American Nuclear Society

MINUTES

Risk-Informed, Performance-Based Principles and Policy Committee (RP3C)

November 16, 2020

Members Present:
N. Prasad Kadambi (Chair), Kadambi Engineering Consultants
Patricia Schroeder (Secretary), American Nuclear Society
Kathryn Murdoch, (Secretary pro tem)
Todd Anselmi, Idaho National Laboratory
James August, Individual
Robert Budnitz, Lawrence Berkeley National Laboratory-retired
Robert Burg, EPM, Inc.
Nilesh Chokshi, Individual
Donald R. Eggett, Eggett Consulting LLC
George F. Flanagan, Individual
Michelle L. French, WECTEC
Kurt Harris, Flibe Energy, Inc.
Ralph Hill, Hill Eng Solutions LLC
David Hillyer, Energy Solutions
Gerald (Tim) Jannik, Savannah River National Laboratory
Marsha C. Kinley, Duke Energy Corporation
Mark A. Linn, Oak Ridge National Laboratory
Jean-Francois (Jef) Lucchini, Los Alamos National Laboratory
Stewart Magruder, U.S. Nuclear Regulatory Commission
Charles (Chip) Martin, Longenecker and Associates
Michael Muhlheim, Oak Ridge National Laboratory
James O'Brien, U.S. Department of Energy
Andrew Smetana, Savannah River National Laboratory
Steven L. Stamm, Individual
Ed Wallace, GNBC Associates
Kent Welter, NuScale Power
Robert W. Youngblood III, Idaho National Laboratory

Guests Present:
Mihai Aurelian Diaconeasa, North Carolina State University
C. Rick Grantom, CRG LLC
Dennis Henneke, GE Hitachi
Steven Nesbit, LMNT Consulting
Chunlie Nie, Framatome
Ivan (Guest)

1. **Welcome, Roll Call & Introductions**
RP3C Chair Prasad Kadambi welcomed all to the virtual meeting. He explained that RP3C reports to the Standards Board in its effort to modernize ANS standards. Members and guests were encouraged to participate in the discussions by using the “raise your hand” feature.

2. Approval of Meeting Agenda

Prasad Kadambi directed members to a presentation prepared to use as a guide throughout the meeting—See Attachment 1. The agenda was approved as presented with the flexibility to move the timing of discussions as need to accommodate presenters and requests.

CATEGORY I: ADDRESS STANDARDS BOARD'S OBJECTIVES

3. RP3C Procedural Guidance Development and Implementation (See Attachment 2 for the Guidance Document)

Prasad Kadambi explained that the purpose of the Guidance Document (GD) is to help working groups understand risk-informed, performance-based methods (RIPB) at a high level. It is supposed be an enabler and to be outcome orientated. It offers outcome attributes but leaves working groups to establish their own outcomes. Think globally while you act locally is the thought behind the GD.

- Status of RP3C GD socialization and training program

  - Structure of GD
    The GD is broken into 6 sections providing the 1) purpose, 2) background, 3) organization, 4) process, 5) defining the outcomes, and 6) RIPB approaches. The GD has four appendices providing roles, responsibilities, examples, and frequently asked questions. Only 5 of the 24 pages are technical. About half of the material is explanatory with the remaining procedural based on feedback.

  - Planning for Socialization and Training
    Kadambi customarily reports progress to and seeks direction from the Standards Board which meets the following day. He seeks opportunities to communicate with working groups to increase awareness of the GD and to offer assistance.

- Commenting Process and Resolution of Comments
  The revised GD was provided to the Standards Board for review and comment in September 2020. Most comments were favorable; however, two commenters offered negative comments. Robert Budnitz is one of the objectors and asked to make a presentation to the RP3C—see Attachment 3.

  Budnitz explained that his criticism of the GD is that it doesn't provide the guidance to risk-inform a standard. He feels that it is not ready for prime time and has concerns that the document has already be shared outside of ANS. Additionally, Budnitz feels that the Joint Committee on Nuclear Risk Management (JCNRM) and probabilistic risk assessment (PRA) should be recognized in the GD. Dennis Henneke agreed and added that JCNRM standards should be included as examples. When questioned, Kadambi explained that the GD was reviewed by RP3C and approved by the Standards Board last year to be issued for trial use. Comments from the trial use and the training program were incorporated into the GD. He believes that the GD provides sufficient guidance for working groups through the use of references like NUREG/BR-0303, "Guidance for Performance-Based Regulation." The RP3C is a resource for working groups, not a consensus committee with formal balloting. The discussion on the GD will be continued at tomorrow's Standards Board meeting.

- Next Steps Toward Delivery of Training
  The first training was offered in May 2020. Comments were received and incorporated into the revised GD. The plan is to offer training twice between November and June ANS meetings, and once between June and November meetings of each year.

4. SMART Matrix for RP3C

- RP3C Actions on Standards Committee Strategic Plan Goals & Objectives
  SMART Matrix—See Attachment 4

  Steven Stamm explained that the Standards Committee Strategic Plan was developed about five years ago at the request of ANS headquarters to provide a vision with goals and objectives. Initiatives were developed for each goal. Basically, initiatives for RP3C were a little bit on the ambitious side. A SMART matrix is used to set actions and due dates which are reviewed at every Standards Board meeting.

  The SMART matrix recognizes training and outreach objectives for RP3C. Stamm clarified that the intent of the matrix is to inform the industry what we are doing, not provide training to those outside of ANS. Providing the GD for use outside of ANS was not considered and would need to be evaluated if it is to be pursued. Kadambi feels it is a subject worth discussing. Standards Board Chair Eggett is an advocate of pursuing such an evaluation, sooner than later.

  Kadambi encouraged members to become more engaged and help support initiatives assigned to RP3C in the SMART matrix.

- RIPB Community of Practice (CoP)
  RP3C initiated CoP presentations as webinars similar to regular meetings in February 2020. Presentations are scheduled the last Friday of each month. The November and December sessions were cancelled due to holidays. Sessions have covered varied areas. The reception has been favorable with increasing participation. Sessions have been recorded and are publicly available on RP3C's webpage.

- CC Chairs Report on RIPB Standards
  Kadambi stated that he is trying to work directly with working groups to capture their experience with concepts and incorporate into the GD.

5. ANS-30.1 and Related Products

Prasad Kadambi reviewed the structure of proposed new standard ANS-30.1, "Integrating Risk and Performance Objectives into New Reactor Safety Designs," and related projects. A draft of ANS-30.1 was issued for a review and comment ballot last April. Significant comments, including comments from RP3C, are currently being addressed by the working group. RP3C took the initiative to address some of the structural elements of ANS-30.1 in two CoP sessions—one by Ralph Hill on system engineering and the other by Ed Wallace on the License Modernization Project and NEI 18-04, "Risk-Informed Performance-Based Technology Guidance for Non-Light Water Reactors." Kadambi recognized that ANS-30.1 is evolving right now. ANS-30.1 Working Group Chair Mark Linn confirmed that he is working on another revision and expects to have it ready by the end of January 2021.

6. Role of CoP and Outcome Expectations

Prasad Kadambi is hopeful that the CoP helps working groups trying to incorporate RIPB methods in ANS standards and to improve understanding of RIPB concepts. Presenters have been those implementing RIPB methods. As discussed earlier, the CoP has held eight sessions in 2020.

Kadambi questioned if the CoP could pursue two major themes as pilots—systems engineering practices and harmonization of consensus standards to enhance its benefit. His thought is if RP3C supports this kind of approach, he would take the idea to the Standards Board tomorrow. The sentiment of members was that the approach would likely not add value to what industry is already doing, but they did see value in incorporating presentations from other standards development organizations (SDOs).

<u>**CATEGORY II:**</u> <u>EXPAND RIPB METHODS</u>

7. NRC's Promotion of Harmonization of Consensus Codes and Standards (C&S)

The U.S. Nuclear Regulatory Commission (NRC) Standards Forum was held on October 13, 2020. Donald Eggett, George Flanagan, Prasad Kadambi, and Robert Budnitz made presentations on behalf of ANS. Budnitz presented in the panel "Harmonization of C&S Under Unified RIPB Principles." Specifically, Budnitz used the example of nuclear power plant heat exchanger seismic design requirements. Six different SDO standards are used but, they are not coordinated. Another presentation in this panel dealt with harmonization of C&S from the American Society of Mechanical Engineers (ASME) and the need for harmonization across ASME standards. Also, of significance was that Kadambi stressed the importance of harmonization of standards for the user community. He added that the RIPB GD is an example of how harmonization may be pursued, and he would like to see ANS take the lead.

8. Rulemaking Under 10 CFR Part 53, "Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors"

A public meeting on 10 CFR Part 53 rulemaking was held on September 22, 2020. Stakeholder discussions were based on topics from an NRC white paper. Prasad Kadambi provided a presentation in a personal capacity to address NUREG/BR-0303, an issue relevant to the RP3C.

<u>**CATEGORY III**</u> <u>SUPPORT TO WORKING GROUP APPLICATION OF RIPB METHODS</u>

9. RP3C Review of ANS-30.3, "Light-Water Reactor Risk-Informed Performance-Based Design" (proposed new standard)

ANS-30.3 Working Group Chair Kent Welter reported that the draft of ANS-30.3 issued for preliminary review has been revised and will be sent back for another view shortly. The working group has good participation and includes some retired NRC staff. Welter will be looking to get input from current NRC staff as well.

Welter is also chair of the proposed new standard ANS-30.2, "Categorization Classification of Systems, Structures, and Components for New Nuclear Power Plants." The Project Initiation Notification System (PINS) form was approved a while ago. The project was recently restarted when he took over the lead. The working group has good diversity but is open to additional members. Bi-weekly meetings are being held with addition subgroup topical meetings. They are trying to provide both high-level guidance for the design phrase and incorporate international guidance for a later stage.

10. Revision of ANS-2.26, "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design"

ANSI/ANS-2.26-2004 (R2017) is being revised. Nilesh Chokshi is the RP3C representative on the working group. ANS-2.26 is an example of a RIPB standard that works with other standards in order to produce an outcome. It uses the kind of guidance that is in the GD. ANS-2.26 has a lot of flexibility, but the way margins are dealt with can be improved. The working group is consolidating existing guidance and looking to get a draft completed by April of next year. Chokshi added that the NRC has a project underway to risk improve seismic design which uses a framework similar to ANS-2.26.

11. RP3C Input on Security Standards (ANS-3.15)

Robert Youngblood participates on the working group developing a proposed new standard ANS-3.15, "Risk-Informing Critical Digital Assets (CDAs) for Nuclear Power Plant Systems," as the RP3C representative. The working group is trying to develop a risk-informed approach to select CDAs. Youngblood stated that the risk-informed selection starts with the identification of CDAs using NRC-approved deterministic selection processes (informative to model development). The Nuclear Energy Institute (NEI) and the NRC are trying to reduce CDAs from 8,000-10,000 down to 4,000 – 5,000. Kent Welter questioned the relationship between ANS-3.15 and Electric Power Research Institute's guidance, the Technical Assessment Methodology (TAM). Michael Muhlheim said they are looking at the EPRI TAM process as well as methods approved by NEI and NRC. The trick has been to use the EPRI's TAM process for new reactor builds. A suggestion was made for Muhlheim and Welter to develop a presentation on converting ERPI's TAM process for new reactor builds.

ACTION ITEM 11/2020-01: Michael Muhlheim and Kent Welter to develop a presentation on converting the EPRI TAM process for new reactor builds. DUE DATE: June 2021

Members were reminded that the JCNRM has a risk-informed security guidance document in development. The two groups share four members and are in contact regularly.

12. Review of Interaction with Other Standards Working Group

The schedule of RIPB standards in development is available as Attachment 5.

- RP3C has interaction on the following standards projects on the schedule of RIPB standards in development:
  - ANS-2.21, "Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink" (revision of ANSI/ANS-2.21-2012; R2016)
  - ANS-2.26, "Categorization of Nuclear Facility SSCs for Seismic Design" (revision of ANSI/ANS-2.26-2004; R2017)
  - ANS-20.2, "Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt-Reactor Nuclear Power Plants" (new standard)
  - ANS-30.2, "Categorization Classification of SSCs for New Nuclear Power Plants" (new standard)

- Input is invited from the following projects on the schedule of RIPB standards in development:
  - ANS-2.22, "Environmental Radiological Monitoring at Operating Nuclear Facilities"
  - ANS-2.34, "Characterization and Probabilistic Analysis of Volcanic Hazards"
  - ANS-3.13, "Nuclear Facility Reliability Assurance Program (RAP) Development"
  - ANS-3.14, "Process for Aging Management and Life Extension of NRNF"
  - ANS-15.22, "Classification of Structures, Systems and Components for Research Reactors"
  - ANS-56.2, "Containment Isolation Provisions for Fluid Systems After a LOCA"
  - ANS-57.9, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)"

13. Changing Environment

- NRC Initiatives
  - NUREG/BR-0303, "Guidance for Performance-Based Regulation"
    Part 53 rulemaking recognizes an important role for NUREG/BR-0303. Prasad Kadambi stated that he sees an opportunity for ANS to provide input to rulemaking. Aggressive schedules for advanced reactor activities are motivating renewed interest in past work

previously in the shadows. Advanced Reactor Content of Applications (ARCAP) is using NUREG/BR-0303. ANS has recently recognized RIPB in its social media interface. The RIPB campaign received what was characterized as a moderate amount of interest.

14. Review of Open Action Items

Prasad Kadambi questioned whether the list of carried actions items are meeting the needs of RP3C members. He asked if the action items should be taken formally or as questions to be answered. Kadambi proposed that action items have a suspense date and be closed unless there is a specific request to follow up. He feels this practice would help meetings be more efficient. Kadambi feels that we should follow action items that provide support to working groups.

15. Other Business

Prasad Kadambi added that he will report on today's RP3C discussions at tomorrow's Standards Board meeting.

16. Next Meeting

The schedule for the next two ANS meetings is provided below:

- ANS Annual Meeting in Providence, RI, at the Omni / Convention Center from June 13-17, 2021
- ANS Winter Meeting in Washington D.C. at the Marriott Wardman Park Hotel from October 31-November 4, 2021

RP3C meetings are planned for Monday afternoon of both meetings either physically or virtually.

17. Adjournment

The meeting was adjourned.

RP3C Action Item Status Report Updated 11/16/20

Action Item	Description	Responsibility	Status/Action
11/2020-01	Michael Muhlheim and Kent Welter to develop a presentation on converting the EPRI TAM process for new reactor builds. DUE DATE: June 2021	Michael Muhlheim, Kent Welter, and Steven Stamm	OPEN
6/2020-01	Members with additional Q&As for Frequently Asked Questions to forward to Prasad Kadambi and James O'Brien for consideration. DUE DATE: September 1, 2020	RP3C Members	CLOSED
6/2020-02	Prasad Kadambi and Kent Welter to consider "controlled design activity" as a CoP topic. DUE DATE: September 1, 2020	Prasad Kadambi, Kent Welter	OPEN Suspend after: 6/14/2021
6/2020-03	Robert Budnitz to confirm Robert Youngblood's membership of the JCNRM's Risk Informed Security Guidance Document Working Group. DUE DATE: August 1, 2020	Robert Budnitz	OPEN Suspend after: 6/14/2021
6/2020-04	William Reckley to let RP3C know what the committee can do to enable NRC's efforts related to Part 53 once approved. DUE DATE: Next RP3C Meeting	William Reckley	CLOSED Overtaken by Events
6/2020-05	Prasad Kadambi to simplify the action item list to be more relevant. DUE DATE: October 1, 2020	Prasad Kadambi	CLOSED Overtaken by Events
11/2019-08	Prasad Kadambi to review RP3C comments on draft standard ANS-3.14-202x, "Process for Infrastructure Aging Management and Life Extension of Nonreactor Nuclear Facilities," and resubmit in the format of the RIPB Guidance Document. DUE DATE: February1, 2020	Prasad Kadambi	CLOSED Overtaken by Events
6/2019-05	David Hillyer to give Mark Linn a call about adding the facility life cycle to ANS-30.1, "Integrating Risk and Performance Objectives into New Reactor Nuclear Safety Designs." DUE DATE: August 1, 2019	David Hillyer	CLOSED Overtaken by Events
6/2019-06	David Hillyer to provide name of potential working group members for ANS-3.13, "Nuclear Facility Reliability Assurance Program Development," to James August. DUE DATE: October 1, 2019	David Hillyer	CLOSED Overtaken by Events
6/2018-02	Prasad Kadambi to review the RP3C Bylaws and update the title of the operating plan or recommend updating the RP3C Bylaws accordingly. DUE DATE: February 28, 2019	Prasad Kadambi	CLOSED Overtaken by Events
11/2016-11	RP3C to prepare a brief, five-slide presentation with a simple perspective explaining RIPB for use at consensus committee meetings.	Prasad Kadambi	CLOSED Overtaken by Events

ATTACHMENT 1

ANS Standards Committee

Risk-informed Performance-based Principles and Policy Committee (RP3C) Meeting

Virtual Meeting

November 16, 2020

Agenda

- Welcome, Roll Call & Introductions
- Approval of Meeting Agenda

Address Standards Board Objectives

- Guidance Document and Comment Resolution
- Standards Committee Training on Guidance Document
- SMART Matrix
- ANS-30.1 and Related Work
- Outcome Expectations on CoP Sessions

Expand RIPB Methods

- Opportunities from NRC Standards Forum
- Opportunities from 10 CFR Part 53 Efforts

Support to WG Application of RIPB Methods

- Review of Interaction with Working Groups
  - Review of work with specific standards and obtain feedback
  - Inputs from Consensus Committees
- Changing Environment
  - NRC Initiatives
  - Industry Initiatives
  - SDO Initiatives (ANS and Others)
- Open Items & Action Items
- Other Business
- Next Meeting, Adjournment
  - ANS Annual Meeting, June 13-17, 2021, Providence, RI

RP3C's RIPB Guidance Document

- The purpose of the guidance is to help a new Working Group Chair to
  - Understand RP3C and its role in ANS
  - Understand RIPB methods at a high level
- Guidance is an enabler
  - Intended to be outcome oriented
  - Offers outcome attributes
  - Outcome expectations defined by WG
- It is part of the plan to evolve the ANS standards program
  - There is a tension between planning for an outcome and a plan to prescribe an outcome

"Think Globally, Act Locally"

Structure and Content of Guidance Document

- Structure
  - Section 1, Purpose
  - Section 2, Background
  - Section 3, Organization
  - Section 4, Process
  - Section 5, Defining the Outcomes
  - Section 6, RIPB Approaches
  - Appendix A, Roles and Responsibilities
  - Appendix B, Background on RIPB Approaches
  - Appendix C, Examples of RIPB Attributes
  - Appendix D, Frequently Asked Questions
- Content
  - Only five of 24 pages is technical
  - About half the material is explanatory and illustrative
  - Rest is procedural based on substantial input from comments

RP3C Outreach

- Presentations to SB at each meeting
- Use every opportunity to communicate
  - WGs increasingly aware of role and potential benefits of RP3C
- Emphasize learning by doing
- Address negative views of ANS standards development
  - Best practices from other domains can be imported beneficially
  - Successful processes from one area of nuclear technology practice can be emulated and adapted
  - Lack of specific data does not mean that there is no available information
  - NRC encouragement of standards has had major impact
- Emphasis on “clean sheet of paper” approach offers more opportunities for creativity and innovation

Commenting and Resolution On Guidance Document

ANS

- Most of the comments address procedural issues and are favorable
- Two commenters offered negative comments
  - Procedural comments accommodated as provided
  - Technical comments are opportunities to provide more information
- GD relies on NRC research from long ago and later efforts unfamiliar to most volunteers in ANS Working Groups
  - RP3C will view these as communication opportunities

Key Background for Guidance Document

- NUREG/BR-0303, "Guidance for Performance-Based Regulation"
  - Published in 2002 after public notice, ACRS review, and presentation to Commission
  - Recently offered as a reference in Reg. Guide 1.233 for reactor applicants
- "Introduction to Implementation and Assessment of Safety for RIPB Technical Requirements in Non-LWRs" was made available for ANS standards
  - Document was produced for Licensing Modernization Project
  - Makes needed connection with NEI 18-04

SB SMART Matrix

- Standards Board (SB) SMART Matrix reflects Standards Committee (SC) Strategic Plan
- Goal#1(D)=incorporate risk-informed, performance-based (RIPB) methods in ANS standards
  - Item D(1) deals with resolving comments on the RP3C RIPB Guidance Document (GD) and making it available
  - The SB Vice-Chair has suggested that the GD be given a name with a unique procedure number
  - The SB Chair suggests that the GD be promoted for use external to ANS, seek ANSI approval in some manner, and explore submitting to NRC for endorsement.
  - Incorporate the GD within the policies and procedures framework of the ANS Standards Committee

SB SMART Matrix
Deliver Internal Training

- First training session was held in May 2020.
  - Audience was mostly leadership level within Standards Committee
  - Comments were received and incorporated into GD
  - No substantive change was required
  - Plan is to offer training twice between November and June ANS meetings, and once between June and November meetings of each year
- Looking externally for training opportunities that support consensus standards
  - There is a clear need for RIPB training in other standards developing organizations (SDOs)
  - The strategic goal of offering RIPB training may be separable: **internal training**; **SDO training**; and **training for external stakeholders**
  - As internal training activity is put into practice, opportunities focusing more on SDOs may become evident
  - There may be a need to develop training packages tailored to stakeholders who are ANS Standards Committee members and those who are not
  - **RP3C is looking for volunteers to cover these variations on the theme of training**

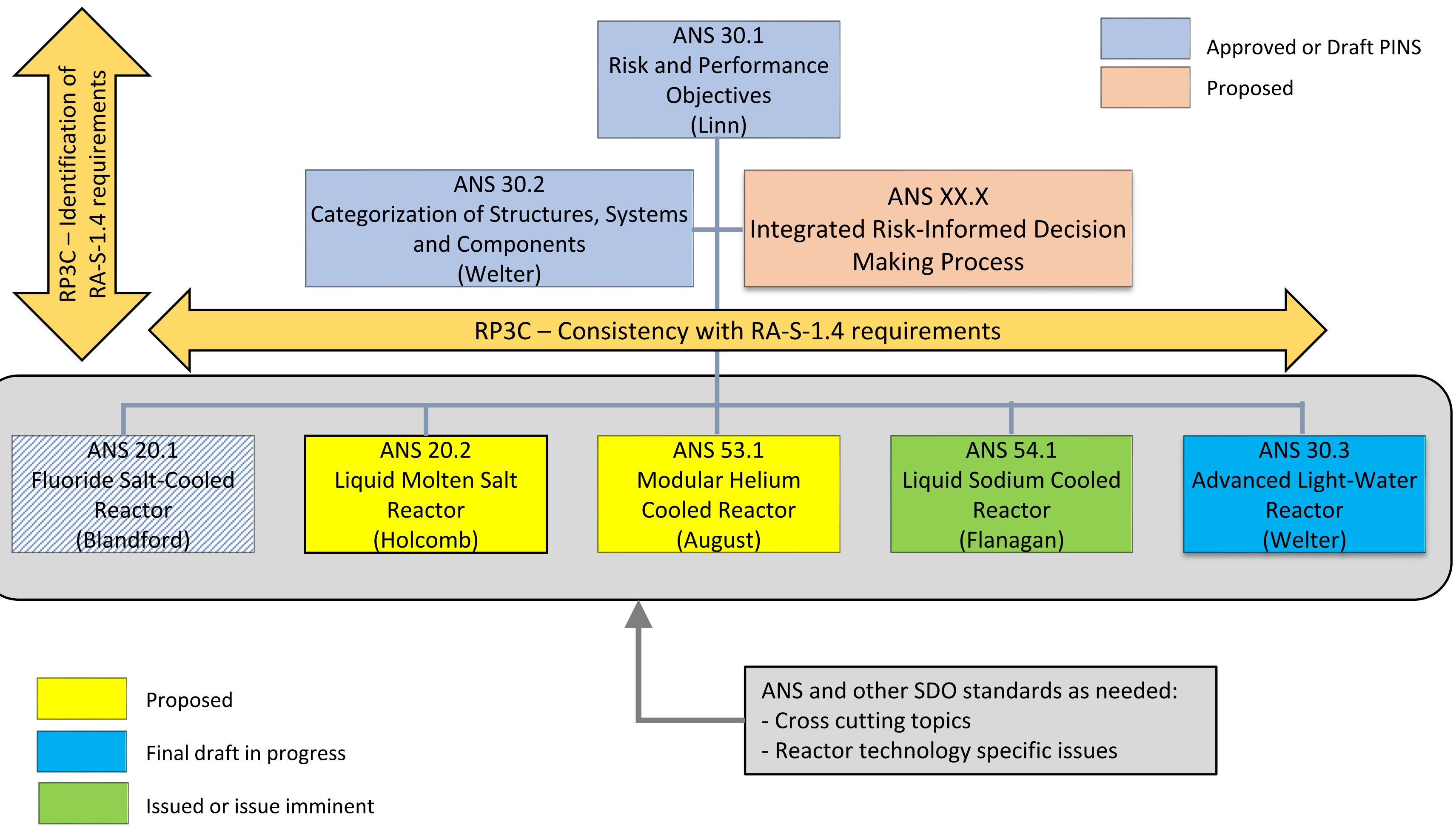
SB SMART Matrix
Deliver External Training

- There is a need for RIPB training in significant segments of industry
  - CoP sessions help but are insufficient
- Additionally, there is a clear need for improving understanding of benefits of ANS standards
  - RP3C has an important but limited role in this.
- Availability of training opportunities can advance ANS brand recognition
- RP3C has contributed significantly to promoting these opportunities already
- External training can be functionally separated into playing different roles
  - Material developed for CoP is available
  - SB has a vital role in delivery

SB SMART Matrix Outreach Activities

- SMART Matrix recognizes training and outreach objectives for RP3C
  - Includes provision to contact and make presentations at NRC RIC, ANS UWC, and vendor owners' groups
  - RP3C as currently constituted is challenged to meet such expectations
  - RP3C is willing to try and report results to the Standards Board
  - RP3C appeals for **volunteers to support** ongoing efforts

ANS New Reactor RIPB Standards Structure



ANS-30.1 Proposed Standard

- On March 5, 2020, a preliminary review ballot of ANS-30.1, "Integrating Risk and Performance Objectives into New Reactor Safety Designs," was issued to the RARCC (only) for comment
- This comment ballot was requested by the SB
- The ballot was closed April 17, 2020. The results were
  - Affirmative were 10
  - Negative were 2
  - Abstentions were 1
- Approximately 125 comments were identified.
  - R3PC comments were previously provided and were considered as companion to this ballot

RP3C Review of Draft Standard ANS-30.1

- Title: “Integrating Risk and Performance Objectives into New Reactor Safety Designs”
- RP3C was provided with a draft document for review in May 2019
- ANS-30.1 WG Chair, presented to the RP3C meeting on June 10, 2019, and indicated his expectations from the RP3C review
- RP3C provided comments and guidance which were discussed at November 2019 meetings
- RP3C provided further input on PB section of draft ANS-30.1 on February 21, 2020
- RP3C updated the input on the PB section within the later draft of ANS-30.1 on May 6, 2020

RP3C Observations Re. Draft Standard ANS-30.1

- The standardization is expected to happen within a high-level structure and a set of processes
- At the highest level, elements of the structure are identified and the relationships and dependencies among them are defined
- The structure of ANS-30.1 is like a four-legged table
  - First leg addresses regulatory processes
  - Second leg addresses the need for sound systems engineering (SE) practices
  - The third leg deals with defense-in-depth (DID)
  - The fourth leg deals with building a safety case from event sequences based on hazard analysis
- RP3C has not had the opportunity to engage with the WG on details relative to these observations
- What was expected to be a philosophical discussion became enmeshed with textual wording

RP3C Review of Draft Standard ANS-30.1 (cont'd)

- Support from Communities of Practice
  - ASME Plant Systems Design Standard (PSD-1)
  - Licensing Modernization Project (LMP)
  - Both support Systems Engineering function and its use through out design process as described in ANS 30.1
  - LMP acknowledges Top Requirements should incorporate other stakeholder issues (Conventional Power Design Practices) as described in ANS 30.1, not solely nuclear safety.
- Overarching *structural* RP3C comment:
  - Specific requirements ought to flow from higher-level (more general) requirements
  - Given an objectives hierarchy, the reason for appropriate "shalls," "shoulds," and "mays" is immediately apparent
    - For example, Process X shall be applied because it is the means to accomplish Objective Y or demonstrate that Y is accomplished
  - Arguably, specific requirements that cannot be rationalized in this way should not be promulgated

ANS-30.1 Proposed Standard

- Standards Board has provided instructions to continue standard preparation
  - Provide resolution to identified comments from the March 2020 review
  - Provide a Draft Revision 3 based on the comment resolutions
  - Because their comments were more general to draft content rather than specific text, the RP3C will be consulted during preparation of this revision
  - To be completed by January 1, 2021

Recent Developments Re. Draft ANS-30.1

- RP3C took the initiative to address some of the structural elements in two sessions CoP
  - Ralph Hill provided a presentation on the SE practice captured with PSD-1
  - Ed Wallace provided a presentation on LMP and NEI 18-04
- Feedback is expected from the WG on whether and how the information provided will be used

RIPB Community of Practice

- Enable communication of practices, challenges, and opportunities
- Open architecture knowledge sharing
- Experience has been gained at NRC and NuScale
- Appears useful for RP3C efforts with addressing issues related to ANS CCs
- Also useful for collaboration with SCoRA
- SB support and direction would be helpful
  - SB indicated that Community of Practice (CoP) is within RP3C purview

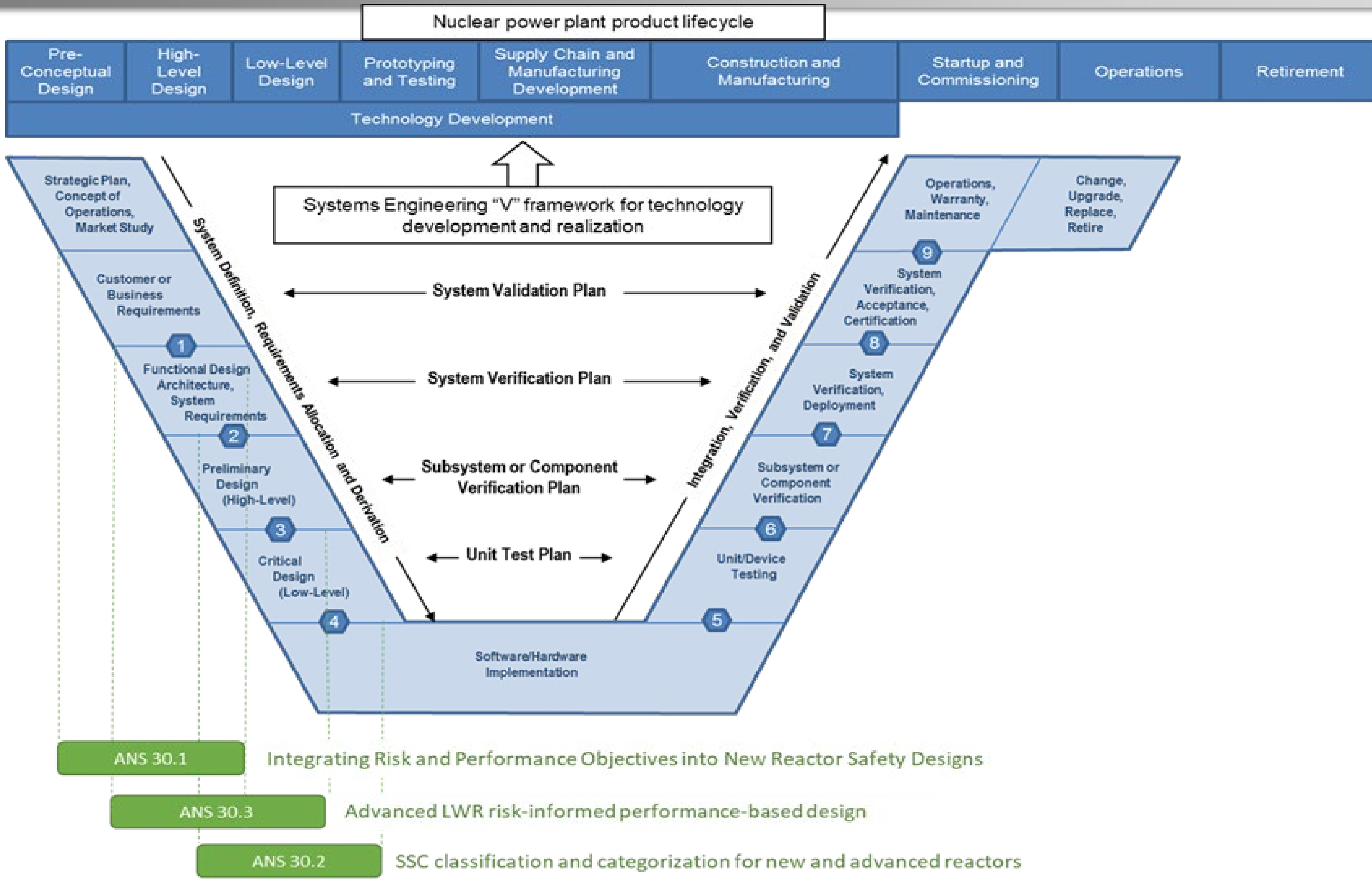
Initiation of CoP Presentations

- Knowledge sharing on RIPB methods and practices will be informal and unstructured
- RP3C initiated CoP presentations as webinars similar to regular meetings
  – Scheduled for last Friday of each month
  – First CoP event in February 2020
  – Eight held in 2020
  – November and December sessions have been cancelled
- Sessions have covered varied areas
  – Three on systems engineering framework for RIPB practices
  – Two advanced reactor vendor presentations
  – Three sessions presented technical information
- Reception has been reasonably favorable
  – Participation in the sessions appear to be increasing
  – Most sessions have been recorded and are publicly available

Can Benefits from ANS CoP Sessions Be Enhanced?

- Provides a virtual space for sharing of RIPB knowledge and ideas across “organizational” boundaries
- Without changing much in what we are doing, can we plan for them more strategically?
- Sharing of knowledge can provide insights into best practices
  - How can we systematically extract such insights?
- Can we pursue two major themes as pilots?
  - Systems engineering practices
  - Harmonization of consensus standards
- If there is support for this, we should develop a proposal to take to the Standards Board

NuScale SE Model as Example



Standards Forum Follow-up

- NRC held Standards Forum on October 13, 2020
- One of the panels was “Harmonization of C&S Under Unified RIPB Principles”
- ANS participants: Budnitz and Kadambi
- Budnitz used example of NPP heat exchanger seismic design requirements
  - Six different SDOs standards involved
  - No systematic evaluation of margins conducted
- Kadambi used RP3C RIPB GD as example of how harmonization may be pursued
  - PB aspect of GD explicitly considers margins for specifying requirements in standards
  - GD approach would define outcome in terms of margin
- Other presentations offered more opportunities

ASME View Re. Harmonization

- Eight ASME Codes were listed
  - Most familiar to the nuclear community are Section III, Section XI, O&M, RA Series, and NQA-1
- Need for better integration across ASME standards was recognized
  - Consistent approach to risk considerations
  - Transition from construction to operation and maintenance
  - Consistency with non-ASME standards
- Recognition that ASME codes are developed for components for construction
  - Risk levels determined outside ASME
  - Graded approach should be maintained

ASCE View Re. Harmonization ASCE-4 and 43

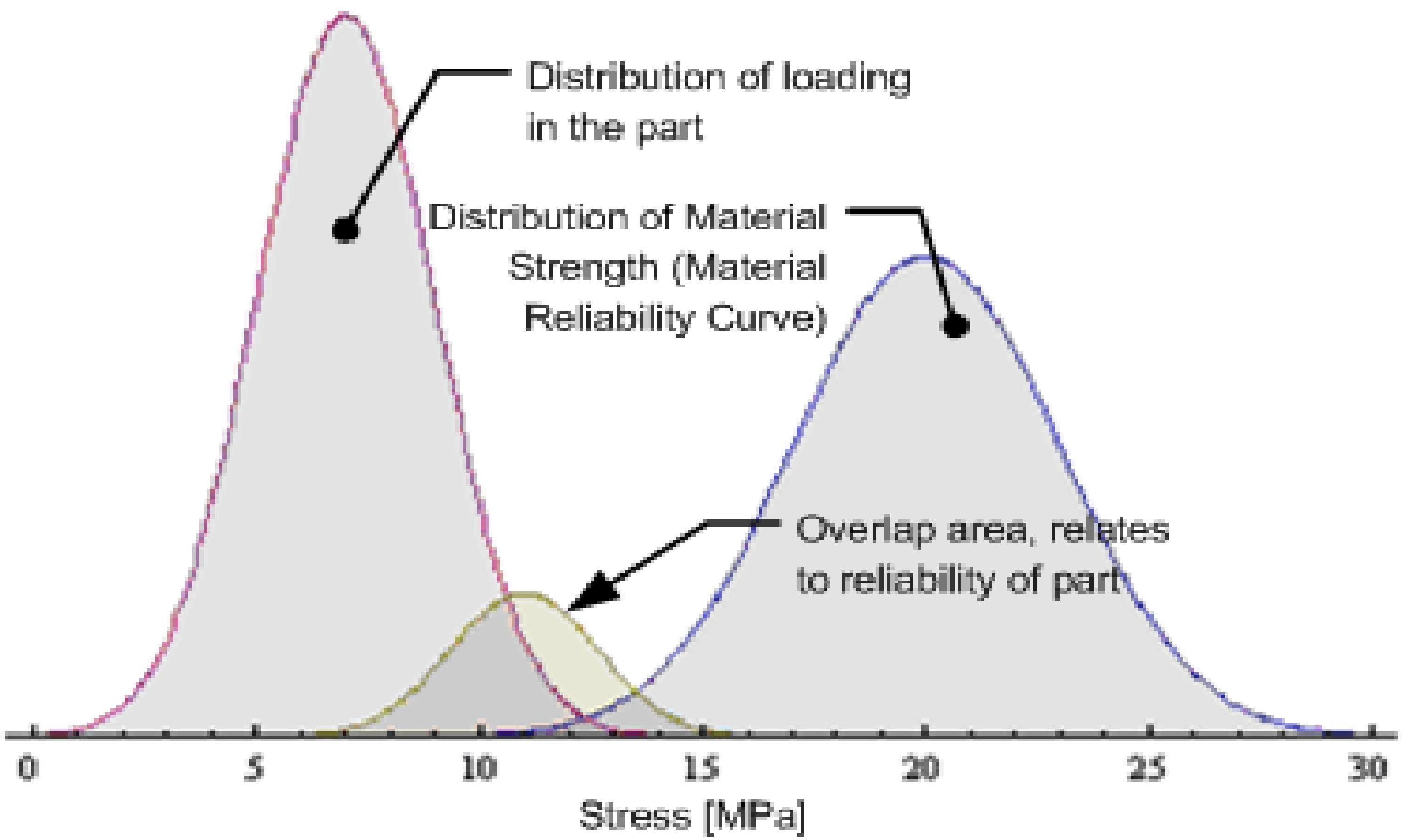
- Concepts of seismic design categories and limit states employed
  - SDC based on unmitigated consequences of failure
  - Limit state is the limiting acceptable condition
  - Disconnect exists in performance expectations because risk targets are specified at the component level, but limit states are defined at the system level
- Seismic capacities are determined to meet
  - Less than 1% probability of unacceptable performance for DBE
  - Less than 10% probability of unacceptable performance for 150% of DBE
- Recognized need for “cross-pollination” between ASME, ASCE, ANS, ACI, AISC, and NRC
  - Need to better understand bases for fundamental assumptions
- Observation: Criteria are implicitly based on treatment and decision-making related to margins

ASME Sec. III, Div. 5
Graphite, Ceramic, Metal Components

- It is significant that rules for metal components will be examined in a functionally equivalent frame to Div.1
- Frame for non-metals must consider:
  - Specificity similar to metals not possible
  - Irradiation behavior is non-linear
  - Material is inherently flawed

It is possible to find a commonality within a PB approach

Margins Framework for Graphite



Panel Overview

- C&S are developed in silos
- Sufficiency as adequacy for service is not addressed
- Efficiency should be seen as minimizing cost and consider time to design, review and build
- Harmonization can be pursued with traditional designs now and RI+PB design in the future
  - Traditional design is sufficient but not efficient
  - RI+PB design requires systems engineering
- Harmonization is not an option but a *must*
- SILOS MUST BE DEMOLISHED

RP3C View: ANS should take the lead

10 CFR Part 53 Rulemaking “RI, TI Regulatory Framework”

- Public meeting held on September 22, 2020
- Stakeholder discussions based on topics from NRC White Paper
  - Framed as questions supporting ACRS and public interactions on rulemaking
  - NRC sought stakeholder input and recommendations on fourteen topic areas
  - Topic 8: “Performance-Based Regulation”
- At the public meeting, six topics were addressed:
  - Topic 5 was “Incorporation and use of performance-based requirements”
- Kadambi provided a presentation in a personal capacity to address an issue relevant to the RP3C GD
  - Issue relates to how requirements developed under Part 53 incorporate performance-based concepts?

RP3C Question: Should RP3C RIPB GD be part of Part 53 Rulemaking?

ANS 30.3 Update

- Completed revision to address reviewer comments
- However, rewriting Section 4, Safety Requirements and Functions to better align with industry best practices
- Expected completion by end of 2020
- ***Need NRC review support***

What ANS-2.26 Does

ANS-2.26:
Assign a "Seismic Design Category (SDC):"

Given the potential consequences of failure, assign a performance criterion: specifically, a *failure probability criterion*.

The other standards then tell you how to go about engineering satisfaction of this criterion.

Figure from Appendix A:

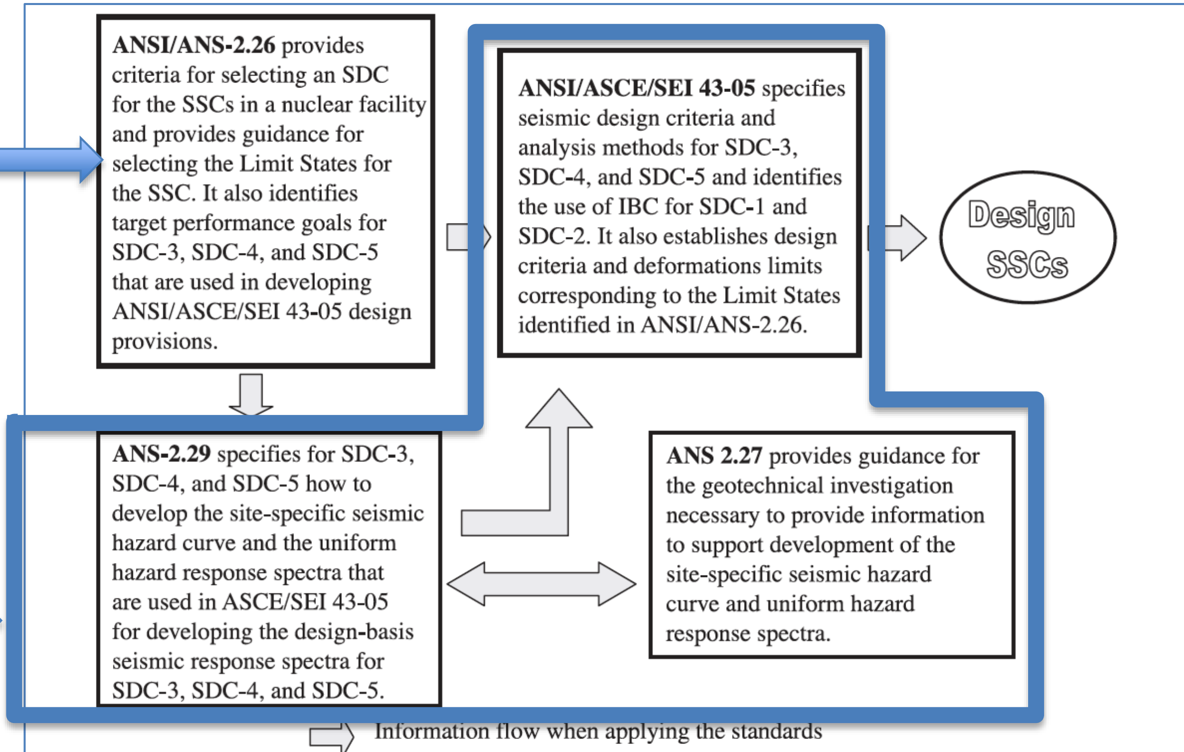


Figure A.1 — Schematic showing the relationships of the seismic standards

The Four Attributes [of performance-based approaches] Discussed in the Commission's White Paper:

1. Failure to meet the predetermined performance standard will not result in an immediate safety concern. (Can margin be estimated realistically, and if so, what is known about it?)
2. Measurable or calculable parameters are available to determine whether the performance standard is met. (Can performance parameters be identified that provide measures of performance and the opportunity to take corrective action if performance is lacking?)
3. The performance standard is based on objective criteria. (Can objective criteria be developed that are indicative of performance?)
4. The licensee or the NRC has flexibility in the method used to achieve the desired performance level. (Is flexibility for the NRC or licensees available consistent with the level of margin?)

To What Degree Does ANS-2.26 Have Those Four Attributes?

- Failure to meet the predetermined performance standard will not result in an immediate safety concern.
  - Yes; if the SSC's seismic performance is supposed to be a failure probability of 1E-6, but it's really 1E-5, that's probably not an immediate *safety* concern.
- Measurable or calculable parameters are available to determine whether the performance standard is met.
  - Yes, at least calculable ones, at least at the design stage. But how would we confirm that the SSC is still good after 15 years?
  - There is a *lot* of modeling involved in claiming that the seismic performance goal is met. And this sort of reliability goal is not literally provable in practice.
- The performance standard is based on objective criteria.
  - Yes.
- The licensee or the NRC has flexibility in the method used to achieve the desired performance level.
  - For the piece of the problem addressed by ANS-2.26, yes; but engineering the seismic performance (implementing the other standards that complete the picture) involves more prescriptive codes governing SSC details.

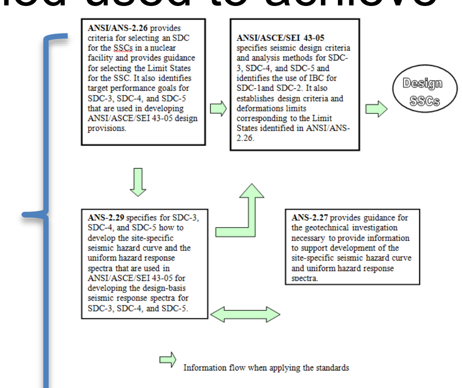


Figure A.1—Schematic showing the relationships of the seismic standards

Comments

- There's a strong tendency for technology-neutral requirements documents to be at least somewhat performance-based.
  - Their technology-neutrality is achieved by focusing on higher levels of the objectives hierarchy.
  - ***This implies flexibility.***
- The need to apply to a spectrum of technologies is addressed by general protocols (tied to high-level objectives) that tell users how to levy requirements on themselves.
  - ANS-2.26 has users characterize the consequences of accidents, and then determine themselves which SDC to apply.
    - Failure of this SSC has potential consequences of X, therefore set criterion at 1E-5 …
  - ***This implies flexibility.***
- However, we need to look at the whole picture, not just ANS-2.26.

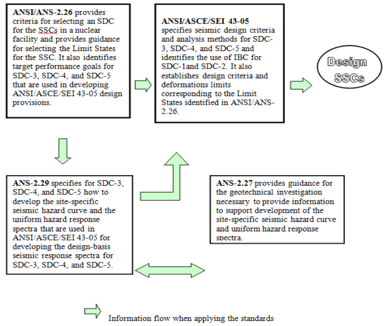


Figure A.1—Schematic showing the relationships of the seismic standards

ANS-3.15

WG 3.15, Cyber Security for Nuclear Systems, is trying to develop a risk-informed approach to select CDAs

- The risk-informed selection of critical digital assets (CDAs) *starts* with the identification of CDAs using NRC-approved deterministic selection processes (informative to model development)
  - CDAs include digital assets in safety, security, emergency preparedness (SSEP) and NERC-related requirements
  - NRC and NEI are working to reduce the number of CDAs, which can currently number ~10,000 at a plant
- Part 1: Risk-inform the list of CDAs (where we are now) ("Allocation")
  - A risk informed down selection process will identify a complement of CDAs whose protection (from attack) provides an adequate level of safety
  - Issues: How best to do this, given a general reluctance to invest in completely new modeling efforts (such as constructing a "cyber PRA")
    - Plants have existing PRAs, but most of the CDAs are not included in a plant PRA; security, emergency preparedness and most components selected to meet NERC requirements are not included
    - Reasoning based on PRA success paths seems to have some promise
    - Either way, CDA "significance" needs to be derived from a scenario-based construct of some kind, and this calls for some work
- Part 2: Protection of CDAs ("Implementation")
    - Given a set of CDAs whose protection seems like enough, if it works: What does that "protection" really entail?

ANS-30.2

Classification and Categorization of SSCs for New Reactor Power Plants (WGC – Kent Welter)

- Working group formed with excellent participation and diversity of membership
- Bi-weekly meetings with additional sub-group meetings to tackle specific issues (e.g., categorization vs classification, process flowcharting, etc.)
- Purpose, Scope, and Application draft sections completed
- Technology-inclusive
- Risk-informed, performance-based
- Systems engineering best practices (nuclear and non-nuclear)
- Consistent with latest NRC guidance (e.g., RG 1.233)
- Incorporates international best practices (e.g., IEC, ONR)
  - To support US NSSS vendors who deploy globally
- Active collaboration with relevant standards
  - ANS 30.1, 30.3, 53.1, 3.13, 15.22, ASME systems engineering, etc.
- Target draft standard April/May 2021

Interaction with CCs and WGs

- Feedback sought from CCs regarding how RP3C is doing relative to helping them with RIPB methods
- CC reports to SB now contain a section addressing modernization (i.e. RIPB methods)
- Currently, the reports only address the limited number of standards that RP3C previously identified as candidates for RIPB
- All standards in LLWRCC were awaiting training on GD
  - RP3C will work with this and other CCs to ensure that training needs are addressed
  - Needs of WGs will be addressed on a case basis
- CCs will be requested to go beyond the list of standards originally identified by RP3C
  - Each portfolio should be categorized and prioritized.

Status of Standards Tracked by Standards Manager

- ANS-2.21-202x, “Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink” (revision of ANSI/ANS-2012; R2016)
- ANS-2.26-202x, “Categorization of Nuclear Facility SSCs for Seismic Design” (revision of ANSI/ANS-2.26-2004; R2017)
- ANS-20.2-202x, “Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt-Reactor Nuclear Power Plants” (new standards)
- ANS-2.35-202x, “Guidelines for Estimating Present & Projecting Future Socioeconomic Impacts from Construction, Operations, and Decommissioning of Nuclear Facilities” (new standard)
- ANS-30.2-202x, “Categorization Classification of SSCs for New Nuclear Power Plants” (new standard)
- ANS-30.1-202x, “Integrating Risk and Performance Objectives into New Reactor Safety Designs” (new standard)

Changing Environment

- Part 53 rulemaking recognizes an important role for NUREG/BR-0303
  - Could represent an opportunity for ANS
- Aggressive schedules for advanced reactor activities is motivating renewed interest in past work previously in the shadows
- Advanced Reactor Content of Applications (ARCAP) is using NUREG/BR-0303
- ANS has recognized RIPB in its public interface with social media
  - Opportunity for standards' volunteers?

RP3C Report to SB

- SMART Matrix Report
  - RP3C proposal to modify
- Procedural GD and Implementation
  - Feedback sought for continuous maintenance and improvement of GD
- RIPB CoP in the context of systems engineering practices
- ANS leadership in harmonization of standards
- CC Chairs Report on RIPB
- Expand RIPB Methods
  - ANS-30.1
  - ASME PSD
  - ANS-30.2
  - ANS-30.3
  - Security standards
  - Seismic categorization model for all types of natural hazards
- Interactions with WG
- Other Items

Action Item Status

SEE ATTACHMENT 4 FOR FULL LIST

Action Item	Description	Responsibility	Status/Action
11/2019-01	RP3C members to provide comments on the two training presentations. NOTE: Ballots will be issued to capture member comments. DUE DATE: January 31, 2019	RP3C Members	Completed Ballots closed 1/31/20
11/2019-02	Consensus committee chairs to identify at least one working group to be included in the pilot training to incorporate RIPB methods. DUE DATE: January 31, 2019	Consensus Committee Chairs	Completed ESCC: ANS-2.26 FWDCC: ANS-57.9 RARCC: ANS-15.22 (ANS-20.2 as alternate) LLWRCC: All WGs NA: NRNFCC, JCNRM, NCSCC, SRACC
11/2019-03	Pat Schroeder to provide George Flanagan and Mark Linn the ANS Policy on Trial Use and Pilot Application Standards to consider whether ANS-30.1, "Integrating Risk and Performance Objectives into New Reactor Nuclear Safety Designs," should be issued for trial use. DUE DATE: December 1, 2019	Pat Schroeder	Completed 11/18/19
11/2019-04	Prasad Kadambi (lead), Ralph Hill, Robert Youngblood, Ed Wallace, Mark Linn, Amir Afzali, and Todd Anselmi to discuss/address differences between ASME and ANS taxonomy (terminology). NOTE: Pat Schroeder to facilitate a call when directed by Prasad Kadambi to discuss harmonization of ASME and ANS taxonomy. DUE DATE: March 1, 2020	Prasad Kadambi, Ralph Hill, Robert Youngblood, Ed Wallace, Mark Linn, Amir Afzali, and Todd Anselmi	Completed Call held 2/26/20

Closing

- **Other Business**
- **Next Meetings**
  - ANS Winter Meeting, November 15-19, 2020, Chicago, IL
  - ANS Annual Meeting, June 15-17, 2020, Providence, RI

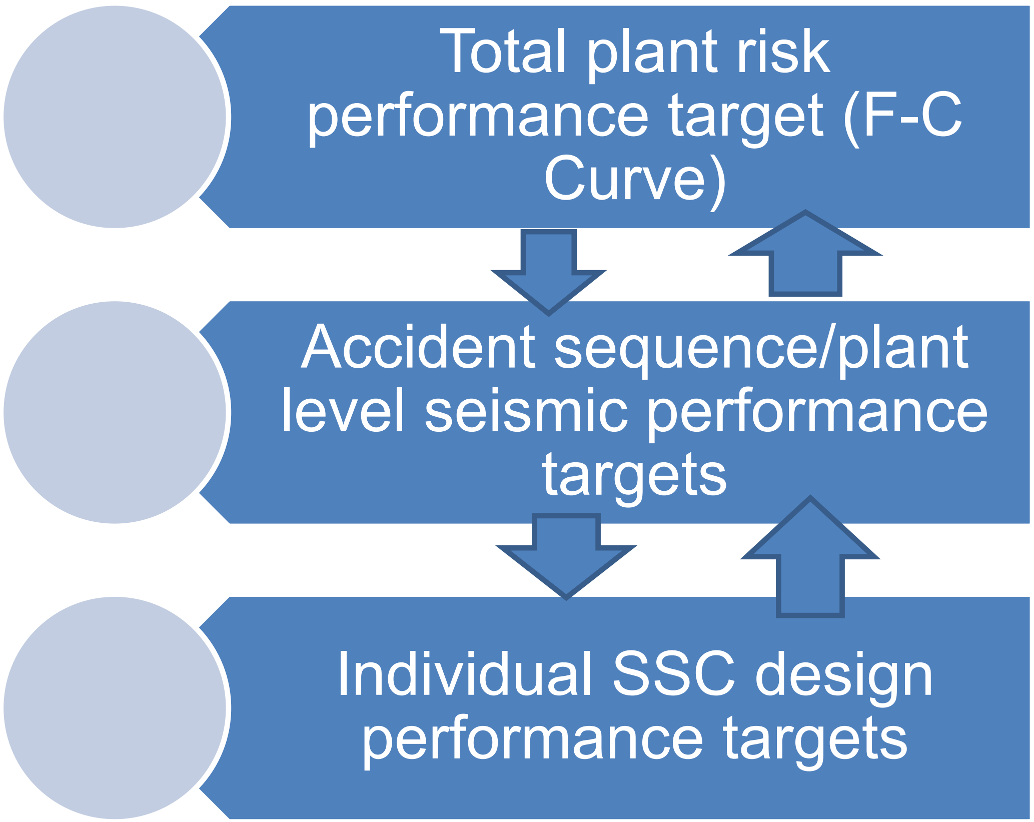
Adjourn and Thank You!

Backup Slides

Backup for:

- Licensing Modernization Project
- ASCE-43

LMP Framework and Application to Structural Analysis and Design (Concepts)



ASCE 43, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities" (2 of 2)

- The acceptable performance level (the target performance goal) is achieved by selecting the return period of the DBE shaking
- Limit state (LS) defines the required performance in terms of the limiting acceptable condition of the SSC
- The limit state (or the design performance) is adjusted based on the ultimate safety function and risk significance of the component

This approach allows to control conservatisms and safety margins in accordance with the risk significance of SSCs permitting more balanced design

ATTACHMENT 2

Incorporating Risk-Informed and Performance-Based Approaches/Attributes in ANS Standards

1 PURPOSE

The purpose of this Guidance Document is to identify the process for using risk-informed and performance-based (RIPB) approaches, as appropriate, when developing or revising American Nuclear Society (ANS) standards. This document also helps the consensus committees, subcommittees, and working groups (WG) decide if and how RIPB approaches can be incorporated into its standards.

This document is intended to be used by all consensus committees during the development of new ANS standards and for revisions of existing ANS standards.

2 BACKGROUND

In 2013, the ANS Standards Board (SB) commissioned the Risk-Informed, Performance-Based Principles and Policy Committee (RP3C) to establish "approaches, priorities, responsibilities, and schedules for implementation of risk-informed and performance-based principles in ANS standards."

The RP3C was then tasked by the SB to develop a plan:

"which would provide the approaches and procedures to be used by ANS Standards Committee consensus committees (CCs), subcommittees (SCs), and Working Groups (WGs) to implement RIPB principles in a consistent manner."

This guidance document represents an element of that plan.

3 ORGANIZATION OF THIS GUIDE

Section 4 identifies the process that could be used to initiate or enhance the incorporation of RIPB approaches during the development of new or revision of existing standards.

Section 5 identifies the process for defining the outcome of a standard. This is a key first step of developing any standard and is particularly important for RIPB standards.

Section 6 discusses RIPB approaches to help standard developers in incorporating these approaches.

This guidance document also contains four helpful appendecies:

- Appendix A identifies the roles and responsibilities of the ANS RP3C.

- Appendix B provides background information on the development of RIPB attributes and how RIPB approaches have been successfully incorporated into the Nuclear Regulatory Commission (NRC) Maintenance Rule (*10 CFR 50.65, "Requirements For Monitoring The Effectiveness Of Maintenance At Nuclear Power Plants"* [1]).

- Appendix C provides examples of RIPB attributes in ANS standards.

- Appendix D provides answers to a series of focused "Frequently Asked Questions (FAQs)" to help users with this Guidance Document.

4 PROCESS

The following describes the process that could be used to initiate or enhance the incorporation of RIPB approaches during the development of new standards or the revision of existing standards.

Sections 6.1 and 6.2 provides information on the types of standards where use of risk-informed insights and approaches, or performance-based requirements and approaches may be appropriate. This Guidance Document does not address graded approaches in detail, but leaves it to the discetion of the Working Group (WG) based on technical insights.

4.1 WG Formation and Project Initiation Notification System Stage

4.1.1 WG Formation Stage

The WG Chair should consider recruiting one or more professionals with some experience in RIPB approaches to be a part of the WG.

The WG Chair should consider requiring the attendance to a training session on this Guidance Document for all WG members at this early standards development stage.

4.1.2 Project Initiation and Notification System (PINS) Development Stage

The PINS form includes the following question for the WG Chair to address:

> *Will this standard use risk-informed insights, performance-based requirements, and/or a graded approach?*

The PINS instructions state that it is strongly recommended that new and revised standards use RIPB requirements, and/or a graded approach, where applicable.

The WG Chair should contact the RP3C Chair for guidance to incorporate these methods while preparing the PINS. If guidance is needed regarding performing a probabilistic risk assessment (PRA) or regarding using a PRA for risk insights, the WG Chair should contact the Joint Committee on Nuclear Risk Management (JCNRM, one of the consensus committees under the ANS Standards Board) or their Sub-Committee on Risk Applications (SCoRA)

Should incorporation of RIBP approach(es) to the standard being developed or revised be deemed to be inappropriate or not effective, the remainder of this procedure is not applicable to that particular standard. The WG Chair should develop a brief evaluation of non-applicability and share it with other stakeholders (e.g., people in the consensus committee). The evaluation should include assumptions and overall assessment for consideration by future WGs. This RIPB non-applicability statement should be submitted with the PINS.

4.2 Standards Development Stage

Once a standard has been deemed appropriate to incorporate RIPB approach(es), the WG Chair shall interface with RP3C.

4.2.1 Early Outlines/Draft

The WG Chair should use this Guidance Document, particularly Section 5, to support incorporation of RIPB approaches into the standard and should reach out to the RP3C and/or JCNRM (via standards@ans.org) to request any necessary assistance throughout the writing process.

The RP3C Chair should identify a RP3C member(s) as primary point(s) of contact, to support the WG, especially during the early stages of standard development.

4.2.2 Pre-Subcommittee Draft

The WG Chair should send the pre-subcommittee draft of the standard to the RP3C Chair for review using judgment as to when the draft is sufficiently mature to materially benefit from the RP3C review. If PRA methods are part of the approach in the standard, the WG Chair should send the draft document to the JCNRM for review. Details of the standard do not necessarily have to be completed.

The RP3C should schedule and perform the review within a reasonable time period to minimize any impact to the standard development schedule. The RP3C review and comments should be confined to how the standard might better employ RIBP approaches.

The WG Chair maintains the authority to adopt, reject, or adapt any of the RP3C recommendations resulting from the review. However, the reasons for such decisions should be documented in the record of the standard.

To benefit future work, WG decisions on the standard should be maintained on the ANS online standards workspace (currently "ANS Collaborate") with a link that can be found on the ANS website under "Standards Workspace."

After the pre-subcommittee draft standard development phase, it might be too late to implement any or all of the RP3C recommendations. Implementation decisions should be based upon the value added versus the difficulty in implementing the recommendations. The WG Chair should consult with the subcommittee and consensus committee chairs to address questions of schedule, volunteer resources (total and appropriate skill sets), extensiveness of standard rework, etc., so as to chart the best path forward and inform the RP3C of its decision.

The WG Chair should document whatever decisions are made in this regard for consideration by future WGs.

5 DEFINING THE OUTCOMES OF A STANDARD

The goal of a standard is to define the approach to the development of products or outputs such that there is a sufficiently high level of confidence that the outcomes will be achieved in an efficient and cost-efficient manner.

Accordingly, a clear understanding and declaration of the ultimate outcomes of the standard is a critical step in the early stage of any standard development effort. A clear statement of the outcome(s) and those attributes that characterize the outcome(s) can also support efforts to determine whether the standard is a candidate for incorporating a performance-based approach. This is discussed further in Section 6.

Defining outcomes as a structured set of performance objectives has been found to be beneficial for design standards. The definition of these objectives should be undertaken at a high level during early design development and at a more detailed descriptive level as the design matures. The needs of the standard's user community should guide such decisions.

6 RISK-INFORMED, PERFORMANCE-BASED APPROACHES

The following discusses RIPB approaches. Table 6-1 provides high-level attributes that are the key elements of the performance-based (PB) and risk-informed (RI) approaches that can be used to support the development of new standards or revision of existing standards. Examples are provided in Appendix B on how these approaches have been used and where their use could be enhanced in some current ANS standards.

6.1 Performance-Based Approaches

All standards specify what is to be done by the standard's user, which is generally described under the Purpose and Scope sections in a standard, and to different levels, to obtain the outcome from the actions taken. A standard should address the "how " of achieving an outcome such that ambiguity of interpretation is minimized.

Depending upon the specific outcome to be achieved, different levels of prescription on how to achieve that outcome may be appropriate. For example, in calculating reactor decay heat, it is necessary to use scientific first principles, representative data, and applicable equations. Therefore, defining the exact steps to perform a calculation may be the best means for achieving the outcome of specifying an appropriate heat load for the design basis. [2] The JCNRM should be consulted if PRA methods are involved as a way to "measure" performance.

Alternatively, a standard's outcome may be of a type where it is appropriate to provide flexibility (i.e. less prescriptiveness) in how to achieve the outcome. For example, a standard might have "not exceeding an exposure limit" as an outcome. The user of the standard can be provided flexibility on how to achieve this outcome, but certain high-level expectations, such as margin and reliability, might be specified. Generally, where there is more margin, there is room for more flexibility.

Note that a standard needs to provide some level of direction/prescription on what needs to be done to achieve the outcome. This is frequently called "Level of Detail (LoD)." If it did not, then the standard would have no "shall" statements and would not be a standard. This is frequently provided as a process that is acceptable to achieve the desired outcome[1]. However, a performance-based standard would keep the direction provided at a high level and would allow flexibility in the specific steps that could be taken to achieve the outcome. The degree of flexibility manifests itself by permitting the standard's user to determine what performance metrics are necessary to ensure success and what the desired values of such metrics should be to

[1] A process generally defines a series of action steps where each action involves input of information, performance of an activity, output products and a decision on acceptability. Information from the process is fed into the next action step or fed back to a previous action step.

declare success, as well as how to measure those metrics. The degrees of "hows" would be up to the standard writer to determine any constraints that would need to be placed on the standard user when determining performance-based metrics, how they will be measured, and what constitutes a success.

This is outlined in a step-by-step manner in the following subsections.

Examples of clear and effective RIPB outcome statements are provided in Appendix C.

6.1.1 Define the Approach (Major Steps) to Obtaining the Outcome

The goal of a standard is to define the approach to the development of products or outputs such that there is a high level of confidence that the outcome will be achieved in an efficient manner.

All standards define and require the use of a structured approach for achieving an outcome. This can be done at a high level or at a more detailed prescriptive manner depending upon the nature of the standard, the preference of the standard writers, and the needs of the standard users. In general, requiring a higher LoD leads to less flexibility for the standard's user, which is frequently the reason LoD becomes a significant consideration.

6.1.2 Determine Whether there are Alternative Approaches for Achieving the Outcome

For some situations, the WG and subcommittee might agree that there is only one approach that will result in achieving the outcome (e.g., calculation of decay heat load). In that case, the standard is generally not considered suitable to being written in a performance-based manner.

In other situations, there may be various means to establish the outcome (e.g., achieving an appropriate fire protection program or radiation protection program). In these situations, the level of specificity in the definition of the process for achieving the outcome, or sub-outcomes, should be determined optimizing LoD. A key consideration is that auditable assurance be provided based on validated principles.

Table 6-1 provides high-level attributes that are the key elements of the RIPB approaches that can support the development of new or revision of existing standards. In the consideration of the performance-based objectives of a standard, it may be beneficial to include risk considerations and/or more formal risk assessment methodologies. If PRA methods are involved, the JCNRM should be consulted. Examples are provided in Appendix C on how these approaches have been used, and where their use could be enhanced in three current ANS standards.

For more detailed background and process steps in determining outcomes, refer to "Introduction to Implementation and Assessment of Safety for Risk-Informed and Performance-Based Technical Requirements in Non-Light Water Reactors" [3] which was developed by the Licensing Modernization Project.

6.2 Risk-Informed Approaches

Risk insights can be used to support decisions on the scope, focus, level of rigor, and/or sophistication of the standard (and the program or process that is the subject of the standard).

Either way, the method for analyzing the "risk" is often by using PRA methods, using methods (or their analog) defined in JCNRM standards.

A "risk-informed" approach to decision-making represents a philosophy whereby risk insights are considered together with other factors to establish requirements that better focus attention on design and operational issues commensurate with specific design objectives. Decisions made in the process and described in a standard can be either risk-based or risk-informed.

Risk-based decisions are made entirely on specified risk criteria, which could be qualitative or quantitative. While it is acceptable to use risk-based steps in a process, broader decisions should be risk informed. For example, a risk-informed process sets up an integrated decision-making structure that allows consideration of a broad range of technical and stakeholder input uncertainties, imperfections in analysis and decision criteria, and knowledge constraints. Regulatory Guide 1.174, *"An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis*," [4] and NEI 18-04 (Rev. 1), *"Risk-Informed Performance-Based Technology Guidance for Non-Light Water Reactors,"* [5] are examples of effective risk-informed processes.

6.2.1 Using Risk Insights to Define the Scope of the Standard

Risk insights can be used to define/narrow the scope of standard, e.g., program elements or structures, systems, and components (SSCs), to those which need to be addressed to achieve the outcome. Facilities with risk models may be able to consider quantitative measures, such as risk importance measures as part of the scoping decision. If the analysis used for this is a PRA or uses PRA methods, the JCNRM should be consulted.

6.2.2 Using Risk Metrics as Part of the Standards Outcome Statement

The outcome of the standard can be stated in terms of risk metrics such as "As Low As Reasonably Achievable" or "consequence at a given frequency." If the analysis used for this is a PRA or uses PRA methods, the JCNRM should be consulted.

6.2.3 Using Risk Insights to Define How to Meet the Standard's Outcome

Risk insights can be used in defining the rigor, sophistication, or level of effort to be used in meeting the standard's outcome. Risk insights can help to help set requirements for testing, surveilling, or inspecting SSCs. For example, a standard that tests a number of similar components could require monthly tests for the high-risk SSC category, quarterly tests for the medium-risk SSC category, and annual tests for the low-risk SSC category.

Using this type of graded system, the nuclear industry has been successful in implementing risk-informed, in-service testing and inspection programs that reduce the rigor and periodicity of tests/inspections, which ultimately translate to both cost and exposure savings. NRC has issued the following regulatory guides that employ this principle:

- Regulatory Guide 1.175, "*An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing*," [6]; and,

- Regulatory Guide 1.178, "*An Approach for Plant-Specific Risk-Informed Decisionmaking Inservice Inspection of Piping*" [7]).

Similar to the categorization and focus above, the increase in level of rigor or sophistication can be applied on a graded scale based on risk insights. The treatments can be different and focused based on the specific risk contribution. For example, an SSC may have different functions during different modes of reactor operation, and the categorization and the suggested treatment may differ for the different functions. Similarly, the level or rigor and sophistication of an analysis called for in a standard or the elements of a nuclear safety program can be tailored based upon risk insights.

Furthermore, the standard can specify the use of probabilistic or statistical methods for achieving the outcome. If these methods employ PRA, PRA methods, or PRA concepts, the JCNRM should be consulted. The nuclear industry has been successful in identifying safety-related SSCs that have little or no safety significance, and reduced the regulatory treatment requirements typically placed on safety-related SSC (*10 CFR 50.69, "Risk-Informed C**ategorization** and Treatment of Structures, Systems and Components*" [8]).

Finally, the standard can allow for different approaches to be used to achieve outcomes, but still require that the approach used be justified to provide an appropriate level of confidence on the accuracy or repeatability of achieving the outcome. An example is where the margin of safety provided (i.e., amount of conservatism) is based on the confidence or uncertainty associated with the data or the process used in achieving the outcome.

Table 6-1 – Key RIPB Attributes

Performance-Based Attributes

P1. The outcome of the standard is clearly defined.

P2. The criteria that are established to achieve the outcome are high level (i.e., provide flexibility in the manner in which the parameter of interest is measured and to determine the criterion for a "successful" level of the metrics).

Risk-Informed Attributes

R1. The standard defines how to develop the risk insights (e.g., the importance of inputs or steps used in the standard).

R2.	The standard defines how to use risk insights (e.g., to specify required actions to achieve the outcome).

7 REFERENCES

[1] 10 *Code of Federal Regulations* 50.65 "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission.

[2] ANSI/ANS-5.1-2014 (R 2019), "Decay Heat Power in Light Water Reactors," American Nuclear Society.

[3] "Introduction to Implementation and Assessment of Safety for Risk-Informed and Performance-Based Technical Requirements in Non-Light Water Reactors," Draft Report (Rev. 1), U.S. Department of Energy, Idaho Operations Office, Contract DE-AC07-05ID14517.

[4] Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," U.S. Nuclear Regulatory Commission.

[5] NEI 18-04 (Rev. 1), "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," August 2019, Nuclear Energy Institute.

[6] Regulatory Guide 1.175, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing," U.S. Nuclear Regulatory Commission.

[7] Regulatory Guide 1.178, "An Approach for Plant-Specific Risk-Informed Decisionmaking Inservice Inspection of Piping," U.S. Nuclear Regulatory Commission.

[8] 10 *Code of Federal Regulations* 50.69, "Risk-informed Categorization and Treatment of Structures, Systems and Components," U.S. Nucler Regulatory Commission.

APPENDIX A

ROLES AND RESPONSBILITIES

The following describes the roles and responsibilities assigned by the ANS Standards Board to support implementation of this Guidance Document.

A.1 ANS STANDARDS BOARD

(a) Approve this Guidance Document and promote its use within all consensus committees.

A. 2 RP3C CHAIR

(a) Assign responsibilities to maintain this Guidance Document (e.g., developing a schedule for its review and update).

(b) Assign responsibilities for developing training on this Guidance Document.

(c) Assign responsibilities of members for review of new and revised standards.

(d) Assign RP3C members to provide guidance to Working Group (WG) chairs during all stages of standards development.

A.3 RP3C MEMBERS

(a) Provide guidance to Working Group (WG) chairs during all stages of standards development.

(b) Support reviews of new and revised standards as assigned by the RP3C Chair.

(c) Develop training on this guidance document as assigned by the RP3C Chair.

(d) Take training on this Guidance Document as specified by the RP3C Chair.

A.4 CONSENSUS COMMITTEE CHAIRS

(a) Support awareness of and implementation of this Guidance Document throughout the various stages of development of new and revised standards to WG Chairs.

(b) Take training on this Guidance Document.

(c) Provide experience-based feedback to improve this Guidance Document.

A.5 WORKING GROUP CHAIRS

(a) Take training on the Guidance Document.

(b) Use this Guidance Document throughout the development of any new or revised standards for which they are leading.

(c) Use guidance available from JCNRM for matters related to PRAs.

(d) Provide experience-based feedback to improve this Guidance Document.

A.6 JCNRM

(a) Be available for consultation and advice when a WG is either using PRA or PRA methods or is contemplating using them or other risk-informed approaches for analysis.

APPENDIX B

BACKGROUND ON RISK-INFORMED AND PERFORMANCE-BASED APPROACHES

B.1 GENERAL BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) has defined the risk-informed, performance-based (RIPB) approach as:

> *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 (1) focus attention on the most important activities, (2) establish objective criteria for evaluating performance, (3) develop measurable or calculable parameters for monitoring system and licensee performance, (4) provide flexibility to determine how to meet the established performance criteria in a way that will encourage and reward improved outcomes, and (5) focus on the results as the primary basis for safety decision-making* [B.1].[2]

In SRM-SECY-98-0144 [B.1] the NRC (at the Commission level) provided characteristic attributes and expected outcomes of applying RIPB approaches in regulations. The following is largely taken from the NRC document [B.1].

<u>Outcome Attributes of Risk-Informed Safety</u>

A "risk-informed" approach to safety decision-making represents a philosophy whereby risk insights are considered together with other factors to establish requirements that better focus licensee and regulatory attention on design and operational issues commensurate with their importance to public health and safety. A "risk-informed" approach enhances the deterministic approach by: (1) allowing explicit consideration of a broader set of potential challenges to safety, (2) providing a logical means for prioritizing these challenges based on risk significance, operating experience, and/or engineering judgment, (3) facilitating consideration of a broader set of resources to defend against these challenges, (4) explicitly identifying and quantifying sources of uncertainty in the analysis (although such analyses do not necessarily reflect all important sources of uncertainty), and (5) leading to better decision-making by providing a means to test the sensitivity of the results to key assumptions. Here, "prioritization" is key; while "risk-informed" means, in part, "not relying purely on the probabilistic risk assessment (PRA)," it also means being able to say that some scenarios or systems are more important than others and understanding how sure we are about the statements we are making. If PRA or PRA methods are used or contemplated, the JCNRM should be consulted.

[2] Indented text in italics recognizes a direct quote from another document.

Outcome Attributes of Performance-Based Safety

A performance-based safety approach is one that establishes performance and results as the primary basis for safety decision-making, and incorporates the following attributes: (1) measurable (or calculable) parameters (i.e., direct measurement of the physical parameter of interest or of related parameters that can be used to calculate the parameter of interest) exist to monitor system, including facility and licensee performance, (2) objective criteria to assess performance are established based on risk insights, deterministic analyses and/or performance history, (3) licensees have flexibility to determine how to meet the established performance criteria in ways that will encourage and reward improved outcomes; and (4) a framework exists in which the failure to meet a performance criterion, while undesirable, will not in and of itself constitute or result in an immediate safety concern. A performance-based approach offers two categories of benefits: (1) the focus is on actual performance rather than satisfaction of prescriptive process requirements, and (2) the burden of demonstrating actual performance can be substantially less than the burden of demonstrating compliance with prescriptive process requirements.

Outcome Attributes of RIPB Safety

A RIPB approach to safety decision-making combines the "risk-informed" and "performance-based" elements. Stated succinctly, RIPB safety is 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 (1) focus attention on the most important activities to achieve the desired results, (2) establish objective criteria for evaluating performance, (3) develop measurable or calculable parameters for monitoring system and licensee performance, (4) provide flexibility to determine how to meet the established performance criteria in a way that will encourage and reward improved outcomes, and (5) focus on the results as the primary basis for decision-making. By "results," we mean actual safety performance, not demonstrations of adherence to mandated processes or prescriptions.

An ANS standard that can validate and verify that the above Commission approved outcomes can be and have been accomplished should have substantially more confidence than otherwise that regulatory approval or endorsement will be achievable.

B.2 EXAMPLE OF REGULATORY APPLICATION: MAINTENANCE RULE

The nuclear industry has had many successes in implementing RIPB approaches. One area that the nuclear industry has been particularly successful has been in establishing maintenance programs to meet the NRC Maintenance Rule (10 *CFR* 50.65) [B.2], which is a RIPB rule.

The following provides examples of RIPB attributes in the NRC's Maintenance Rule. Although there are significant differences between what is put in a regulation versus a standard, the identification and discussion of some of the key attributes in the Maintenance Rule can be beneficial in understanding what is meant to use RIPB attributes/approaches.

B.2.1 Outcome

The rule states in (a)(1):

> *[liciensees] shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components, as defined in paragraph (b) of this section, are capable of fulfilling their intended functions.*

This is, in essence, the required "outcome" which places responsibility on licensees to clearly define intended functions. It is clear (Attibute P1 from Table 6-1 of this Guidance Document) and supports performance-based implementation because it establishes a high-level goal. The goal is reasonable assurance of capability such that functional failure is unlikely relative to the design objectives. It is also risk informed because it includes a qualitative risk metric as part of the outcome (Attribute R2). Note that there are other ways for a rule (or standard) to be risk informed, so one should not think that a numerical risk metric must be included in the outcome(s) as the only way for a standard to be risk informed.

B.2.2 Method for Achieving Outcome

Several parts of the rule provide instructions for achieving the outcome. Examples include:

Example 1: *These goals shall be established commensurate with safety and, where practical, take into account industry-wide operating experience.*

This is a high-level instruction for how to meet part of the Maintenance Rule's outcome and flexibility is provided on how best to perform this (Attribute P2).

Example 2: *Performance and condition monitoring activities and associated goals and preventive maintenance activities shall be evaluated at least every refueling cycle provided the interval between evaluations does not exceed 24 months.*

This is another example of a high-level instruction for how to meet part of the Maintenance Rule's outcome (Attribute P2), but it does also include some prescriptive elements.

Example 3: *[t]he licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities. The scope of the assessment may be limited to structures, systems, and components that a risk-informed evaluation process has shown to be significant to public health and safety.*

This is an example of a high-level instruction for meeting an element of the Maintenance Rule as well as a requirement of develop risk insights and to use risk insights in meeting the Maintenance Rule outcome (Attributes P2, R1, and R2). It implies a PRA by indicating the acceptable process to conduct an evaluation.

B.3 REFERENCES

[B.1] Staff Requirements Memorandum SECY-98-0144, "White Paper on Risk-Informed and Performance-Based Regulation," March 1, 1999, U.S. Nuclear Regulatory Commission.

[B.2] 10 Code of Federal Regulations 50.65 "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," U.S. Nuclear Regulatory Commission.

APPENDIX C

EXAMPLES OF RISK-INFORMED PERFORMANCE BASED ATTRIBUTES IN ANS STANDARDS

The following provides examples of performance-based and risk-informed (RIPB) attributes in American Nuclear Society (ANS) standards. The examples are organized to cross reference the attributes to those listed in Table 6-1 of the main body of this Guidance Document.

Different types of standards (i.e., standards that define a design basis event; standards that define a safety program, etc.) are used as examples because each of the types can been seen to be more (or less) easily amenable to make use of RIBP approaches. The examples offered are for illustration with reference to the version noted.

C.1 Example 1: ANSI/ANS-2.26-2004 (R2017), "CATEGORIZATION OF NUCLEAR FACILITY STRUCTURES, SYSTEMS, AND COMPONENTS FOR SEISMIC DESIGN" [C.1]

ANSI/ANS-2.26-2004 (R2017) [C.1] is a "design basis event" type of standard.

C.1.1 Performance-Based Attributes

C.1.1.1 Attribute PB-1: Outcome

ANSI/ANS-2.26-2004 (R2017) [C.1] states in the SCOPE section that:

> *This standard provides (a) criteria for selecting the seismic design category (SDC) for nuclear facility structures, systems, and components (SSCs) to achieve earthquake safety and (b) criteria and guidelines for selecting Limit States for these SSCs to govern their seismic design. The Limit States are selected to ensure the desired safety performance in an earthquake.*[3]

In simple terms, the outcome could be stated to be:

> "The outcome of the use of this standard is the identification of the Seismic Design Category (SDC) and Limit States for Structures, Systems, and Components (SSCs) to achieve earthquake safety." It is implied that limit states provide the bases for acceptance criteria for ensuring desired safety performance.

C.1.1.2 Attribute PB-2: High-Level Criteria

Three examples of appropriate criteria that have this attribute are provided below:

> *One of the SDCs listed in Table 1* (page 3 [C.1]) *shall be assigned to the SSCs based on the unmitigated consequences that may result from the failure of the SSC by itself or in combination with other SSCs.*

[3] Indented text in italics recognizes a direct quote from another document.

Following determination of the regulatory requirements applicable to the project or to the facility, a safety analysis or integrated safety analysis shall be performed. The guidelines provided in this standard and other applicable standards such as Refs. [4] and [5] should be used.[4]

To achieve the objectives of this standard, the safety analyses shall evaluate the uncertainties with determining failure and the consequences of failure. The depth and documentation of the uncertainty analyses should be sufficient to support the judgment that categorization based on Table 1 (on page 3 [C.1]) *and the design requirements in ASCE/SEI 43-05 produce a facility that is safe from earthquakes.*[5] [Note that this is also an example of a risk-informed approach.]

Note that although ANSI/ANS-2.26-2004 (R2017) [C.1] includes many criteria that provide what needs to be done, it does include some prescriptive criteria and it invokes other consensus standards that provide very prescriptive criteria for the design of safety SSCs. For example:

SDC-1 and SDC-2 in conjunction with the International Building Code and SDC-3, SDC-4, and SDC-5 in conjunction with ANS-2.27, ANS-2.29, and ASCE/SEI 43-05 establish the design response spectra (DRS) and SSC design and analysis Requirements.[6]

ANSI/ANS-2.26-2004 (R2017) [C.1] also includes some guidance that supports use of a PB approach to achieving the standards outcome.

The scope and comprehensiveness of the safety analysis will vary with the complexity of the facility, its operations, and the contained hazard. The assignment of an SDC to an SSC determined to have a safety function is based on the objective of achieving acceptable risk to the public, the environment, and workers resulting from the consequences of failure of the SSC.

C.1.2 Risk-Informed Attributes

C.1.2.1 Attribute RI-1: Development of Risk Importance

An example of a criterion that has this risk-informed attribute is:

One of the SDCs listed in Table 1 (page 3 [C.1]) *shall be assigned to the SSCs based on the unmitigated consequences that may result from the failure of the SSC by itself or in combination with other SSCs.*

[4] Refs. [4] and [5] in the quote from ANSI/ANS-2.26-2004 (R2017) are provided in Sec. C.4, REFERENCES, as Refs. [C.2] and [C.3].
[5] The full citation form ASCE/SEI is provided in Sec. C.4, REFERENCES, as Ref. [C.4].
[6] Documents cited in this quote not previous recognized can provided in Sec. C.4, REFERENCES, as Refs. [C.5], [C.6], and [C.7].

This criterion specifies that a higher SDC will be assigned to SSCs whose failure would have greater consequences. There is indirect reference to consideration of the single failure criterion through assessment of failure of an SSC by itself or in combination with other SSCs.

C.1.2.2 Attribute RI-2: Use of Risk Insights

An example of a criterion that has this attribute is:

> *The scope and comprehensiveness of the safety analysis will vary with the complexity of the facility, its operations, and the contained hazard. The assignment of an SDC to an SSC determined to have a safety function is based on the objective of achieving acceptable risk to the public, the environment, and workers resulting from the consequences of failure of the SSC.*

C.2 Example 2: ANSI/ANS-2.3-2011 (R2016), "ESTIMATING TORNADO, HURRICANE, AND EXTREME STRAIGHT LINE WIND CHARACTERISTICS AT NUCLEAR FACILITY SITES" [C.8]

ANSI/ANS-2.3-2011 (R2016) [C.8] is also a "design basis event" related standard that could be applied for identifying a specific design basis extreme wind event.

C.2.1 Performance Based Attributes

C.2.1.1 Attribute PB-1: Outcome

ANSI/ANS-2.3-2011 (R2016) [C.8] states in the SCOPE section that:

> *This standard establishes criteria for acceptable guidelines to estimate the frequency of occurrence and the magnitude of parameters associated with rare meteorological events such as tornadoes, hurricanes, and extreme straight line winds at nuclear facility sites within the continental United States.*

The outcome from the use of ANSI/ANS-2.3-2011 (R2016) [C.8] could be stated to be:

> An estimate of "the frequency of occurrence and the magnitude of parameters associated with rare meteorological events …"

This is a good, clear PB outcome statement related to expections associated with inputs to safety analysis.

C.2.1.2 Attribute PB-2: High-Level Criteria

An example of a criterion that has this attribute is:

> *Tornado hazard probability models shall account for the following:*
>
> *(1) constant or gradations of velocity along and across the tornado path;*
> *(2) meteorological conditions affecting the site;*

(3) topographical features surrounding the site; and
(4) biases in reporting occurrence and velocity of tornadoes on target structures.

This is performance-based because it provides broadly based statements on what needs to be considered but does not provide details on how to account for these items.

Another example of a criterion that has this attribute is:

Two basic approaches in the characterization of wind-generated missiles are recognized as acceptable in this standard:

(1) a standard spectrum of missiles; and
(2) a probabilistic assessment of the hazard.

This is somewhat performance-based (i.e. high level) because it provides options for achieving acceptable outcomes.

C.2.2 Risk-Informed Attributes

None identified.

However, the following is an example of a **non**-RIPB feature:

The height of the radial inflow layer shall be at least 0.35 R. Above this height, the radial wind is assumed to be zero or to flow outward.

Note: This does not mean the standard or the criterion is not appropriate in that this provision may represent an optimization to obtain an outcome efficiently based on the science, industry history, and/or risk mitigations. There are times when it is very appropriate to be prescriptive using expert judgement and so, in this way, compliant with RIPB methods. It is recommended that the underlying assumptions inherent to such an approach be documented so that if the standard is applied when such assumptions have changed, this can be identified by the user and addressed in a way that conforms with intent.

C.3 Example 3: ANSI/ANS-2.21-2012 (R2016), "CRITERIA FOR ASSESSING ATMOSPHERIC EFFECTS ON THE ULTIMATE HEAT SINK" [C.9]

Note: For the following example a draft was used to suggest how issues regarding application of this Guidance Document may arise while the draft is being worked on actively. This example only serves to illustrate specific points which may not apply as the draft is finalized.

ANSI/ANS-2.21-2012 (R2016) [C.9] is a "design analysis" type standard. Its importance lies in the key role of atmospheric conditions for the fundamental safety function of adequate heat removal. Restrictions on allowable atmospheric conditions could have economic impacts.

C.3.1 Performance Based Attributes

C3.1.1 Attribute PB-1: Outcome

ANSI/ANS-2.21-2012 (R2016) [C.9] states in the SCOPE section that:

> *This standard establishes criteria for acceptable guidelines to estimate the frequency of occurrence and the magnitude of parameters associated with rare meteorological events such as tornadoes, hurricanes, and extreme straight line winds at nuclear facility sites within the continental United States.*
>
> *Required analyses are provided for a meteorological assessment of the ultimate heat sink to ensure that design temperatures and cooling capacity requirements for the facility are met.*

The outcome could be stated to be:

> "A determination is made of whether design temperature and cooling capacity requirements for the ultimate heat sink of a facility are met."

The performance-based outcome accommodates uncertainty in the acceptability criteria. Risk-informed aspects of the approach are captured by the frequency evaluation.

Note that the introductory statement could be better written (to be consistent with other ANS introduction statements) as:

> *This standard establishes criteria for performing an analysis to determine whether design temperature and cooling capacity requirements for the ultimate heat sink for a facility are met.*

Another example of a criterion that has this attribute is:

> *Ultimate heat sinks shall be designed to have the cooling capacity to provide sufficient cooling water at the maximum allowable inlet temperature under the most adverse meteorological conditions expected for the power plant climatic regime.*

This is a good performance-based statement for the limiting challenge of a "design basis event."

Note that one element of performance-based approaches in industry is the verification that the outcome is met using measurements. The design goal under the most extreme conditions likely could not be verified by measurement, but measurement of parameters at actual conditions could be compared with calculational results to provide confidence that the goal is met. It would be good to consider whether adding this type of criterion would benefit standards.

C.3.2 Risk-Informed Attributes

C.3.2.1 Attribute RI-1: Development of Risk Importance

An example of a criterion that has this attribute is:

> *The results of the 10-year–or–longer simulation with several extreme events shall be used to perform extreme value statistical analyses that project the most extreme weather conditions for the expected license period of the power plant, which could be 60 years or more.*
>
> *The U.S. Nuclear Regulatory Commission provides guidance in regard to the critical time period. In the case of a cooling lake, the lake temperature may reach a maximum in five days following a shutdown. Therefore, three critical time periods to be included in the assessment are five days, one day, and 30 days to ensure the availability of a 30-day cooling supply. The three periods need not occur contiguously but may be combined to produce a synthetic 36-day period that may be used as the design basis for the lake. In the case of a wet cooling tower, the meteorological conditions resulting in maximum evaporation and drift losses shall be the worst 30-day combination of the controlling parameters such as wet-bulb temperature and wind speed.*

This does incorporate some risk-informed elements as it incorporates some factors that contribute to risk-informed decision making.

C.4 REFERENCES

[C.1] ANSI/ANS-2.26-2004 (R2017), "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design," American Nuclear Society.

[C.2] DOE-STD-3009-2014, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports," Change Notice No. 1, U.S. Department of Energy.

[C.3] NUREG-1513, "Integrated Safety Analysis Guidance Document," U.S. Nuclear Regulatory Commission (May 31, 2001).

[C.4] ASCE/SEI 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities," American Society of Civil Engineers/Structural Engineering Institute.

[C.5] International Building Code®, 2018, International Code Council, Inc., 2018.

[C.6] ANSI/ANS-2.27-2008 (R2020), "Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments," American Nuclear Society.

[C.7] ANSI/ANS-2.29-2008 (R2020), "Probabilistic Seismic Hazards Analysis," American Nuclear Society.

[C.8] ANSI/ANS-2.3-2011 (R2016), "Estimating Tornado, Hurrican, and Extreme Straight Line Wind Characteristics at Nuclear Facility Sites," American Nuclear Society.

[C.9] ANSI/ANS-2.21-2012 (R2016), "Criteria for Assessing Atmoshperic Effects on the Ultimate Heat Sink," American Nuclear Society.

APPENDIX D

FREQUENTLY ASKED QUESTIONS REGARDING RISK INFORMED, PERFORMANCE BASED, AND THE GUIDANCE DOCUMENT

1. How is the Guidance Document to be used by standards writers and reviewers with no familiarity about risk-informed, performance-based (RIPB) concepts?

The Guidance Document provides information that will help standards writers and reviewers understand RIPB concepts and provides references that can be used to get additional information. Most importantly the Guidance Document identifies ANS resources (e.g., Risk-Informed, Performance-Based Principles and Policy Committee) that can help them get support to overcome difficulties. Additionally, training is available to standards writers and reviewers to better understand RIPB principles and how to apply them.

2. Is the Guidance Document relevant to a specific technology or design being developed by a potential vendor?

The Guidance Document is relevant to every design and the standards that support the development of nuclear facility technologies including nonreactor and decommissioning facilities. However, as discussed in this Guidance Document, some standards will utilize RIPB to different degrees and in different manners or maybe not at all depending on the identified outcomes desired for the documents being produced.

3. How does the Guidance Document apply to ANS standards currently in use for operating light water reactors?

The committees and working groups (WGs) responsible on a continuing basis for maintenance of these standards can use the Guidance Document to evaluate how a current standard might be revised to become more effective if RIPB approaches are adopted.

4. How to make use of the Guidance Document to decide on "level of detail" (LoD) issues?

The LoD in a standard can be important for standards providing "what" is needed to meet the outcome of the standard rather than "how" to meet the outcome. References provided in the Guidance Document address defining performance objectives in a structured approach through which a user of the standard can see how much detail is really needed to ensure clarity. More detail than is needed can lead to confusion and unintended consequences. This also relates to the level of prescription that is considered necessary to have confidence in achieving the outcome and the degree of flexibility which is considered appropriate. The Guidance Document discusses this and also includes examples where the LoD is discussed for specific standards.

5. How is the Guidance Document to be used to incorporate RIPB concepts and methods in standards developed by other Standards Developing Organizations (SDOs) or by standards developed by the International Organization of Standardization (ISO)?

The Guidance Document is available as a reference for other SDOs or ISO committees. The concepts in the Guidance Document are also applicable to how standards from these organizations can be made more RIPB.

6. I'm having some trouble understanding the difference between "risk-informed," "risk-based," "risk-metrics and "risk-insights." Can you explain the differences?

Try it like this: Risk-insights are the knowledge criteria (risk-based decisions and/or a risk-informed process) based on experience related to how the plant structures, systems, and components (SSCs) might be impacted by a variety of scenarios envisioned by the design organization. Then "risk-based" criteria are developed using "risk-metrics" (deterministic criteria) to attempt to deal with those scenarios. When the design begins to mature, a risk-analysis (i.e. probabilistic risk assessment) is used to ensure that SSCs perform the functions necessary to mitigate and reduce the consequences of the occurrences of these scenarios. For further information and acceptable definitions, see the Glossary in NEI 18-04 (Rev. 1), "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," August 2019.

7. Can you provide some examples of what you call "outcomes"?

Outcome – Calculation of reactor decay heat over time to ensure that heat removal capability will reliably maintain acceptable temperature profiles in the reactor and associated systems.

In calculating reactor decay heat, it is necessary to use scientific first principles, representative data, and applicable equations; therefore, defining the exact steps to perform should be the best means for achieving this outcome.

8. What is the difference between "outcomes" and "outputs"?

The difference between "outcomes" and "outputs" is fundamental and profound.

- Outputs are what is produced, be it physical or virtual, for a specific type of customer or end user.
- Outcomes are the difference the product makes.
- Outcomes are the benefits to the customers (internal to processes or external to projects).
- Outputs are important products, services, profits, and revenues.
- Outcomes create meanings, relationships, and differences.

- Outputs, such as revenue and profit, enable us to fund outcomes; but without outcomes, there is no need for outputs.

Consensus standards provide tools, methods, and processes to recognize and measure outcomes.

9. What do you mean by RIBP "attributes"?

Webster's Dictionary definition: a quality or feature regarded as a characteristic or inherent part of someone or something. As applied to the results of applying the RIPB approach, "attributes" offer specific criteria by which characteristics of outcomes can be critically examined.

As applied to the Guidance Document: flexibility, observations indicative of margins, and required actions to achieve outcomes compliant with identified risks. Additionally, the "attributes" can help identify and implement monitoring of the right parameters. For example, cost and operational complexity can become obscured unless outcomes are examined critically to identify and correct unnecessary requirements.

10. Where do I find out what the responsibilities of a member of a standards' WG are?

Please begin by reviewing the "ANS Standards Committee Procedures Manual for Consensus Committees", Sections 6 and 7.

An ANS WG is the writing committee for ANS consensus standards. These groups of about a dozen people each are responsible for creating the text of ANS standards that have been approved by the ANS Standards Board through the Project Initiation Notification System and assigned to them. They make decisions about existing standards' maintenance and respond to requests for clarification or interpretation of existing standards.

WGs routinely use an online platform to communicate and conduct routine business and standards development. This platform provides a place to share current drafts with committee members and to collaborate. WGs meet as often as needed, with some choosing to meet at bi-annual ANS meetings held in June and November of each year. Further information may be obtained on the ANS website www.ans.org under the heading "Standards."

ATTACHMENT 3

Problems with the draft RP3C guidance document on incorporating RIPB approaches into ANS standards

16 November 2020

ANS Standards Board's RP3C Committee

Robert J. Budnitz

Energy Geosciences Division (retired)
Lawrence Berkeley National Laboratory
University of California
Berkeley CA 94720 USA
<RJBudnitz @ LBL.gov>

a caveat

I am the ANS co-chair of the ANS-ASME "Joint Committee on Nuclear Risk Management", and in that capacity I am a member of the ANS Standards Board and of RP3C, but the views here and mine, and nobody else's.

5 major steps that a standard's author(s) need to accomplish to make their standard "RIPB"

- **Need to identify what "risk" is involved**
  OR what "performance" is being sought

- **Need to identify a metric: how to "measure" the risk OR the performance**

- **Need to determine how much risk (OR how much degradation of performance) is tolerable, and how much "margin" is needed**

- **Need to identify how to measure (or analyze) the performance or the risk to determine if it exceeds the threshold.**

- **Need to embed the above in SHALL requirements in the standard.**

The problem

- **Nothing like the above is contained in the "guidance" document.**
- **Hence the author(s) of a standard are given <u>no "guidance"</u> on the <u>steps</u> needed to make their standard "risk-informed" or "performance-based," beyond articulating an "outcome."**
- **When the author(s) of a standard ask, "*OK, so what do we need to do to make our standard's requirements "RIPB"?*" no answers can be found in this draft document.**
- **This is, therefore, <u>not</u> an RIPB guidance document of much use to a new standard's authors in their RIPB struggle.**
- **<u>What is needed</u>? <u>The 5 steps in my previous slide</u>!**

The draft document is a draft

- **The draft document should <u>not be circulated</u> as if it is ready for use, <u>nor touted as anything other</u> than a draft still under development.**

- **In 8 words, "<u>It is not yet ready for prime time</u>."**

ATTACHMENT 4

SMART Matrix for ANS SC Strategic Plan – Open Items Only - Update 11/6/2020 (Comments Incorporated)

RP3C Actions

A SMART strategic plan consists of goals that are **S**trategic, **M**easurable, **A**ttainable, **R**ealistic and **T**ime-related. This matrix takes each of the Initiatives in the ANS SB Strategic Plan and defines the specific activities that need to be accomplished for each Goal and Objective along with its proposed schedule and responsibility. This is a living document. Updates and comments from Standards Board Members will be solicited and the plan adjusted.

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
Completed	Near Term	Overdue			
Goal #1 Align Standards Development Priories with Current and Emerging Needs					
D.1. Manage the resolution of comments to the RP3C RIPB Guidance Document and send the product to Standards Manager for issuance for use on standards	RP3C Chair	Collect comments and recommendations from Working Groups using the trial use Guidance Document.	Jim O'Brien leading effort		
D.1. Manage the resolution of comments to the RP3C RIPB Guidance Document and send the product to Standards Manager for issuance for use on standards	RP3C Chair	Manage the resolution of comments and send resulting document to Standards Manager for issuance as a policy or procedure.	Jim O'Brien leading effort		
D.3. Conduct training of consensus committees and working groups.	RP3C Chair	Conduct Training for all applicable CCs.	Ongoing	Ongoing Mostly Done	
D.6. Developing presentation materials that can be used to inform other industry groups as to the benefits and use of the ANS Standards Committee risk-informed and performance based standards activities	RP3C Chair	Develop presentation package for use with other industry groups and submit to SB for approval.	Ed Wallace leading	CoP presentation of 10/30/2020 is first step	
D.6. Developing presentation materials that can be used to inform other industry groups as to the benefits and use of the ANS Standards Committee risk-informed and performance based standards activities	RP3C Chair	Contact appropriate organizations to make presentations at NRC RIC, ANS UWC, and owners' groups.	Ed Wallace to lead Currently on going		
D.6. Developing presentation materials that can be used to inform other industry groups as to the benefits and use of the ANS Standards Committee risk-informed and performance based standards activities	RP3C Chair	Make presentations at a minimum of 2 groups.	Ed Wallace to lead		

ATTACHMENT 5

Schedule of ANS Standards in Development using RIPB Properties (November 2020)

Standards Project	Draft App'd by WG	+4 months SubC or Preliminary Review/Comment Resolutions	+6 months 1st CC Ballot/Comment Resolutions (concurrent PR)	+4 months 2nd CC Ballot/Comment Resolutions (concurrent PR)	+2 weeks ANS Standards Board Certification	+2 Weeks ANSI Approval	~4 months Publication
ANS-2.22 (T. Jannik)/*ESSC (C. Mazzola) Environmental Radiological Monitoring at Operating Nuclear Facilities JCNRM Rep:	Sept 2021	Oct-Jan 2022	Feb-Jul 2022	Aug-Nov 2022	Dec 2022	Dec 2022	Apr 2023
ANS-2.21 (M. Kinley)/*ESCC (C. Mazzola) Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink JCNRM Rep:	Dec 2020	Jan - Apr 2021	May - Oct 2021	Nov - Feb 2022	Mar 2022	Mar 2022	Jul 2022
ANS-2.26 (D.Clark) /*ESCC (C. Mazzola) Categorization of Nuclear Facility SSCs for Seismic Design JCNRM Rep:	PINS submitted to ANSI 10/1/19. Kickoff meeting held 10/27/20. Schedule TBD.						
ANS-2.34 (S. McDuffie)/*ESCC (C. Mazzola) Characterization and Probabilistic Analysis of Volcanic Hazards RP3C Rep: N. Chokshi / JCNRM Rep:	Mar 2021	Apr - Jul 2021	Aug - Jan 2022	Feb - May 2022	Jun 2022	Jun 2022	Oct 2022
ANS-3.13 (J. August) / *LLWRCC (M. French) Nuclear Facility Reliability Assurance Program (RAP) Development JCNRM Rep:	Path forward to be discussed at 11/17/20 LLWRCC meeting.Committee being reconstituted.						
ANS-3.14 (T. Anselmi)/*NRNFCC (C. Martin) Process for Aging Management and Life Extension of NRNF JCNRM Rep: J. O'Brien			Jul 2019 - Oct 2020	Nov 2020 - Feb 2021	Mar 2021	Mar 2021	Jul 2021
	Draft issued to SCoRA & RP3C 7/19/19 in parallel to NRNFCC ballot. Comments taking longer than anticipated to address.						
ANS-3.15 (M. Muhlheim/*LLWRCC (M. French) Risk-Informing Critical Digital Assets (CDAs) for Nuclear Power Plant Systems JCNRM Rep: R. Budnitz & G. Hudson	Schedule TBD						
ANS-15.22 (B. Meffert)/*RARCC (G. Flanagan) Classification of Structures, Systems and Components for Research Reactors JCNRM Rep:	Dec 2021	Jan - Apr 2022	May - Oct 2022	Nov - Feb 2023	Mar 2023	Mar 2023	Jul 2023
ANS-20.2 (D. Holcomb / *RARCC (G. Flanagan) Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt-Reactor Nuclear Power Plants JCNRM Rep:	Jul 2021	Aug - Nov 2021	Dec - May 2022	Jun - Sept 2022	Oct 2022	Oct2022	Feb 2023
ANS-30.1 (M. Linn) / *RARCC (G. Flanagan) Risk-Informed & Performance-Based NPP Design Process JCNRM Rep: D. Johnson/K. Fleming/A. Maioli	Mar 2020	Mar 2020-?					
	RARCC preliminary review ballot closed 4/17/20. Schedule to be determined once comments addressed. Draft not sent to RP3C or SCoRA at request of RARCC Chair.						
ANS-30.2 (K. Welter) / *RARCC (G. Flanagan) Categorization Classification of SSCs for New Nuclear Power Plants	Apr 2021	May - Aug 2021	Sep - Feb 2021	Mar - Jun 2021	Jul 2021	Jul 2021	Nov 2021

Schedule of ANS Standards in Development using RIPB Properties (November 2020)

Standards Project	Draft App'd by WG	+4 months SubC or Preliminary Review/Comment Resolutions	+6 months 1st CC Ballot/Comment Resolutions (concurrent PR)	+4 months 2nd CC Ballot/Comment Resolutions (concurrent PR)	+2 weeks ANS Standards Board Certification	+2 Weeks ANSI Approval	~4 months Publication
JCNRM Rep: R. Grantom							
ANS-30.3 (K. Welter)/*LLWRCC (M. French)	Jul 2019	Aug 2019 -Nov 2020	Dec - May 2021	Jun - Sept 2021	Oct 2021	Oct2021	Feb 2022
Advanced LWR RIPB Design Criteria and Methods		Draft issued to SCoRA, RP3C, RARCC 8/15/19. Comments taking longer than anticipated to address. Schedule TBD.					
JCNRM Rep:							
ANS-56.2 (E. Johnson)/*LLWRCC (M. French)	Nov 2021	Dec-Mar 2022	Apr-Sept 2022	Oct-Jan 2023	Feb 2023	Feb 2023	Jun 2023
Containment Isolation Provisions for Fluid Systems After a LOCA							
JCNRM Rep:							
ANS-57.2 (R. Browder) / *FWDCC (J. Lucchini)	Mar 2021	Apr - Jul 2021	Aug - Jan 2022	Feb - May 2022	Jun 2022	Jun 2022	Oct 2022
Design Requirements for LWR Spent Fuel Storage Facilities at NPPs							
JCNRM Rep:							
ANS-57.9 (M. Sanders)/*FWDCC (J. Lucchini)	Nov 2023	Dec-Mar 2024	Apr-Sept 2024	Oct-Jan 2025	Feb 2025	Feb 2025	Jun 2025
Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)							
JCNRM Rep:							
ANS-57.11 (OPEN) / *NRNFCC (C. Martin)							
ISAs for Nonreactor Nuclear Facilities		Closed 6/2/19 with significant comments; resolutions require additional time. Schedule TBD.					
JCNRM Rep:		Draft provided to RP3C, SCoRA, and NCSCC on 4/3/19.					

*= ANS responsible consensus committee

ANS Contacts: Prasad Kadambi, RP3C Chair: Phone: 301-236-4162 -- Email: praskadambi@verizon.net

ESCC = Environmental & Siting Consensus Committee

FWDCC = Fuel, Waste, & Decommissioning Consensus Committee

LLWRCC = Large Light Water Reactor Consensus Committee

NRNFCC = Nonreactor Nuclear Facilities Consensus Committee

RARCC = Research and Advanced Reactors Consensus Committee