ANS-30.3-2022 Endorsement

NRC Public Meeting

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- Key Concepts
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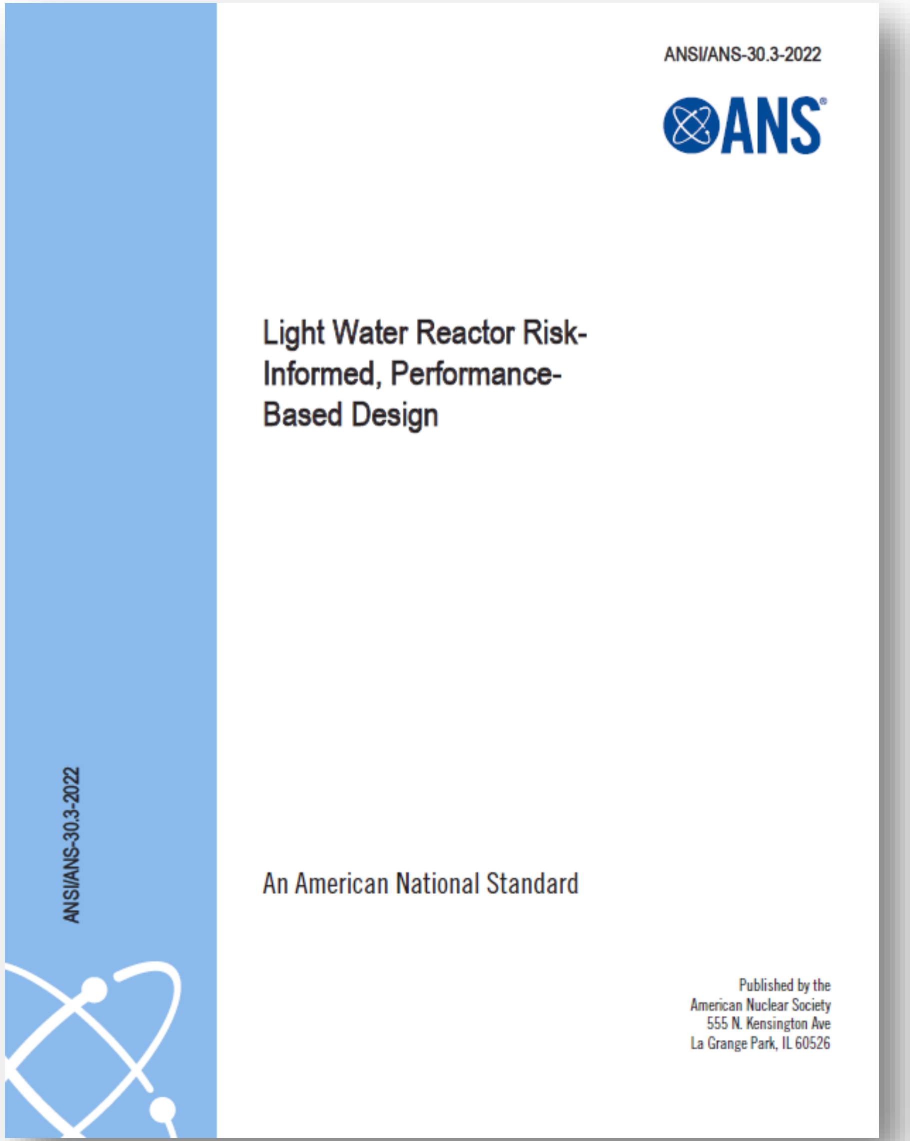
Introduction

- ANS-30.3-2022 establishes a minimum set of process requirements for the designer to follow in order to appropriately combine deterministic, probabilistic, and performance-based methods during light-water reactor (LWR) design development.
- A distinction is made between the safety design of a reactor product and the overall set of design activities that necessarily includes economic, environmental and other considerations. In other words, RIPB design is a sub-process within the overall reactor design and product development process.


ANSI/ANS-30.3-2022

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Light Water Reactor Risk-Informed, Performance-Based Design

An American National Standard

ANSI/ANS-30.3-2022

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

Introduction (cont.)

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.)

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

Introduction (cont.)

Development and approval timeline

- **2012 – 2014** – NuScale pre-application engagement with NRC for US600 Design Certification Application (DCA)
  - Drove need for new RIPB LWR standard. July 19, 2012 pre-application slides (https://www.nrc.gov/docs/ML1220/ML12208A172.pdf)
- **2017** – ANS-30.3 Project Initiation Notification System (PINS) approved
- **2019** – 1st draft / public comment period
- **2021** – 2nd draft / ballot
  - Incorporation of industry lessons learned. July 31, NuScale RIPB Design and Licensing Lessons Learned (https://www.ans.org/file/1913/Nuscale_RIPB_Design+&+Licensing+Lessons_7-30-20.pdf)
- **2022** – 3rd draft / recirculation ballot
- **July 2022** – ANSI approval

- Premise: demonstrating the successful application of ANS-30.3 in a licensing application (and NRC endorsement) will help to broaden use of the standard and support first-mover applications
  - NuScale is actively using guidance from ANS-30.3 to support their 2022 Standard Design Approval Application (SDAA) to the NRC (e.g., SSC classification process)

- ~35 reviewers from 4 ANS committees RP3C, SCORA, RARCC, and LWRCC (including individuals from the NRC)
- ~230 review comments addressed
- Level of detail (use of shall and should) and definitions/terms was a common theme amongst the many comments.

Introduction (cont.)

Key References

- **ANS-30.1,** "Integrating Risk and Performance Objectives into New Reactor Safety Designs" (draft standard guideline), 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).

Key concepts

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.)

Formal performance-based decision making and requirements management

- Requirement to establish a formal decision analysis process.
    - Without a formal risk-informed and performance-based (RIPB) decision analysis process, decisions made over the evolution of a design may become ambiguous, conflicting, or inefficient.
- Requirement to employ requirements management for establishing requirements, evaluate options, identify acceptable options, and track integration of requirements into the reactor product.
- Describes a decision-making structure within which requirements associated with the processes described meet specified acceptance criteria and thereby achieve the standard's outcome objectives in a formal way.
    - A substantial part of the value of ANS-30.3 as a voluntary consensus standard is on account of this formal decision-making structure.

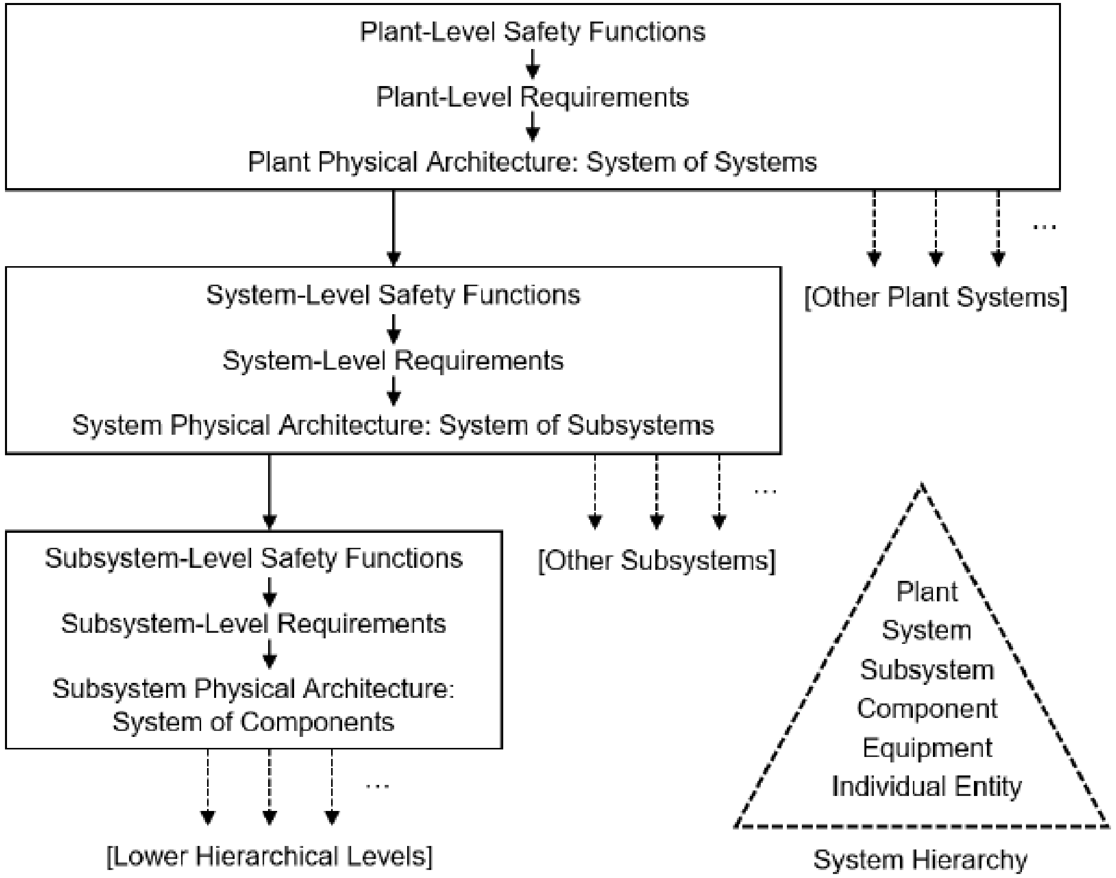

Figure 1 – Relationship structure for safety functions, safety requirements, and physical architecture

Industry Use and Example Applications

- "Importance of Systems Engineering to Support Risk-Informed, Performance-Based Methods,“ February 28, 2020, by Kent Welter (NuScale)
- "Update to NuScale’s SSC Classification and D-RAP Processes to Support First Plant Deployment,” July 30, 2021, by Patrick Conley (NuScale)
- "ANS-30.3 Performance-Based Decision Making,“ October 29, 2021, by Kent Welter (NuScale)
- “Use of a Risk-Informed Performance-Based Advanced Reactor Design Standard to Categorize and Classify Components for a Current Generation Nuclear Power Plant,” PSAM 16 Conference, June 2022, by David Blanchard (AERI)
- NRC Safety Evaluation for NuScale Topical Report, “Methodology for Establishing the Technical Basis for Plume Exposure Emergency Planning Zones at NuScale Small Modular Reactor Plant Sites,” Revision 3, October 2022.
- "NuScale Systems Engineering—Requirements Management,“ February 24, 2023, by Kevan Griffith (NuScale)
- "Benefits of Adoption of RIPB Approaches for Operating Reactors' Licensing and Standards,“ August 25, 2023, by Svetlana Lawrence (INL) and N. Prasad Kadambi (Kadambi Engineering)
- "Technology-Inclusive Implications of ANS-30.3, 'LWR Risk-Informed, Performance-Based Design,“ February 23, 2024, by N. Prasad Kadambi (Kadambi Engineering)

Observation: Some LWR SMR vendors have chosen to adopt an IAEA approach to RIPB design and licensing, while others have decided to adopt ANS-30.3-2022. Still others remain undecided. Adoption of performance-based US consensus standards helps to ensure American leadership in deployment of new nuclear technologies.

Significance of ANS-30.3 for ANS and other voluntary consensus standards?

- ANS-30.3 is a transitional voluntary consensus standard that bridges the gap between design practices that have provided the solid basis for demonstrating the viability of LWRs as a well-known technology.
- ANS views ANS-30.1, 30.2, and 30.3 as being a suite of interrelated standards which can help make progress on efforts such as the EPRI/NEI North America Advanced Reactor Roadmap.
- Additionally, ANS sees opportunities for working with ASME on standards such as Section III, Division 5 and Section XI, Division 2.

How does ANS-30.3 address RIDM? (cont.)

- ANS-30.3 takes its cue from Nuclear Energy Innovation and Modernization Act (NEIMA) and the defined attributes of a technology-inclusive regulatory framework as evidenced by the following:
  - [14] "Technology-inclusive regulatory framework.—The term ''technology-inclusive regulatory framework'' means a regulatory framework developed using methods of evaluation that are flexible and practicable for application to a variety of reactor technologies, including, where appropriate, the use of risk-informed and performance-based techniques and other tools and methods."
- NEIMA focuses on NRC and regulation, but <u>ANS-30.3 focuses on the LWR design process</u>.

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 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.

High-level NRC comments and ANS response

- **NRC high-level comment #1**
  - *ANSI/ANS-30.3-2022 provides broad and high-level guidance to designers of advanced light water reactors. While this objective is consistent with the standard's intended purpose as design guidance, standards endorsed by the NRC in the past have included substantially more detail.*

- **WG Response**
  - *ANSI/ANS-30.3-2022 is a performance-based standard; therefore, it would not normally be expected to contain the level of technical detail typically found in prescriptive documents. With a global move toward modern performance-based design and licensing guidance, higher-level standards like ANSI/ANS-30.3-2022 provide flexibility to the reactor designer in establishing processes and procedures tailored to their own unique business needs and process while still maintaining strong tenets of nuclear safety. In addition, ANSI/ANS-30.3-2022 contains 150-plus “shall” statements across a wide range of design processes. It should be noted that the “shall” statements express a wide range of levels of detail.*

  - *It should also be noted that ANSI/ANS-30.3-2022 offers users ways of taking advantage of recent evolutions in the NRC’s regulatory practice, which is more open to performance-based concepts and methods. Section 11, “Performance-based decision making,” may be seen as groundbreaking because it explicitly draws from the Commission’s modernization efforts documented in Staff Requirements Memorandum (SRM) for SECY-98-144, “White Paper on Risk-Informed, Performance-Based Regulation.”*

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High-level NRC comments and ANS response (cont.)

- **NRC high-level comment #2**
  - *NRC Comment #2 (General): On several topics, the standard contains guidance that is noticeably different information from established NRC regulations, policy, guidance, and endorsed documents (e.g., guidance for Title 10 of the Code of Federal Regulations (10 CFR) 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors," and 10 CFR 50.47 "Emergency plans").*

- **WG Response**
  - *The standard represents established state-of-practice techniques (e.g., NuScale Design Certification and Standard Design Approval Application) and is expected to be fully compliant with existing NRC light water reactor (LWR) regulations. In addition, the standard provides guidance in some areas (e.g., risk-informed single failure criterion) whereby designers may take exceptions to specific regulations or guidance with appropriate justification on a case-by-case basis. Section 11, "Performance-based decision making," on regulatory conformance describes how a designer might develop such justification for departures or exceptions, which are allowed under the existing regulations. Additional specific comments are addressed via responses to NRC Comment #5 (10 CFR 50.69) and #7 (10 CFR 50.47).*

Summary and Next Steps

- ANS-30.3-2022 is a transitional, risk-informed and performance-based process standard which meets the technology-inclusive intent of NEIMA
- It is a new standard being adopted by first-mover SMR vendors (e.g., NuScale)
- NRC endorsement of the standard will support first-mover licensing applications and broader adoption of US consensus standards, helping to ensure American leadership in deployment of new nuclear technologies
- Continued discussion between ANS, industry, and the NRC is requested with special attention on performance-based decision making and requirements management