related
  - Non-safety-related with special treatment
  - Non-safety related
- Describe how the SSC safety classification approach identifies the structured application of special treatment requirements for the unique first-of-a-kind features in the NGNP design
- Describe how the NGNP safety classification approach aligns with NRC expectations for greater use of risk-informed licensing practices

SSC Safety Classification Discussion Issues (1.4)

- What is the role of safety classification in risk-informed, performance-based (RIPB) licensing approach for the NGNP?
- What is an appropriate, systematic, and reproducible approach to safety classification in a RIPB licensing approach?
- What are appropriate safety classification categories for the NGNP?
- How are deterministic approaches used and integrated into the safety classification process for the NGNP?
- How are RIPB approaches used and integrated into the safety classification and special treatment processes?
- What is the approach for assigning special treatment to assure the required degree of reliability and ca[ability for safety-related SSCs?
- What is the approach for assigning special treatment to assure the required degree of reliability and capability for SSCs classified as non-safety related with special treatment?

Regulatory Foundation

Regulatory Requirements *(continued)*

- 10 CFR 50.2
  - Based on LWR technology and design
  - Safety-related SSC definition
    - Assure integrity of RCPB
    - Assure capability to shutdown
    - Prevent or mitigate accidents to limit offsite exposure

Policy Statement (2.2)

Policy Statement on the Regulation of Advanced Reactors

- Same degree of risk to the public as required for current LWRs
- Advanced reactors are expected to provide enhanced safety margins
- Advanced reactors are expected to use simplified, inherent, passive, or other innovative means to achieve safety functions
- Implements defense-in-depth

Regulatory Guidance (2.3)

- SECY-02-0139 questioned the extent to which PRA should be used to establish plant licensing basis
- Alternative regulatory framework discussed in SECY-93-087, SECY-94-084, and SECY-95-0132

Regulatory Guidance (2.3) *(continued)*

- SECY-10-0034, "*Potential Policy, Licensing, and Key Technical Issues for SMR Designs*"
  - Commission approved use of probabilistic approach for safety classification
  - Recent NRC reviews of LWR designs using deterministic judgment and insights from PRAs
    - Safety margins were determined to be adequate to ensure integrity and performance of safety-significant SSCs
    - Special treatment requirements are addressed
  - NRC expects to apply this approach to most advanced reactor designs
  - Progressive movement over the last many years to today's RIPB regulatory approach

Regulatory Guidance (2.3) *(continued)*

- Regulatory Guides relevant to safety classification apply to LWR technology and design
  - Various aspects are technology-neutral
  - May apply or be adaptable to HTGR technology
  - Some criteria may require reevaluation for application to HTGR technology
- RG 1.26 Quality Group Classification
  - Applies to LWR design
  - Classification aligns with ASME III requirements for LWRs
  - ASME III, Division 5, for gas-cooled reactors under development

Regulatory Guidance (2.3) *(continued)*

- 10 CFR 50.69 permits implementation of alternative regulatory framework with respect to "special treatment"
  - Implementing guidance in RG 1.201 and SRP 3.2.2
  - SSCs of low safety significance can be removed from the scope of certain special treatment requirements
  - SRP 3.2.2 does not include criteria for reviewing a risk-informed categorization approach
- RG 1.201 Categorizing SSCs According to Their Safety Significance
  - Risk-informing special treatment requirements
  - Perform traditional 10 CFR 50.2 safety classification
  - Apply risk insights from PRA
  - Expands the safety and non-safety categories for special treatment based on safety significance

Regulatory Guidance (2.3) *(continued)*

- SSC safety functions include
  - Design-basis functions
  - Functions credited for preventing or mitigating severe accidents
- Special treatment commensurately applied for the categorized SSCs to maintain their functionality

Regulatory Precedents (2.4)

- MHTGR pre-application review
  - SECY-93-092 & NUREG-1338 (PSER)
    - Use of risk-insights in LBE selection and SSC classification
    - First application of RIPB approach
    - Provides a starting point for today's application
    - MHTGR licensing process was discontinued
    - Represents a new and innovative approach
    - Significant progress has been made

Regulatory Precedents (2.4) *(continued)*

- Exelon PBMR pre-application review
  - Special treatment based on required function for DBE
  - Use of PRA proposed to classify components
- PBMR white paper on safety classification August 28, 2006
  - NRC RAIs provided
  - Responses provided
  - PBMR licensing discontinued and RAI responses not reviewed by NRC

Insights from Regulatory Foundation

- Greater use of risk methodologies and insights are expected for operating plants and new reactors
- Integration of risk methods into design phase activities is expected for the NGNP
- Risk-informed decisions are expected as a means of complementing traditional deterministic decisions against established rules
- Use of RIPB processes help compensate for LWR-centric rules in areas where design differences are meaningful to safety decisions
- 10 CFR 50.69 and RG 1.201 provide a regulatory framework for application of risk insights for safety classification

Elements of SSC Safety Classification Approach

NGNP Approach to SSC Classification (3.1 & 3.2)

- **SSCs are classified relative to their safety significance**
- **Three primary safety classification categories**
  - **Safety-Related,**
  - **Non-Safety-Related with Special Treatment, and**
  - **Non-Safety-Related.**

NGNP Approach to SSC Classification (3.4 & 3.3)

- Safety classification is made in the context of specific, required safety functions performed by the SSC.
- SSCs are classified as safety-related (SR) or non-safety-related with special treatment (NSRST) depending on the frequency region.
- Special treatment to ensure that the SSCs classified as SR and NSRST have the capability and reliability, given the environment and conditions of the LBEs under which the SSCs are relied on to perform their safety function.

Classification of SSCs as Safety-Related (3.4.2)

- SSCs classified as Safety-Related are those relied on to prevent or mitigate the consequences of accidents which could result in potential significant offsite exposures.
  - SSCs relied on to perform required safety functions to prevent or mitigate the consequences of Design Basis Events (DBEs) to comply with the TLRC .
  - SSCs relied on to perform required safety functions to prevent the frequency of Beyond Design Basis Events (BDBEs) with consequences greater than the 10 CFR 50.34 dose limits from increasing into the DBE region.
- Based on prior experience and engineering judgment, this will include:
  - HTGR Fuel – serves as the primary barrier preventing the release of radionuclides
  - Reactor Shutdown System – controls core heat generation

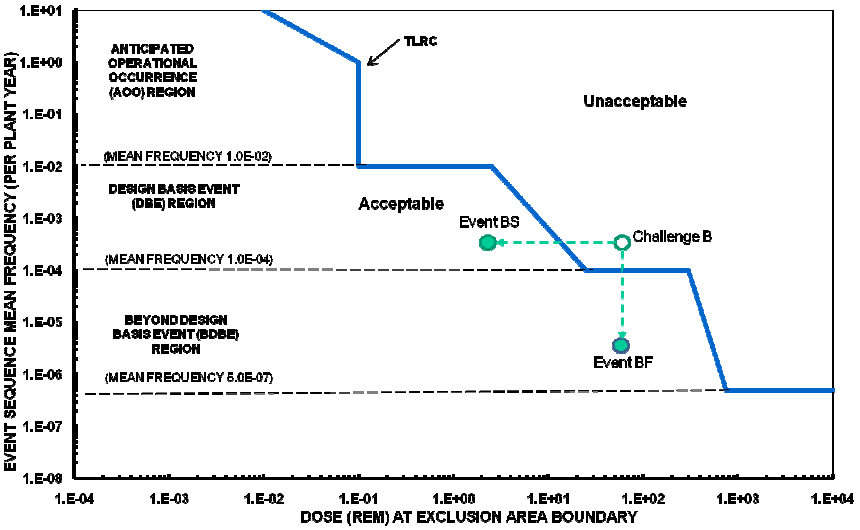
Classification of SSCs as Safety-Related (3.4.2)

(continued)

- The first step in the process of classifying SSCs as safety-related is to determine the required safety functions for DBEs and BDBEs.
  - For DBEs, the required safety functions are those functions that need to be performed during DBEs to meet the TLRC.
  - For BDBEs with consequences above the DBE region's dose limits of 10 CFR 50.34, the required safety functions are those that need to be performed to prevent them from increasing in frequency into the DBE region where their consequences would be unacceptable.

- Next, for each required safety function, determine which SSCs are available and have sufficient capability and reliability to meet the required safety function. From this review, a set of SSCs is classified as safety-related to assure that the required safety function is accomplished.

Example of Risk-Informed Approach (3.5) Safety-Related SSCs



Pebble Bed Example of Safety Classification for Core Heat Removal Function

Are SSCs Available and Sufficient to Remove Core Heat in the DBE?							SSCs Classified as Safety Related?
Alternative Sets of SSCs	DBE 1c	DBE 2b	DBE 6c	DBE 7a	DBE 7b	DBE 11b	
Reactor PCU ACS	*No*	*No*	*No*	*No*	*No*	*No*	
Reactor SBS ACS	*No*	*No*	*No*	*Yes*	*No*	*No*	
Reactor CCS ACS	*No*	*Yes*	*No*	Yes	*Yes*	*Yes*	
Reactor Reactor vessel Active RCCS ACS	*Yes*	Yes	*Yes*	Yes	Yes	Yes	
Reactor Reactor vessel Passive RCCS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reactor Reactor vessel Building & ground	Yes	Yes	Yes	Yes	Yes	Yes	

Note: ***Italics*** indicates response during DBE

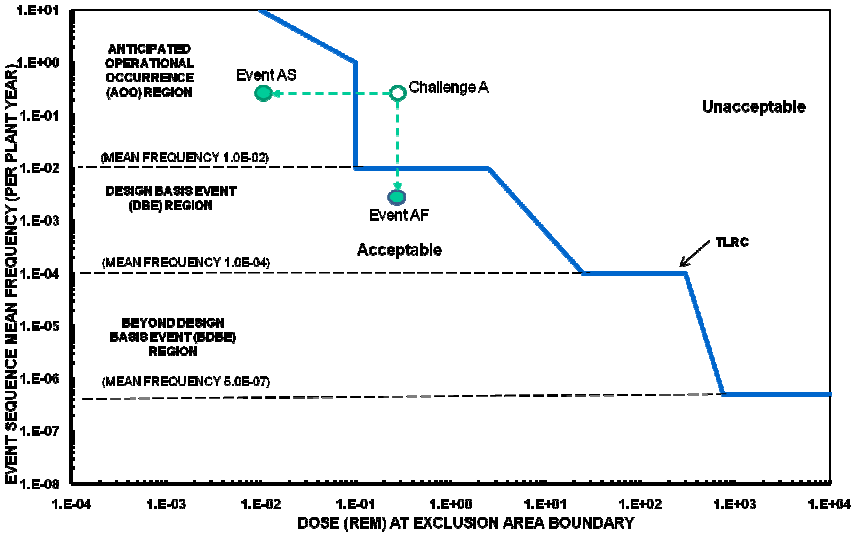
SSCs Classified Non-Safety-Related with Special Treatment (3.4.3)

- **SSCs classified as non-safety-related with special treatment are those relied on:**
  - **to perform safety functions to mitigate the consequences of AOOs to comply with the TLRC;**
  - **to perform safety functions to prevent the frequency of DBEs with consequences greater than the 10 CFR 20 offsite dose limits from increasing into the AOO region.**

SSCs Classified as Non-Safety-Related with Special Treatment (3.4.3) *(continued)*

- Analogous to the selection of SR SSCs, the functions that are needed to meet the TLRC for AOO events are determined from a review of the PRA.
- Since DBEs can have consequences above those acceptable for AOOs, assurance must be provided that the frequency of events with consequences greater than the 10 CFR 20 dose limits for the AOO region are lower than the cut off for AOO events.
- The SSCs available to perform these safety functions are reviewed to select a set to receive greater attention from a risk, safety margin, and defense-in-depth perspective and are classified as NSRST.

Example of Risk-Informed Approach (3.5) NSRST SSC



Special Treatment for Safety-Related SSCs 3.6.1

- Special treatment for safety-related SSCs is commensurate with that needed for the SSCs to achieve their capability and reliability requirements during select LBEs to meet the TLRC.
- Capability requirements are derived from accident mitigation considerations, for DBEs
- Reliability requirements are derived from accident prevention considerations, for DBEs and BDBEs

NSRST SSCs

- Special treatment for the non-safety-related with special treatment category of SSCs is commensurate with that needed for the SSCs to perform their capability and reliability requirements during AOOs.
- Capability requirements are derived from accident mitigation considerations, for AOOs
- Reliability requirements are derived from accident prevention considerations, for AOOs and (low consequence) DBEs
  - Special treatment may be applied to implement assumptions made in the PRA about the characteristics of SSCs that are modeled as well as those that may be screened out due to a low frequency of occurrence.

Representative Special Treatment Options

Special treatment requirements	SR SSCs	NSRST SSCs
Design requirements for SSC capabilities to mitigate specific LBE challenges	√	√
Numerical targets for SSC reliability and availability to perform safety functions	√	√
Design requirements for independence, redundancy, and diversity	√	
Design requirements for safety margins and design conservatism	√	
Codes and Standards for design, material procurement, fabrication, construction, and operation	√	
Seismic design basis	√	√
Seismic qualification testing	√	
Equipment qualification testing	√	
Quality assurance and quality control	√	√
Operational performance monitoring	√	√
Operational controls	√	√
Technical specifications	√	
Materials surveillance testing	√	
Pre-service and in-service inspection	√	√
Pre-service and in-service testing	√	

√ Indicates a level of special treatment for safety-related SSCs or consideration of the need for special treatment for NSRST.

White Paper Outcome Objectives (4.2)

Feedback is requested from the NRC regarding the acceptability of the following statements:

1.The NGNP approach to risk-informed safety classification and special treatment that blends the strengths of deterministic and probabilistic methods is acceptable.

2.The NGNP risk-informed safety classification categories and the bases for SSC classification within each category are acceptable.

3.The special treatment for the SR category of classification is commensurate with ensuring the SSCs' ability to perform their safety function for DBEs and high consequence BDBEs.

4.The special treatment for the NSRST category is commensurate with ensuring the SSCs' ability perform their safety function of providing significant defense-in-depth.

Q&A