Recent and Planned Developments and Updates in Codes and Standards, Part 1

- **Moderator:** Angela Buford, Branch Chief, NRR/DNRL/NVIB

- **Panelists/Speakers:**
  - George Flanagan (ANS)
  - Kent Welter (ANS)
  - Ralph Hill (ASME)
  - Steven Unikewicz (ASME)
  - Timothy Adams (ASME)

Research and Advanced Reactor Consensus Committee (RARCC)

2022 Activities

Presented to the NRC 2022 Standards Forum
September 28, 2022

Responsibilities & Organization of RARCC

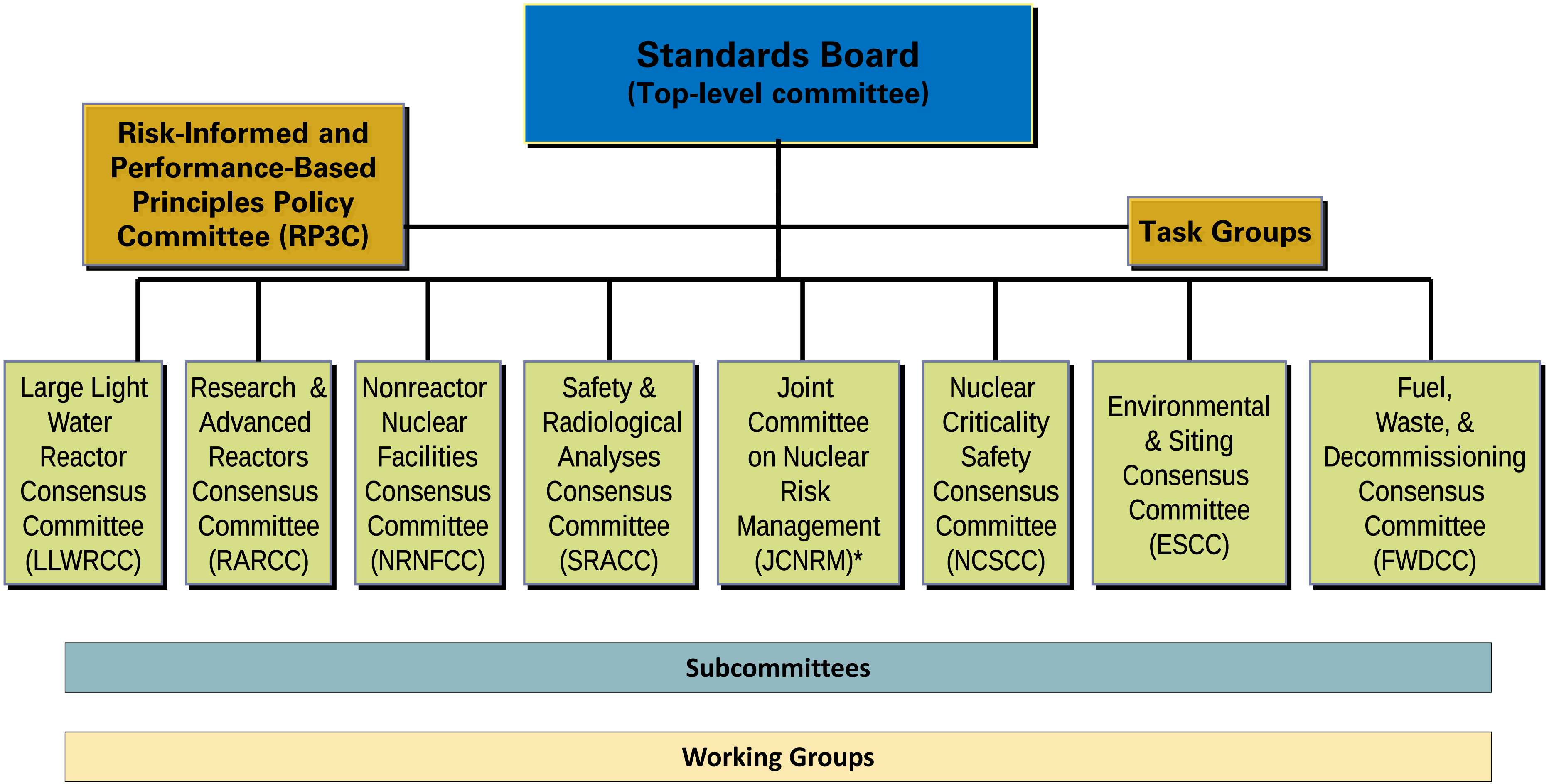
RARCC is responsible for the preparation and maintenance of voluntary consensus standards for the design, operation, maintenance, operator selection and training, and quality requirements for current and future research and test reactors including pulsed critical facilities, reactors used for the production of isotopes for industrial, educational, and medical purposes and current and advanced non-large LWRs. The scope includes but is not limited to water-cooled and non-water cooled Small Modular Reactors, Generation III+ and IV reactors, and future non-light water cooled/moderated large commercial reactors.

The RARCC standards include but are not limited to the design and operation of the nuclear island, the balance of plant, and other systems within the plant boundary affecting safety and operations.

It has two subcommittees:

- Research and test reactors (10 standards or projects in development)
- Advanced reactors (5 standards or projects in development)

The ANS Standards Committee



**The JCNRM is a joint ANS and ASME consensus committee.*

Research and Test Reactor Standards & Projects

- ANS-1-2000 (R2019), Conduct of Critical Experiment – current standard
- ANS-14.1-2004 (R2019), Operation of Fast Pulse Reactors – current standard
- ANS-15.1-2007 (R2018), Development of Technical Specifications for Research Reactors – current standard
- ANS-15.2-1999 (R2021), Quality Control for Plate-Type Uranium-Aluminum Fuel Elements – current standard
- ANS-15.4-2016 (R2021), Selection and Training of Personnel for Research Reactors – current standard
- ANS-15.8-1995 (R2018), Quality Assurance Program Requirements for Research Reactors – current standard
- ANS-15.11-2016 (R2021), Radiation Protection at Research Reactors – current standard
- ANS-15.16-2015 (R2020), Emergency Planning for Research Reactors – current standard
- ANS-15.21-2012 (R2018), Format and Content for Safety Analysis Reports for Research Reactors – current standard
- ANS-15.22-202x, Classification of Structures, Systems and Components for Research Reactors – new standard in development

RARCC Advanced Reactor Current Standards

- **ANS-53.1-2011 (R2021), Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants**
  - A revision of the current standard is being initiated.
  - The revision will focus on making the standard more inclusive of other high temperature gas reactor types. This will include a broader range of fuel particle designs and coatings, and different types of gas coolants. (The current standard focus is helium and Triso ® type fuels.)
  - The basic graphite moderator used in the design will be retained. Fuel types include micro and macro structure.
  - The update will also update the terminology, defense-in-depth, and safety design approaches to align with the newer (2019) Nuclear Modernization Program initiative.
  - The approach to safety design will go beyond the originally exclusive probabilistic risk assessment approach, and both Chapter 15 Design Control Document (aka FSAR) safety analyses and SSC categorization will be updated to reflect the current three category baseline of safety related (SR), non-safety related (NSR) and NSR with special treatments (ST) (NSRWT).


ANSI/ANS-53.1-2011

American Nuclear Society

nuclear safety design process for
modular helium-cooled reactor plants

an American National Standard

REAFFIRMED
October 7, 2021
November 1, 2016
ANSI/ANS-53.1-2011; R2021

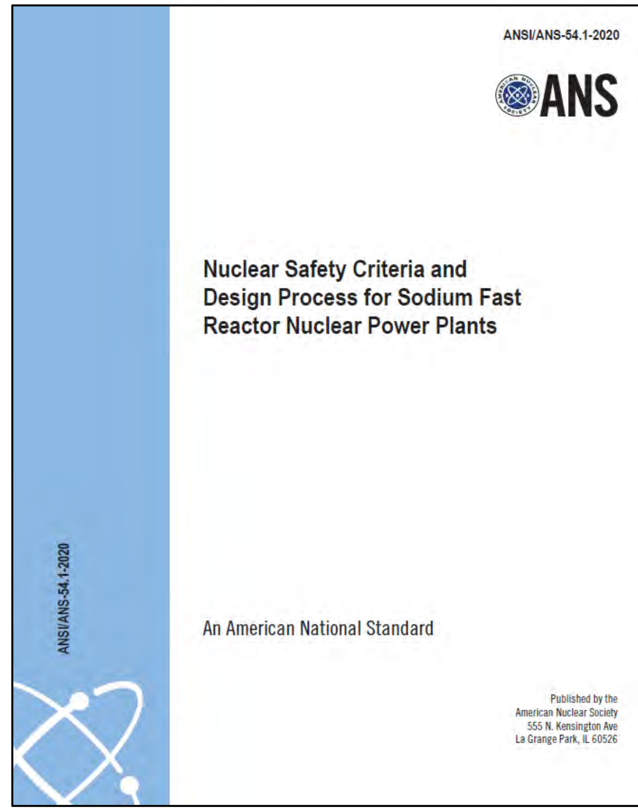
This standard has been reviewed and reaffirmed with the recognition that it may reference other standards and documents that may have been superseded or withdrawn. The requirements of this document will be met by using the version of the standards and documents referenced herein. It is the responsibility of the user to review each of the references and to determine whether the use of the original references or more recent versions is appropriate for the facility. Variations from the standards and documents referenced in this standard should be evaluated and documented.
This standard does not necessarily reflect recent industry initiatives for risk informed decision-making or a graded approach to quality assurance. Users should consider the use of these industry initiatives in the application of this standard.

ANSI/ANS-53.1-2011

published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

RARCC Advanced Reactor Current Standards (Cont'd)

- **ANS-54.1-2020, Nuclear Safety Criteria and Design Process for Sodium Fast Reactor Nuclear Power Plants**
  - This standard was approved in 2020 and remains current.
  - The scope covers all sodium fast reactor nuclear power plants, irrespective of level of power production and energy end use. It also applies to configurations in which there are one or more reactor units (modules) on a site.
  - The standard is intended to apply to all fuel types.
  - The heat transport system is not restricted to a particular configuration, and thus, this standard applies to loop, pool, hybrid, or other arrangements.
  - This standard also pertains to on-site storage of spent fuel prior to its removal for recycling or long-term storage.


ANSI/ANS-54.1-2020

ANS

Nuclear Safety Criteria and Design Process for Sodium Fast Reactor Nuclear Power Plants

ANSI/ANS-54.1-2020

An American National Standard

Published by the
American Nuclear Society
555 N. Kensington Ave
La Grange Park, IL 60526

RARCC Advanced Reactor Projects

- **ANS-20.2-202x, Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel, Molten-Salt Reactor Nuclear Power Plants – new standard in development**
  - The standard provides (1) design criteria for liquid-fuel, molten-salt reactors (MSRs) that match the safety intent of the 10 CFR 50 Appendix A, general design criteria following an equivalent process to that performed by NRC Regulatory Guide 1.232 for modular high-temperature gas-cooled reactors and sodium-cooled fast reactors, (2) definitions of MSR terminology important for safety evaluation, (3) describes distinctive safety considerations for MSRs, and (4) an MSR focused description of a risk-informed design process following the methodology described in NEI 18-04.
  - The standard was issued for formal ballot to the RARCC and parallel public review in August 2022. The ballot is scheduled to close September 21, 2022. Two objections were carried from the preliminary review. The RARCC ballot currently has six objections. Comments were submitted on the standards' structure; definitions; lack of requirements; control room requirements, use of risk-informed, performance-based methods; and consistency.

RARCC Advanced Reactor Projects (Cont'd)

- **ANS-GS-30.1-202x, Integrating Risk and Performance Objectives into New Reactor Nuclear Safety Designs – new guidance standard in development**
  - The ANS Standards Board directed ANS-30.1 to be converted from a requirements standard to a guidance standard.
  - The top-tier, technology-inclusive guidance in the advanced reactor framework remains in place with this change.
  - The purpose of this guidance standard is to ensure that qualitative and quantitative hazard and risk evaluation methods, which provide significant RIPB input for supplementing traditional design processes, are adequately addressed in preparation of technology-specific new reactor safety designs. To achieve this purpose, this guidance standard stipulates objectives essential for supplementing deterministic nuclear safety design practices with RIPB information derived from qualitative and quantitative risk evaluations. Incorporation of such risk and performance information during design is emphasized.
  - The draft guidance standard is expected to be issued for review before the end of this year.

RARCC Advanced Reactor Projects (Cont'd)

- **ANS-30.2, Classification and Categorization of Structures, Systems, and Components for New Nuclear Power Plants – new standard in development**
  - Establishes requirements and guidance to aid designer in developing a SSC classification process, describes how to categorize SSC functions based on safety performance criteria, provides requirements and guidance enabling advanced reactor designers (LWRs and non-LWRs) to develop processes for incorporation of risk-informed performance-based (RIPB) principles and methods into classification of SSCs.
  - Builds upon ANS-58.14 (Safety and Pressure Integrity Classification Criteria for LWRs), ANS-53.1 (Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants), and NEI 18-04 (RIPB Technology-Inclusive Guidance for Non-LWRs).
  - Harmonizes U.S. and international SSC classification guidance.
  - Bi-weekly meetings being held.
  - Draft anticipated by August 2023 to begin subcommittee review.

Potential New Advanced Reactor Standards

- RARCC is considering the need to resurrect historical standard ANS-54.8, Liquid Metal Fire Protection in LMR Plants.
- RARCC is exploring additive manufacturing standards.
- RARCC is following EPRI's Digital Twins Working Group to be in a position to support standards needs when determined.
- RARCC has been approached by two groups to develop some new standards in support of advanced reactors.
  - New or revision to ANS withdrawn standards on liquid metal coolants, dealing with sodium properties and fires
  - New standard in conjunction with Safety & Radiological Analysis Consensus Committee (SARCC) on "Initial Fuel Loading and Startup Tests for First-Of-A-Kind Advanced Reactors"
- Interaction with the newly formed Coalition for Advanced Reactor Licensing (CARL)

Challenges of New Advanced Reactor Standards

- Examples of challenges encountered in addressing new standards for advanced reactors include:
  - Many designers are in preconceptual or conceptual design phases so they are not sure what standards will be needed.
  - Many designers are unwilling to release information about their designs.
  - Some designer teams are small, and currently they do not have the manpower nor financial resources to support standards development.
  - Some designers do not think they need new standards or plan to use or modify existing standards to meet their needs.
- ANS has formally asked its members to suggest new standards for advanced reactors and is participating in new discussions with other SDOs to address these issues
- Note: These issues have been described in earlier meetings with the designers at meetings sponsored by ANS and NRC (previous standard forums).

QUESTIONS?

ANS-30.3 – LWR Risk-Informed Performance-Based Design

by Kent Welter, ANS-30.3 Working Group Chair

NRC Standards Forum
September 28, 2022

Outline

Introduction Key

Definitions Key

Concepts Key

References

Regulatory Endorsement

Introduction

Development and approval timeline

- 2017 – PINS approved
- 2019 – 1st draft / public comment period
- 2021 – 2nd draft / ballot
- 2022 – 3rd draft / recirculation ballot
- July 2022 – ANSI approval

[ANS 30.3-2022, Light Water Reactor Risk- Informed, Performance- Based Design]

Introduction (Cont'd)

Purpose

- provides requirements for the incorporation of risk-informed, performance-based (RIPB) principles and methods into the nuclear safety design of new commercial light water reactors (LWRs)
- establishes a minimum set of requirements for the designer to follow in order to appropriately combine deterministic, probabilistic, and performance-based methods during design development

Introduction (Cont'd)

Scope

- definition of safety requirements
- licensing-basis event (LBE) selection
- design-basis safety analysis
- probabilistic risk assessments (PRAs)
- severe accident analysis
- classification and categorization of structures, systems, and components (SSCs)
- systematic defense-in-depth (DID) evaluations
- performance-based decision analysis

Introduction (Cont'd)

Application

- technology-neutral elements but is intended for use in designing and licensing new commercial LWR designs under Title 10 of the Code of Federal Regulations (10 CFR) Part 50 or 10 CFR Part 52
- may be applied in whole or in part to operating reactors at the discretion of the designer and owner/operator

Key Definitions

- **defense-in-depth (DID):** A hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of AOOs and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive material and workers, members of the public, or the environment, in operational states and, for some barriers, in accident conditions (IAEA Safety Glossary)
- **risk-informed decision process:** A process that uses risk information and insights from PRA along with traditional deterministic approaches and judgments to inform decisions
- **performance-based:** An approach to design or regulation that relies upon the desired, measurable results or performance outcomes based on objective criteria rather than a prescriptive process, technique, or procedure
- **safety function:** A specific purpose that must be accomplished for safety for a facility or activity to prevent or to mitigate radiological consequences of normal operation, AOOs, and accident conditions (IAEA Glossary).

Key Concepts

Structured DID

- Level 1 – Prevention of abnormal operation
- Level 2 – Control of abnormal operation and detection of failures
- Level 3 – Control of accidents within the design basis
- Level 4 – Control of severe plant conditions
- Level 5 – Mitigation of consequences of significant radiological releases

Key Concepts (Cont'd)

Importance of formal decision analysis process

- The designer shall establish a formal decision analysis process as early as practical in the design process.
- The decision process is crucial to the successful implementation of RIPB principles and methods into the design process by providing a formal mechanism for
  - evaluating plant capability
  - programmatic DID alternatives
  - resolving regulatory conformance issues
  - guiding expert and independent reviews
  - evaluating the costs and benefits associated with design options or changes.
- Without a formal RIPB decision analysis process, decisions may become ambiguous, conflicting, or inefficient.

Key Concepts (Cont’d)

Importance of systems engineering

- an interdisciplinary design process based on the methods and processes of the systems engineering discipline should be implemented for the design of a new reactor
- These processes and methods should include a systems engineering plan or systems engineering management plan that describes how the systems engineering effort, in the form of processes, methods, and activities tailored for one or more life-cycle stages, should be managed and conducted within the organization of the actual project.

Key Concepts (Cont'd)

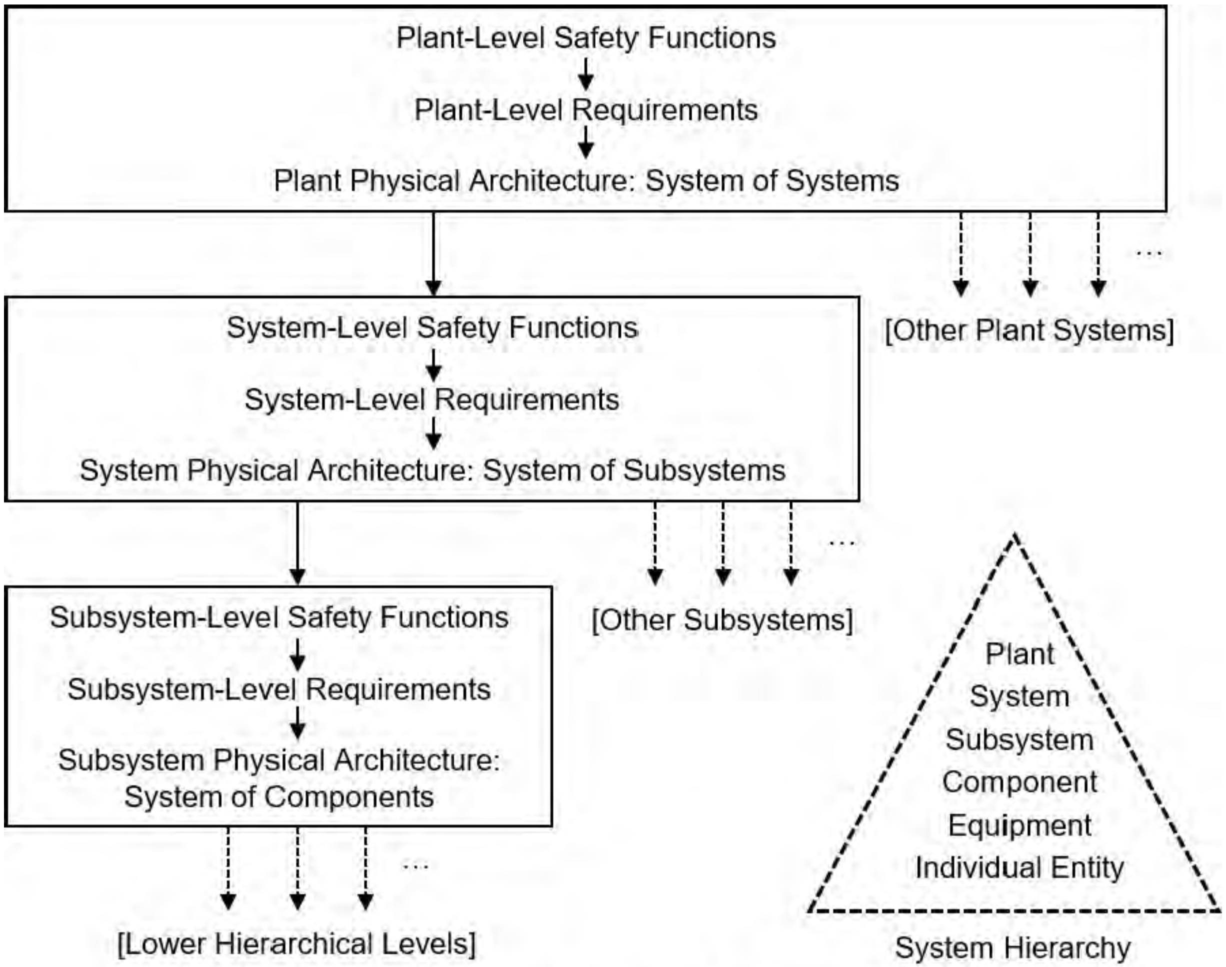
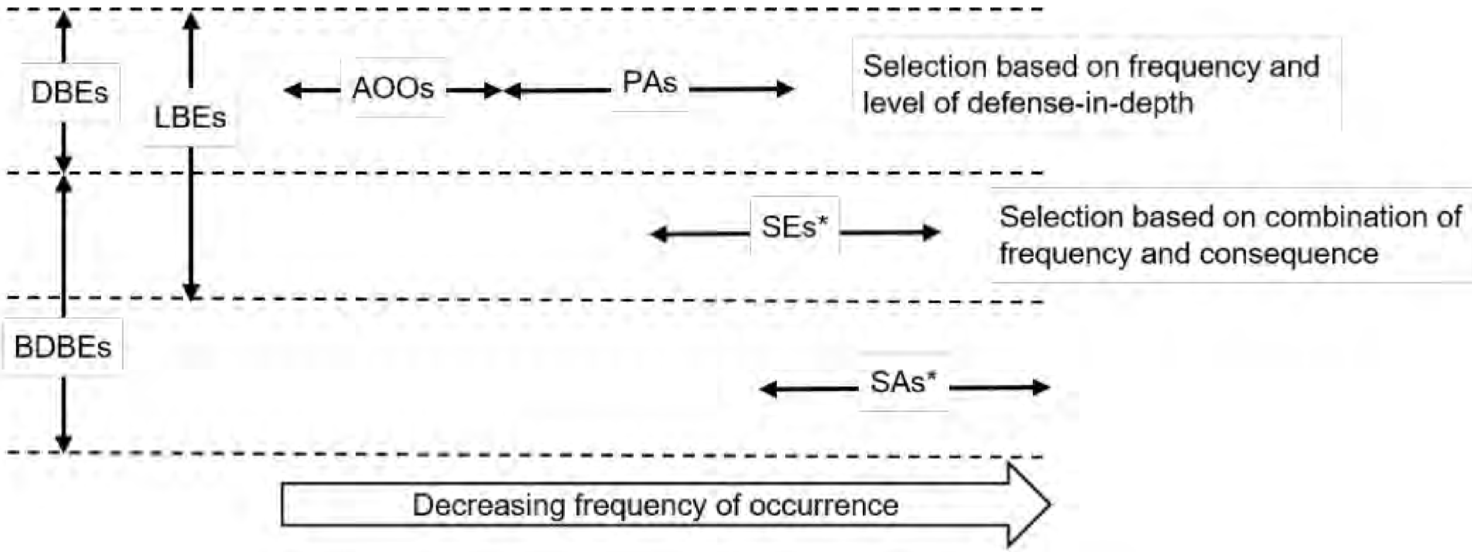


Figure 1 – Relationship structure for safety functions, safety requirements, and physical architecture

Key Concepts (Cont'd)



AOO: anticipated operational occurrence
BDBE: beyond-design-basis event
DBE: design-basis event
LBE: licensing-basis event
PA: postulated accident
SE: special event
SA: severe accident

*NOTE: NRC guidance necessitates specification of a core damage event for design-basis dose evaluations. These are often called special events (See Sec. 5.4).

Figure 2 – Selection of LBEs

Key Concepts (Cont'd)

Performance-based decision-making

- objective criteria to assess performance based on risk insights, deterministic analyses, and/or performance history
- quantitative and qualitative RIPB decision criteria to support transparent and repeatable decisions NUREG/BR-0303 describes how qualitative and quantitative criteria should be developed and used for decision-making
- recognition of different levels and types of DID when considering alternatives, including evaluation of safety margins
- evaluation of trade-offs on plant capital and operation cost versus risk reduction
- adequate treatment of uncertainties in the PRA results and the impact of these uncertainties on the decision-making process

Key References

- **ANS-30.1,** "Integrating Risk and Performance Objectives into New Reactor Safety Designs" (proposed draft standard guideline in development), American Nuclear Society, La Grange Park, Illinois.
- **NUREG-0800,** "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,"
- **NUREG-1855**, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking," Rev. 1, U.S. Nuclear Regulatory Commission (Mar. 2017).
- **Regulatory Guide 1.200,** "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities," Rev. 3, U.S. Nuclear Regulatory Commission (2020).
- **EPRI TR-016780,** "Advanced Light Water Reactor Utility Requirements Document," Volume 1, Revision 2, Electric Power Research Institute, Palo Alto, California
- **EPRI TR-1026511**, "Practical Guidance on the Use of Probabilistic Risk Assessment in Risk-Informed Applications with a Focus on the Treatment of Uncertainty," Electric Power Research Institute, Palo Alto, California (2012).
- **NEI 18-04**, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," Rev. 1, Nuclear Energy Institute, Washington, D.C. (2019).
- **ISO/IEC/IEEE 15288:2015**, "Systems and Software Engineering—System Life Cycle Processes," A joint standard of the International Organization for Standardization, International Electrotechnical Commission, and Institute of Electrical and Electronics Engineers (2015).
- **NUREG/BR-0303**, "Guidance for Performance-Based Regulation," U.S. Nuclear Regulatory Commission (2002).

ANS-30.3 Regulatory Endorsement

ANS Standards Board has sent a letter to the NRC on August 9, 2022, requesting their endorsement of ANS-30.3 in:

- RG 1.206, “Applications for Nuclear Power Plants” and
- RG 1.233, “Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors”

The ANS Standards Board seeks regulatory endorsement of this standard as an important contribution to advancing the mandates in the Nuclear Energy Innovation and Modernization Act (NEIMA) of 2019.

The ANS has contributed significantly to the modernization of nuclear safety standards.

Regulatory endorsement of this standard would enable NRC to report to Congress significant progress in implementing the advanced reactor regulatory activities plan.

ASME | PLANT SYSTEMS DESIGN

SETTING THE STANDARD

New ASME Standard on Plant Systems Design

NRC Standards Forum

Virtual Meeting, September 28, 2022

Ralph Hill, Chair ASME
Plant Systems Design Standards Committee
Hill Eng Solutions, LLC

Disclaimer

All statements made by the speaker represent his opinion alone, and do not necessarily represent the position of ASME.

Topics

- Introduction, including:
  - Scope
  - Key Processes
  - Overview
- RIPB Design
- Defense in Depth
- Safety Significance
- Summary

PSD Scope

… is a technology-neutral standard for design of facilities with potential for significant hazards to the health and safety of the public, the worker, and protection of the environment.

It can be applied to:

- electrical power generation,
- oil refining,
- oil and natural gas production,
- petrochemical,
- chemical,
- pharmaceutical, and
- hazardous waste treatment and storage

Key PSD Processes

1. Conduct plant process hazard evaluations and analysis in the early phases of design that:
   a. Provide early identification of hazards, including strategies to avoid and mitigate them
   b. Advance as the design matures
   c. Provide structure to the development of a quantitative risk assessment

Key Design Processes (Continued)

Incorporate and integrate:

2. Systems engineering design processes, practices, and tools with traditional architect engineering design processes, practices, and tools
3. Risk informed probabilistic design processes, practices, and tools with traditional deterministic design processes using reliability and availability targets

PSD Overview

- Structured approach to technical requirements definition
- Functional requirements – *What*
- Performance requirements – *How Well*
- Safety requirements
- Ability to track and trace technical requirements

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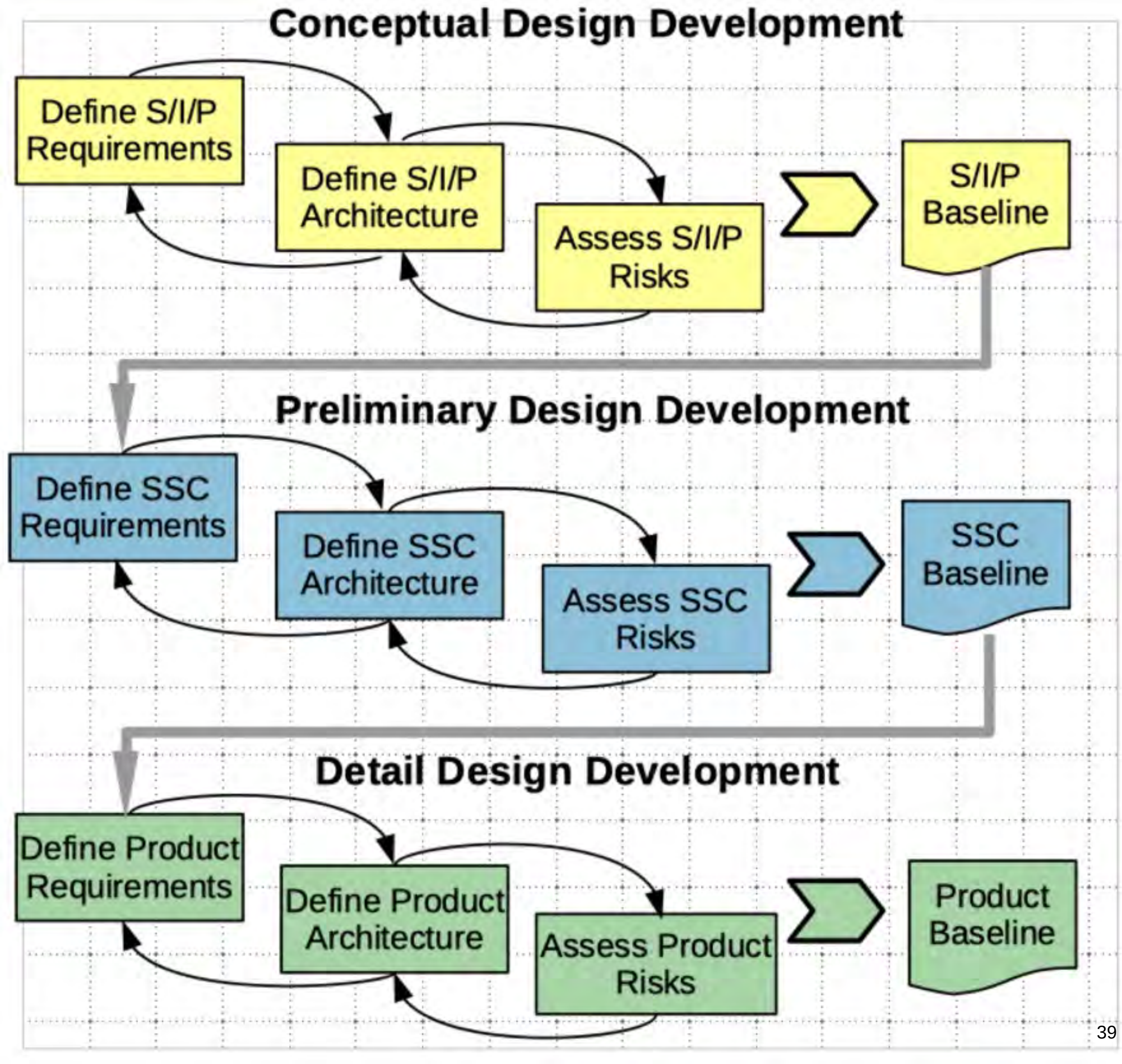
PSD Overview (Continued)

- Requirements are addressed at the correct phase of design development in an efficient manner
- Optimizes design, reduces latent design errors, minimizes re-design and re-work
- Provides a more cost-effective design

PSD Overview



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Risk-Informed Performance-Based Concepts (RIPB)

- RIPB Regulations
- RIPB Decision Making
- RIPB Design
- PSD Implementation of RIPB

RIPB Regulation

"… an approach in which risk insights, engineering analysis and judgment (including the principle of defense in depth and the incorporation of safety margins), and performance history are used, to

- focus attention on the most important activities,
- establish objective criteria for evaluating performance,
- develop measurable or calculable parameters for monitoring system and licensee performance,
- provide flexibility to determine how to meet the established performance criteria in a way that will encourage and reward improved outcomes, and
- focus on the results as the primary basis for regulatory decision-making."

RIPB Decision Making

Uses a balance of deterministic and probabilistic analysis methods to:

- characterize and help reduce uncertainties
- focus on what is important from a safety perspective to make better decisions

RIPB Design

- Ensure risk contributions associated with processes and SSCs are accurate
- Compare target reliabilities against operating experience-based data
- Avoid excessive optimism or conservatism that can distort the design inappropriately
- Use operating experience-based data to inform failure frequencies

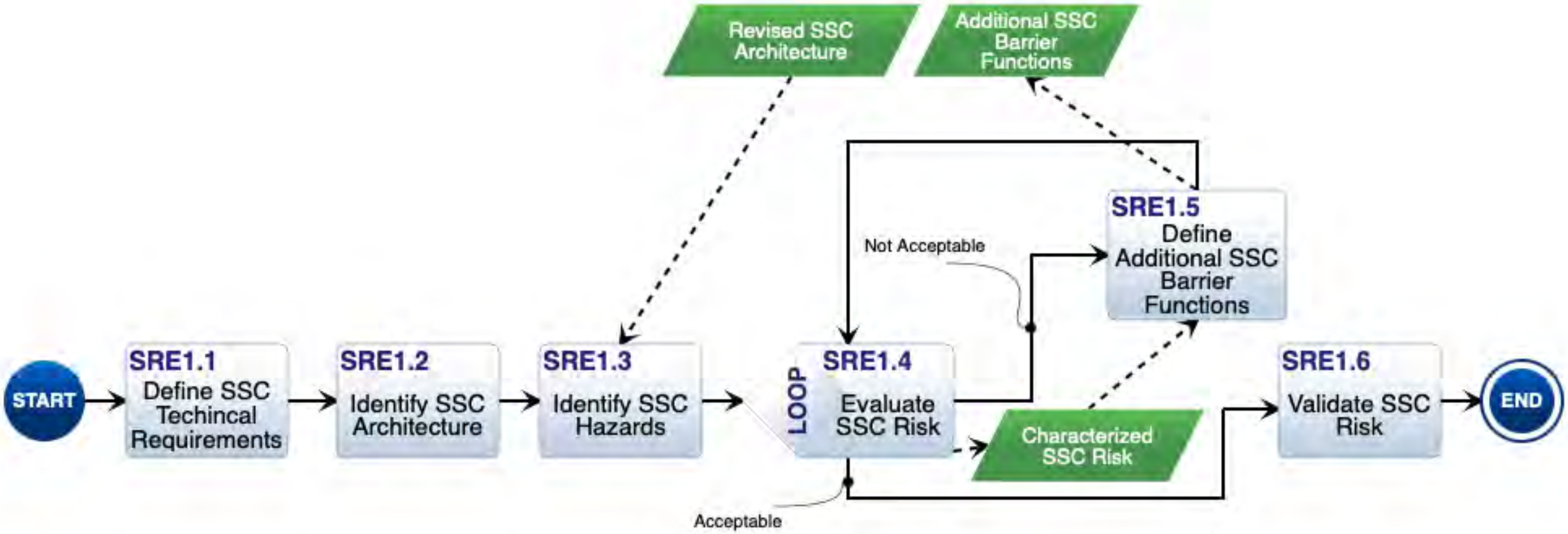
PSD RIPB Processes

- Qualitative and quantitative risk evaluations are used to inform design development
- Design processes are performance-based by application of the systems engineering processes establishing functional and performance requirements at each phase of design development
- Design processes are are technology-neutral since they do not presuppose an engineered solution to a given design challenge.

Defense in Depth

"An approach to designing and operating nuclear facilities that prevents and mitigates accidents that release radiation or hazardous materials. The key is creating multiple independent and redundant layers of defense to compensate for potential human and mechanical failures so that no single layer, no matter how robust, is exclusively relied upon. Defense in depth includes the use of access controls, physical barriers, redundant and diverse key safety functions, and emergency response measures." NRC NUREG-2122

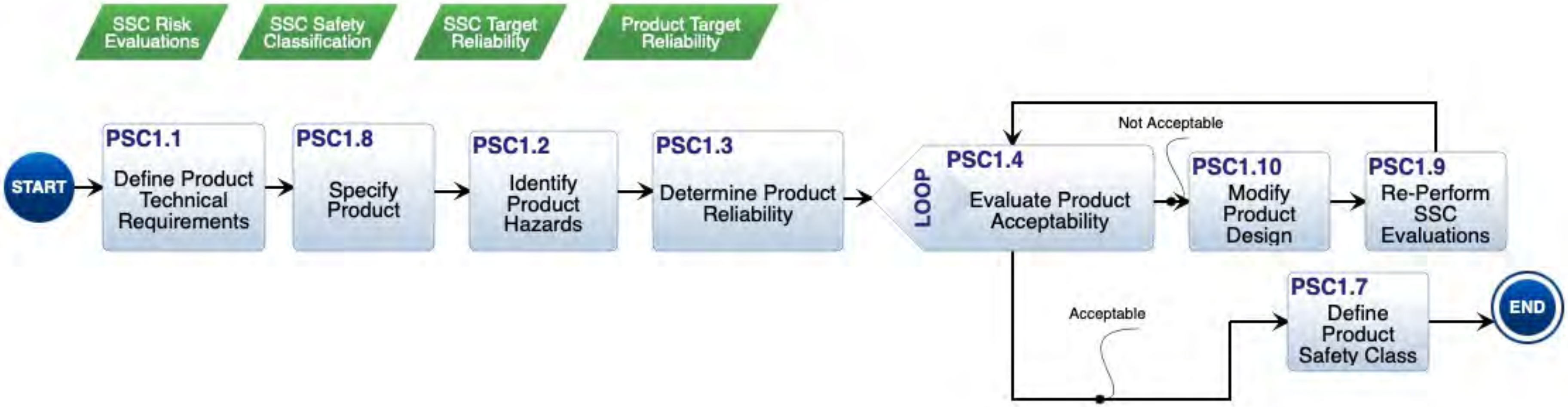
PSD Defense in Depth



Safety Significant SSCs

”… – those structures, systems and components that are significant contributors to safety as identified through a blended risk-informed process that combines PRA insights, operating experience and new technical information using expert panel evaluations.” NEI 00-04

PSD Safety Significant SSCs



Summary

- Incorporates and integrates systems engineering, hazard and risk evaluation, and probabilistic design methods into traditional design processes
- Provides detailed process and guidance on how to perform and integrate industry and regulatory concepts of:
  - defense in depth
  - safety significance
  - risk-informed and performance-based concepts

… into a seamless design process.

ASME QME-2 Qualification of Mechanical Equipment
ASME OM-2 Operation and Maintenance of Nuclear Power Plants

Steven Unikewicz

ASME Fellow

ASME Board of Nuclear Code and Standards

Tom Ruggiero, PE

ASME Fellow

QME-2, General Requirements

Overview

- Background
- QME-1 / QME-2
- OM / OM-2
- Going Forward

Backround

- .The codes were written for Water-Cooled Reactor Plants
- Component Based Codes
- There is no consideration for Advanced Reactors
- QME and OM Codes are mature and fully developed
- Terms like Safe Shutdown, Cold Shutdown and Design Basis Event may be redefined
- The term “significant” is used throughout with no basis for meaning
- QME and OM were written for operating plants not new designs

New Codes

- Logical format, Logical Layout
- Avoid circular referencing
- Clear language, remove conflicts
- No redefining of words and terms
- Clear descriptions rather than shorthand terms
- Remove adjectives that have multiple definitions
- No “if practical/practicable” or other similar interpretive phrases

Qualification for Mechanical Equipment

ASME QME-1-2017

QME provides the requirements and guidelines for the qualification of active mechanical equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear facility.

QME-2

- Function based Code
  - Qualify the function
- Risk-Informed / Graded Approach to Qualification
- Scope – Pumps, Valves, Dynamic Restraints
  - In Discussion - Eliminate use of Active / Passive
    - Does it apply to other mechanical equipment?
- It will form the baseline for IST within OM-2

QME-2 Going Forward

- ASME Working Group met in August
- Fall 2022 next working Group Meeting
- 2023 Prepare DRAFT for full Committee Review

OM – A Component Code

- Several sections of the current OM Code require verification of component design basis. This is not the original intent of IST.

- The original concept of OM was to ensure operational readiness and be able to monitor and detect degradation.
- OM is not to ensure operability rather;
  - Ensure operational readiness.
  - Detect degradation
  - Trend results so that a component can be reworked before failure
- These three objectives will still be part of the new code.

OM Scope - Issues

- Scoping Issues continue to arise

  Components that are not ASME 1, 2 & 3

- A scope statement that encompasses all of the components that are important to safety is difficult.

- The question of importance to safety need not rest with the code writers. Instead, it should be with the plant designer and their regulator.

Plant Design and IST

- Pump, Valve, Restraint component functions are the same irrespective of System Function. Component selection, installation and qualification before IST.

- Component Qualification and baseline for subsequent IST will be in QME

  - O&M should use data obtained during qualification

OM 2 - Prerequistites

- Component is correctly specified, designed and qualified.
- The qualification includes the data for subsequent IST.
- All IST Components identified during the Licensing of the plant.
  - Plant designer and the Regulator; not by the code.
- The system and component are designed to be tested irrespective of plant mode.

A NEW OM CODE - CONCEPT

- Applicable for any type of Plant.
  - No selection of components within OM-2 because;
    - Components for IST identified and qualified during design/licensing, manufacture process
- Consider the function of the component rather than the system
- OM Purpose to;
  - Periodically to verify operational readiness
  - Trend degradation
  - Allow prediction of when rework is required
- No Mandatory Appendices

OM-2 Going

- Outline and Base Document – Done
- September 19, 2022 - OM2 Meeting
- November 3, 2022 – First Final Draft
- December 2022 – Present to OM Standards
- 2023 – Resolve Comments
- 2024 – Issue OM-2 as a new Code

Questions?

ASME Section III Seismic Design Steering Group - Introduction

NRC Standards Forum
September 2022
Virtual Meeting

Timothy M. Adams
Vice Chair, Section III Standards Committee
Chair, SC-III, Seismic Design Steering Group

JENSEN HUGHES
Advancing the Science of Safety

Purpose of Steering Committee

- To Provide Oversight and Guidance on Seismic Design In Section III
- Committee Develops & Recommends Actions
- Develop a Roadmap for Implementation
- Implementations will be by Applicable Book Section Committees

Observations

- The Scope and potential effort has expanded significantly
- Multiple Industry Initiatives on Seismic Design
  - Breath of Advanced reactors is a challenge
  - Shifting to Performance and/or probabilistic Shifting Design
  - Trick is how to translate that to component construction rules – SC III is a Component Construction Code
- The SC III Seismic Design is dated and needs significant work
- *Implementation will be a large, complex task with multiple interfaces outside of ASME SC III*

ASME SETTING THE STANDARD

Summary of Issues Identified

1. Extreme ground motions should be addressed by committee.
   a. Work in conjunction with ASME/JSME Extreme Event Task Group
   b. How to fit within the current Code Structure?
2. Take up component protection by seismic isolation, but not seismic isolation systems more generally.
   a. Design of distribution systems across the Building Isolation Boundary
   b. Design of distribution systems attached to equipment modules or components or skids
3. Treatment of seismic stresses for all Section III components, including fatigue effects
   a. Primary stress issue? Fatigue issue? Buckling? Some Combination?
4. Elastic Analysis Updates
   a. Better definition of multiple input response spectra
   b. Revisit Damping values and basis
   c. Revisit use of Newmark-Hall Inelastic Response Spectra (NUREG/CR-0098)
5. Elastic vs. inelastic analysis
   a. Strain-based criteria
   b. How to use elastic analysis with inelastic acceptance criteria
   c. Cyclic counting method in reference to Seismic
   d. Strain Hardening Effects (Fatigue Action Plan)
   e. Look at Section VIII, Div. 2 Strain-Based
6. Aftershocks is an issue that may need to be addressed
   a. Long duration earthquakes
7. Cumulative Absolute Velocity (CAV) as a metric for ground motions intensity
   a. More of an ASCE issue that would be provided as input rather than a topic to be addressed by this group.
   b. For ground motions effects, not in our scope.
   c. Appendix N response time history analysis may need to look at this.

Summary of Issues Identified

8. Regulatory Guide 1.166, Rev. 1 pre-earthquake planning, shutdown, and restart of a nuclear power plant following an earthquake.
    a. Safety Report 66
    b. How to handle extreme earthquakes – margin issue
9. Significance of the vertical component of seismic excitation
    a. Coupling of horizontal and vertical
    b. Especially Base Isolated systems
10. High Frequency effects on Seismic Design
11. Needs of advanced reactor designs
    a. Some will be low pressure designs
    b. Safety significance of components
    c. Investment protection – cost of repair/replace
    d. Maintain Core Geometry for LMCFR
12. Effects of seismic on break locations [HELB]
13. Look at how to generate time histories for component analysis(ASCE-4 Chapter 6?)
    a. From floor spectra
    b. Damping
    c. Correlation requirements
    d. Other issues
14. Seismic decoupling of piping systems
    a. Attached to equipment
    b. Branches attached to header
15. Effect of performance based Design on Seismic Design (ASCE-43/4; alternate requirements)

ASME
SETTING THE STANDARD

Summary of Issues Identified

- **Possible new Items from Letter ballots**
  - **Non-linear structural (support effects)**
  - **Increased damping effects form Due to energy dissipation of supports (piping)**
  - **Seismic Design of Graphite Core supports**
  - **Seismic design of flange bolting for leak tightness**
  - **Support design issues or requirements**
  - **Uniform Hazzard Spectra and Hard Rock High Frequency Content**
  - **More details on valve design requirements**
  - **Class MC containment issues**

Schedule of Implementation

- Roadmap Draft - Completed
- Solicit Advanced reactor Input post July 2021 Code week - Completed
- Issue draft for review and comment before August 2022 Code week – Completed
- Target Section III approval by End of 2022
- Selected implementation as 2025 Strategic item(s)
- Monitor, Track, Oversee Progress of Implementation
- Provide Guidance and Support
- Maintain an Updated Roadmap

ASME SETTING THE STANDARD

USNRC Engagement

- Some of the concepts and issues are very different than current design methods and rules
- Some of the concepts come from ongoing work being done at the USNRC
- Regular Involvement with the USNRC thru public meetings would be of great benefit
  - Understand the concepts
  - Get early Regulatory feedback
  - Address concerns, issues early on in the process

ASME Section III Seismic Design Steering Group

Thank You

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